

UNIVERSITY OF LEIPZIG

Department of Computer Science

Generation of a Java front end for a standalone CICS application
accessed through MQSeries
&
Securing CICS with RACF

Diplomarbeit – Master Thesis

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Born: 1976/07/14

Subject: Computer Science

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Leipzig, August 2004

EXECUTIVE SUMMARY

This master thesis deals with the design, programming, implementation and presentation of on-line business applications for IBM's On-Line Transaction Processing (OLTP) system called Customer Information Control System (CICS). According to the book "Designing and Programming CICS Applications" published by John Horswill [HOR00] we explain two out of many feasible procedures to present the functionality of CICS resp. CICS business applications.

As the main result, we create for each of both procedures a business application representing a little clip of a bank customer account program. These applications access a database-like file stored on an Operating System/390 (OS/390) server to create, read, update, and delete customer accounts. Both use CICS not only as a transaction processing system but also as an application server that manages business applications 24 hours a day for 7 days a week. The difference between the two business applications are the data transfer and information display methods. The first procedure describes how to create a business application that uses the legacy 3270 interface to inquire a customer record stored on the OS/390-server and how to display the information on a 3270 terminal screen (also called as the green screen). In contrast, the second business application uses message queuing provided by IBM's Message Oriented Middleware (MOM) product MQSeries to transfer the request data to and the response data from the customer account file between CICS and the Java Virtual Machine (JVM). This JVM runs on a WINDOWS2000 client, whereas MQSeries has to run on both – the OS/390-server and the WINDOWS2000 client. For this procedure, the so-called MQSeries CICS Bridge – an interface between CICS and MQSeries on the OS/390-server – is installed and activated. It is also described how to use the Message Queue Interface (MQI) that connects MQSeries and JAVA on the client computer system.

Hence, the business logic component is used by both sample applications, but they differ in the presentation logic components. The programs of the business logic component, written in the programming language COBOL, are responsible for the data transfer to and from the customer account file to update or read it, for the business calculations, and for the error handling. The presentation logic component of the first business application – the CICS application NACT – is also written in COBOL and use the Basic Mapping Support (BMS) to set up the 3270 interface. In the second business application called the MQSeries CICS application MQNACT the programs of the presentation logic component are written in JAVA.

Additionally, this master thesis describes the security management of CICS using IBM's External Security Manager (ESM) Resource Access Control Facility (RACF). The main part of this procedure is to allow only authorised terminal users an access to an existing CICS address space, including some CICS default user IDs as for example the CICS Region User ID (CRU), and the Default CICS User ID (DCU). Furthermore, the authorised user should/may use only those CICS resources for which a permission exists. Securing CICS resources is explained on the examples of the CICS Transactions Security mechanism and the CICS Command Security mechanism.

“There is no human on the world from whom you cannot learn something.”

(Albert Schweitzer)

Acknowledgements

My thanks goes to Prof. Dr. Wilhelm G. Spruth who gave me the best support and who never despaired on my English writing.

I wish to thank Peter Missen, head of the CICS User Group at IBM Hursley UK, for helping, for redacting this text, and, of course, for working with the CICS User Group.

My technical thanks goes to Dr. Paul Herrmann who always sustained the functionality of the JEDI OS/390-server.

Many thanks goes also to:

Nils Michaelsen for his encouragement in my work,

Ulrike Kirsch (IBM Leipzig Germany) for her support on MQSeries,

Sandro Varges (IBM Mainz Germany) for his support on CICS (“Haeh, What is a CSD, Sandro?”),

Thomas Renner (IBM Leipzig Germany) for his support on RACF and JCL,

Ingo Karge who provided for me a desk at the IBM Leipzig location,

the CICS User Group, especially to Paul ..., James Taylor, and Kevin ..., and

to everyone at IBM Leipzig.

I would also like to thank my family for their constant support.

For my lovely butterfly Ivonne Lange, the sun should always shine. Thanks for your support, for your lovely cooking, for your understanding in my work and for your +encouragement. Together we will fight the future!

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LIST OF ABBREVIATIONS

Abbreviation	Paraphrase	Chapter
ACID	Atomicity, Consistency, Isolation, Durability	2
AIX	alternate index	3.4.1
AMI	Application Messaging Interface	4.2.5
AMS	Access Method Services	3.4.1
API	Application Programming Interface	4.2.5
API	Application Programming Interfaces	4.2.1
CICS	Customer Information Control System	2
CMAM	CUSTOMPAC MASTER APPLICATION MENU	3.2
COMMAREA	communication area	3.3.4
CRS	Cross-Region Sharing	3.4.2
CRUD	Create, Read, Update, Delete	3.3.3
CSD	CICS System Definition	3.5.1
CSS	Cross-System Sharing	3.4.2
CWA	Common Work Area	3.3.5
DASD	Direct Access Storage Devices	3.3.5
DCT	Destination Control Table	3.3.5
DSA	Dynamic Storage Area	3.3.5
DSLU	DATA SET LIST UTILITY	3.1
DSU	DATA SET UTILITY	3.1
EIBAID	EXEC Interface Block Attention Identifier	3.3.2
ESDS	Entry-Sequenced Data Sets	3.4.1
ETDQ	Extrapartition TDQ	3.3.5
FCT	File Control Table	3.3.1
FIFO	First in, First out	4.2.3
HTTP	HyperText Transfer Protocols	4.2.1
IMS	Information Management System	3.4.1
ISPF/PDF	Interactive System Productivity Facility/Program Development Facility	3.1
ITDQ	Intrapartition TDQ	3.3.5
JCL	Job Control Language	3.3.2
JMS	JAVA Message Service	4.2.5
KSDS	Key-Sequenced Data Set	3.4.1
LSR	local shared pool	3.5.1
MCA	Message Channel Agent	4.2.6.2
MMC	Microsoft Management Console	4.5.1
MQ	Message Queuing	4.2.1
MQI	Message Queue Interface	4.1
MQSC	MQSeries commands	4.4.2.2
MVS		1
OS/390	Operating System for a 390 processor	1
PDS	partitioned data set	3.1
PLT	Program List Table	4.4.2.4
QM	Queue manager	4.2.2
QMC	QM Clusters	4.2.4
RLS	Record Level Sharing	3.4.2
RPC	remote procedure calls	4.2.1
RRDS	Relative-Record Data Sets	3.4.1
SAM	Sequential Access Method	3.3.5
SDS	sequential data set	3.1
SDSF	System Display and Search Facility	3.4.2
SIT	System Initialisation Table	3.5.2
TCP/IP	Transmission Control Protocol/Internet Protocol	4.1
TD	Transient Data	3.3.5
TDQ	Transient Data Queues	3.3.5
TRANSID	transaction identifier	3.3.2
TS	Temporary Storage	3.3.5
TSQ	Temporary Storage Queues	3.3.5
TUA	Terminal User Area	3.3.5
TWA	Transaction Work Area	3.3.5

UoW	Unit of Work	3.3.1
VSAM	Virtual Storage Access Method	3.4.1
PDF	Portable Document Format	Notices

NOTICES

Conventions in this Master Thesis

Throughout this master thesis, the following conventions are used:

Bold

Indicates important words or word phrases.

Italics

Used for WINDOWS2000 file names, for proper names of MQSeries for WINDOWS2000, for JAVA statements, and for menu items and their sub items.

Italics bold

Indicates JAVA class names.

UPPERCASE ITALICS

Indicates data set, file, program, and script names used on the OS/390-server. Furthermore, this style is used for proper names of the CICS RACF security management (User IDs, Group IDs, security profile names, security classes, and so on).

“Italics”

Italics surrounded by non-italics quotes indicate citations.

UPPERCASE

Used for CICS object names, MQSeries object names, abbreviations, proper names in general, and some other special names.

Lucida Console

This format type indicates commands outside the continuous text. Also used in the listings and in the clip-pings of them.

Lucida Console Italics

Using this format style indicate commands and their parameters used in the continuous text.

[...]

These brackets enclose the shortcuts for sources listed in on page .

About the CD-ROM

The CD-ROM accompanying this master thesis contains the source and compiled code of the developed applications (COBOL and JAVA code) and the scripts that are required to run these applications. The source code and scripts are stored into folders of the CD-ROM in reference to the chapters where they are named (Table 1). Additionally, all the code referring to OS/390 is stored on the JEDI OS/390-server¹. The code resp. scripts applying to OS/390 data sets are stored on the CD-ROM into subdirectories of the listed folders in Table 1. Each subdirectory represents a high qualifier of an OS/390 data set. For example, the script *C001* is stored to following directory on the CD-ROM: *listings\chapter3\os390\scripts\cics\common\sysin\c001*. This script is also stored to the JEDI OS/390-server into the data set CICS.COMMON.SYSIN as a member called *C001*. Each script is linked from the chapter to an entry in its associated appendix. This entry links directly to the scripts on the CD-ROM.

Besides the source code, the CD-ROM contains the referenced textbooks, if available as an electronic book. They are accompanied in IBM's own format readable by the IBM Softcopy Reader. Some of them are also available as Portable Document Format (PDF) files. The documents can be directly downloaded from the CD-ROM's directory *books* or accessed through a web browser when the file *index.html* is opened. Within this file there can also be linked to downloaded electronic documents referenced to in the text, that have been stored within the CD-ROM because of future unavailability.

Code / scripts named in	Code / scripts related to	Code / scripts stored to folder:
chapter 4 "The CICS Business Application NACT"	COBOL code Other OS/390 scripts	listings\chapter3\os390\cobol listings\chapter3\os390\scripts
chapter 5 "The MQSeries CICS Business Application MQNACT"	OS/390 scripts JAVA code MQSeries batch files	listings\chapter4\os390\scripts listings\chapter4\windows\java listings\chapter4\windows\mqseries
chapter 6 "Securing CICS with RACF"	OS/390 scripts	listings\chapter5\os390\scripts

Table 1: Contents of the CD-ROM

¹ JEDI OS/390-server is one of the OS/390-servers of the university of Leipzig, Germany. For an apply of a login refer to the homepage jedi.informatik.uni-leipzig.de.

1 INTRODUCTION TO OS/390

1.1 Introduction

For the computers of the IBM System/390 architecture exist a variety of operating systems, which are implemented in dependence of the size of the installation. That are Transaction Processing Facility (TPF), Multiple Virtual Storage/Enterprise Systems Architecture, System Product Version 4 and Version 5 (MVS/ESA SP Version 4 & 5), Virtual Machine/Enterprise Systems Architecture (VM/ESA), Virtual Storage Extended/Enterprise Systems Architecture (VSE/ESA), and OS/390. All these operating systems have been developed by IBM. Further, there exist some other operating systems which also run on S/390 computers, for example Amdahl's operating system Universal Time Sharing Release 4 (UTS R4), and Hitachi's operating system Hi-OSF/1-MJ² a UNIX variation. All the mentioned operating systems create “*a different application execution environment with its own set of advantages and disadvantages.*” ([HAF01]) Primarily, these environments vary in the interfaces between the applications and the operating systems. Further, they use central storage and create its virtual storage structure differently. Using both storage areas were an important reason to develop periodical enhancements of the operating systems for the S/3xx hardware.

The components of this master thesis are implemented on an S/390 computer system running with the operating system OS/390 Version 2 Release 7 (V2R7).

² “OSF/1 is a variant of the Unix operating system that was largely a product of the so-called “Unix wars” of the mid- and late 1980s. OSF/1's roots lie in being one of the first operating systems to use the Mach kernel developed at Carnegie Mellon University.” from <http://encyclopedia.thefreedictionary.com>

1.2 History of OS/390

All the operating systems belonging to OS/390 have been evolved through several generations of large-computer systems (Figure 1). The evolution starts with the OS/360 family developed in 1964 on behalf of the introduction of the S/360 computers. It consists of the operating systems Primary Control Program (OS/PCP) as the simplest one, Multiprogramming with a Fixed number of Tasks (OS/MFT), and Multiprogramming with Variable number of Tasks (OS/MVT). OS/PCP had a sequential scheduler and could only handle 1 task at a time using maximum 12 KB central storage, whereas OS/MFT allowed up to 15 tasks to be processed at a time with a pre set memory

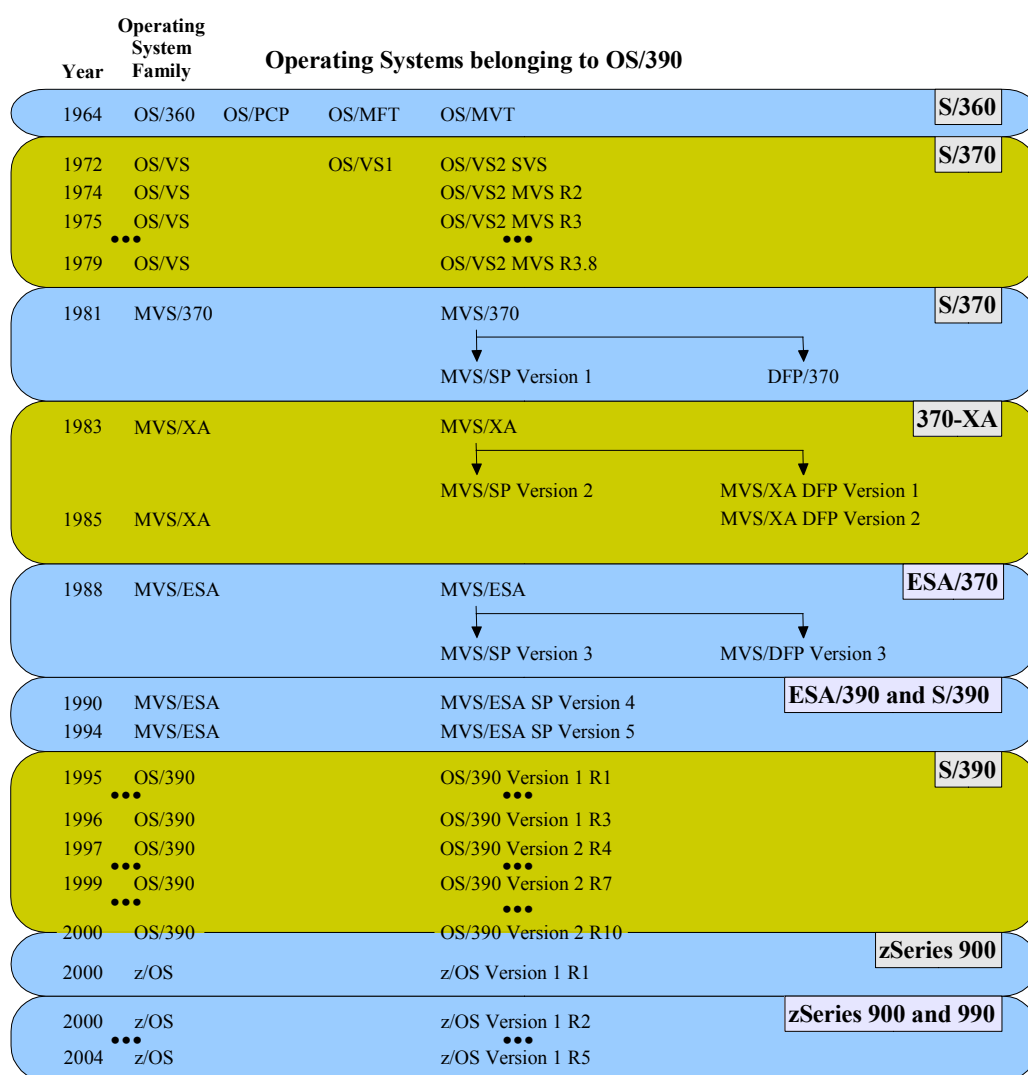


Figure 1: Pedigree of the operating systems belonging to OS/390

allocation of central storage (up to 64 KB). The same amount of tasks could be processed by OS/MVT, but these tasks could share whatever central storage was installed on the computer system (maximum 128 KB).

Eight years later, IBM announced System/370 hardware, that provided virtual storage capability. At the same time, the next OS family OS/VirtualStorage (OS/VS) has been introduced to utilise the new hardware. OS/360 has to be transformed into a virtual storage system. Because many customers preferred OS/MFT and others OS/MVT both should be satisfied. OS/MFT was improved to become OS/VS1 and OS/MVT became OS/VS2, taking account of virtual storage in only a single partition up to 16MB ($2^{24}\text{bits} = 16 \text{ MB}$). Therefore, OS/VS2 has also be named as OS/VS2 Single Virtual Storage (SVS).

In 1974 the next offered release supported multiple virtual storage for each address spaces up to 16 MB and was named OS/VS2 Multiple Virtual Storage (MVS) Release 2 (R2). The third release of OS/VS2 MVS (1975) provided so-called Selectable Units (SUs) to allow the customer to tailor their operating system only to functions they needed. In 1979, the last update OS/VS2 MVS R3.8 was published. Exceptionally, it was required as an installation base for the next developed operating system MVS/370 introduced with the new S/370 hardware. What has been named as MVS/370 were in real a combination of two products – MVS/Service Product Version 1 (MVS/SP V1) and Data Facility Product/370 (DFP/370). This OS supported the 26 address bits of the central storage provided by the processor architecture, hence, the MVS/370 could address up to 64 MB of this memory. Although, the operating system had could utilise these 26 bits ($2^{26}\text{bits} = 64 \text{ MB}$) instead of the 24 bits for its virtual storage, IBM did not wanted it because many existing MVS/370 applications would not properly work. Therefore, only up to 16 MBs for virtual storage could be addressed per address space by MVS/370.

This problem has been resolved by a new hardware – the S/370 eXtended Architecture (370-XA), firstly shipped in 1983. For the first time, the computer system had have 31 bits ($2^{31}\text{bits} = 2\text{GB}$) of central storage and a dynamic channel capability for I/O. The 370-XA has been utilised by a new version of MVS/370, called MVS/eXtended Architecture (MVS/XA). This OS package also consisted of two products that made up the operating system – MVS/SP V2 and MVS/XA DFP V1. MVS/SP V2 supported both storage areas, whereas MVS/XA DFP V1 contained five updated data-management function of OS/VS2 MVS R3.8 besides the functions of DFP/370. Hence, OS/VS2 MVS R3.8 was not more required as a base for the new operating system. Dynamic channel architecture could access up to eight I/O channels, although the hardware had only four. This was the most visible feature of the new OS and I/O boosted dramatically. Furthermore, MVS/XA supported the whole 31 bits to build the virtual storage up to 2 GB per address space. However, central storage could only be addressed by MVS/XA in the range of maximum 256 MB (28 bits). Additionally, to provide compatibility with previous versions, MVS/XA still supported the 24 bit mode for addressing virtual storage areas. In 1985 the second version of MVS/XA DFP was published.

MVS/ESA was the successor of the MVS/XA operating system and has been introduced in 1988. This operating system run on a new hardware called Enterprise Systems Architecture/370 (ESA/370). It contained the third versions of MVS/SP and MVS/XA DFP. Two years later (1990), a new hardware has been introduced – the ESA/390 and ES9000 S/390 family. For both systems only a new version of one product of MVS/ESA has been

provided – MVS/ESA SP V4. The DFP version was not more needed. All its functions were integrated in the new OS. In 1993, the fifth and last version of MVS/ESA SP was delivered. When in 1995 a new version was put on the market, it was renamed to OS/390 Version 1 Release 1. Until October 2000 there were published every half year a new release of OS/390 – the last was release 10. These operating systems for the S/390 architecture are elaborated in the next chapter “OS/390 in general”.

However, OS/390 has also been replaced in 2000 by the z/Operating System (z/OS) family for the zSeries computers³. These computer systems now provide the 64 bits addressing of the central storage, which the OS also supports (2^{64} bits = 17.179.869.184 GB = 16.777.216 Terabytes (TB) = 16.384 Petabytes (PB) = 16 Exabytes (EB)).

Please look for a brief history for the operating systems of S/3xx computers in [HAF01] and on the interesting homepage of T. Falissard [FAL01].

3 Is it a myth? The “z” in z/OS and zSeries paraphrases the meaning of “zero down-time” of the zSeries computer systems, as IBM internal propagates. It means, that the zSeries computers, on which z/OS runs, do not have any down-time. Understand it as a homage to their stable computer systems. Of course, it is a marketing philosophy.

1.3 OS/390 in general

An operating system like OS/390 is the intermediate layer between the application software and the hardware; it works behind the scene. An OS consists of a set of programs to create and manage the environment in which other programs resp. applications can execute. Additionally, it allows to run several of those programs at the same time. Each OS (OS/390, too) can be categorised into following operating-system functions (according to [ES-1011]):

- Services (for application programs): contain functions provided by the OS that release the programs from managing them.
- Resource Management: distributes resources to the application programs as they are running. Such resources are the processor storage, processors, and I/O channels.
- Storage Management: divides the main storage proportionally and sufficiently to run the programs in the system.
- Timer Services: supports time-dependent functions in application program logic.
- Serialisation Services: coordinates the shared resources and maintain the integrity of updated resources.

In contrast to personal computer systems, large computer systems like S/390 can have multiple processors. Managing these processors in a so-called multi-processing system is another must for such an operating system. It must also handle interrupts generated by the S/390 hardware to allow pre-emptive multitasking (giving the programs execution priorities). As last but important feature, the OS must identify a hardware-detected error (machine or program check) to react appropriate.

OS/390 has been designed for enterprise computing to change rapidly highly competitive business environments. This operating system is described in [HAF01] as “*a network-ready, integrated operational environment for S/390.*” An important advantage of OS/390 is that it remains operational through system difficulties and it can be quickly recovered after a system disaster. According to [ES1011] OS/390 has the following characteristics:

- High-availability and high-performance
- Air-tight security
- Connectivity diversity
- Flexibility to handle ever growing complex integrated work flows
- Affordability in costs for the user.

Actually, OS/390 was a new name for the MVS/ESA SP Version 5 Release 2.2 (V5R2.2) (re-branding) introduced in 1995 (see Figure 1 on page 24, too). The name OS/390 belongs to the S/390 architecture. However, this system was introduced in 1990 with the Enterprise System Architecture/390 (ESA/390) and the ES/9000 S/390.

From this architectures the present name S/390 has been derived. The operating system running on the ESA/390 and S/390 systems was MVS/ESA until 1995. To honour the S/390 system MVS/ESA was renamed to OS/390.

In contrast to MVS/ESA, OS/390 has been delivered within a basic installation package containing a set of separate but required products needed for S/390 operation. Optional functions could be additionally added to the installation. All in all, OS/390 can be a bundling of up to 70 software components. To distinguish the operating system from the OS/390 package, the older name MVS was used by the system operators to identify the OS. Because that the base OS of the OS/390 package is actually not more than MVS/ESA, the main operating system features are described by means of MVS/ESA.

As mentioned above, MVS/ESA was the successor of the MVS/XA operating system. The evolution of operating systems is closely related with the storage management. As same as MVS/XA, MVS/ESA supports the 24-bit and 31-bit mode of operation. But in contrast to MVS/XA, which only supported 256 MB of central storage (contrary, architecture allowed up to 2 GB), MVS/ESA supported the whole 2^{31} bits = 2 GB of central storage. Virtual storage could be maximum of 2 GB per address space (often called region) created by both operating systems. However, MVS/ESA can build another virtual storage area called data spaces ranging in size from 4 KB to 2 GB. This storage area is byte addressable by an application program to store and access application relevant data, nothing more. The normal virtual address spaces were thenceforth called primary address spaces. Once again, applications can only run in a separate primary address spaces, not in data spaces. The data spaces are accessible by the applications through a facility called Access-Register Addressing. Of course, an application running in a primary address space can furthermore access another application running in another allocated primary address space to pass control or to access data. Primary address spaces are linked together using the Cross Memory Facility linkage as already used in earlier MVS versions.

MVS/ESA provides a better expanded storage utilisation than MVS/XA. This storage technique has been introduced in 1985 and was firstly supported by MVS/XA at the same time. On S/390 systems is maximum 8 GB expanded storage available. Access to expanded storage has only the central storage to transfer still needed information that is just not used or has a low priority. If this information is needed, it must be moved back to the central storage. This transfer is managed by the operating system using paging instead of bytes-addressing.

What the expanded storage is for the central storage, is another address space called hiperspace for the primary address space firstly supported by MVS/ESA. However, hiperspace normally resides in the expanded storage to use its storage method (paging). Each data stored under control of the application program into the hiperspace must be moved to the primary address space before the application program it can use. Today, OS/390 uses the same storage management products and methods as MVS/ESA resp. MVS/XA.

With the introduction of MVS/ESA SP V4 in 1990 were delivered some resource enhancements for new and old facilities. There has been added a support to connect a few processors to a single logical unit called a system complex (Sysplex). Synchronising the time-of-day clocks on each sysplex is supported by a new facility called Sysplex Timer. The new ESCON I/O channels have also been now supported. Another software function, called

Cross System Coupling Facility (XCF), has been added to the new operating system. “*XCF provides the application programming interface and services to allow communication among application groups on the separate processors and provides a monitoring («heartbeat») and signaling capabilities.*” ([HAF01]) XCF is used by the Job Entry Subsystem 2 (JES2), CICS eXtended Recovery Facility (XRF), among others. Advanced Program-to-Program Communications/MVS (APPC/MVS) has been included in later releases of MVS/ESA SP V4. There have been also added some new functions to manage the storage environment. MVS/ESA SP V4 supports as first the open systems environment with a POSIX-compliant API.

One of the main enhancements of MVS/ESA SP V5 introduced in 1994 was the support for Parallel Sysplex services for up to 32 MVS/ESA systems. This method is called Coupling Facility. A new software product called the WorkLoad Manager (WLM) has been introduced to define processing goals reflecting to specific business needs. The most important package expansion was the MVS Open Edition, today called UNIX System Services (USS). For a better batch handling there was included a product called BatchPipes/MVS.

MVS/ESA SP V5 was the last operating system version having the name MVS/ESA. OS/390 Version 1 Release 1 has been delivered in 1995. The base operating system, also called Base Control Program (BCP) was still named MVS/ESA V5 R2.2. OS/390 V1R1 includes some base and optional elements. These have been also delivered as further enhancements within the OS/390 V2R7 described in the next chapter. After OS/390 V1R3 there has been announced in 1997 as next operating system OS/390 Version 2. It started with the release 4 to continue the release numbers. Within OS/390 V2 it has been firstly included the Domino Go Webserver (now named WebSphere Application Server (WAS)). Furthermore, Tivoli's TME 10 Framework has then integrated into OS/390. Distributed Computing is completed by the addition of the ENCINA Toolkit Executive, DCE Application Support providing RPC, and the Lightweight Directory Access Protocol (LDAP) client support. There have been added some enhancements to WLM and to the USS (UNIX Application Services as Shell, Utilities, and Debugger). USS now supports the UNIX 95 resp. XPG4.2 X/OPEN Company's Single UNIX Specification including all the commands and utilities referred to it. Within the next release 5, OS/390 included as main part an updated Domino Go Webserver. When a new hardware function support (here: FICON channel support) was available, all OS/390 releases down to release 3 have to be updated by a new software function. OS/390 V2R6 introduced in September 1998 included some important enhancements for the eNetwork Communications Server support and for the Parallel Sysplex function. Six months later, in March 1999, OS/390 V2R7 was available – the OS package that is installed on the JEDI OS/390-server.

Beyond OS/390 V2R7, there have been published 3 more releases of OS/390 before the new operating system z/OS has been announced in 2000 for the new zSeries computer systems. The features of the elements of these operating systems will not be reflected here, please refer to [HAF01]. Also, use this book for a comprehensive overview of the referenced products for the operating systems.

1.4 OS/390 V2R7

On the JEDI OS/390-server is installed OS/390 V2R7 which has been offered in March 1999. Besides the base operating system it contains a set of so-called OS services, distinguished into base elements always delivered and optional features delivered on demand. Furthermore, USS has been also packaged as a base OS service into OS/390. The important base Systems Services are the Base Control Program (BCP), JES2, Interactive System Productivity Facility (ISPF), and TSO/E. System Modification Program/Extended (SMP/E) and the optional System Display Search Facility (SDSF) are Systems Management Services, among others, that have been installed on the JEDI OS/390-server. Another important product that has been firstly included into OS/390 V2R5 is the WebSphere Application Server (WAS). The optional Security Services including the Security Server and the Resource Access Control Facility (RACF⁴) have been also installed on OS/390-server. Some additional components contain the language compilers for COBOL, Object-Oriented COBOL, PL/I, C/C++, JAVA Development Kit (JDK) 1.1.8 with the SWING package and a JAVA Virtual Machine (JVM). Table 2 gives an overview of all base and optional elements of OS/390 V2R7.

On the JEDI OS/390-server are installed furthermore two application managers that support the high-performance transaction processing: Information Management System (IMS) and Customer Information Control System (CICS⁵).

OS Services	Base Elements		Optional Features
Systems Services	<ul style="list-style-type: none"> • BCP • Bulk Data Transfer (BDT) • DFSMSdftp • EREP • ESCON Director Support • High Level Assembler (HLASM) • ICKDSF 	<ul style="list-style-type: none"> • ISPF • JES2 • MICR/OCR Support • TSO/E • 3270 PC File Transfer Program • FFST • TIOC 	<ul style="list-style-type: none"> • JES3 • Bulk Data Transfer (BDT) File-to-File • Bulk Data Transfer (BDT) SNA NJE
Systems Management Services	<ul style="list-style-type: none"> • Cryptographic Services (includes ICSF) (new) • HCD • SMP/E • Tivoli Management Framework (new) 		<ul style="list-style-type: none"> • DFSMSdss, DFSMSrmm, DFSMSshm • HCM • Open Cryptographic Services Facility (OCSF France) (new) • OCSF Security Level 1, 2, 3 (new) • RMF • SDSF • System Secure Sockets Layer (SSL) Crypto (new)

Table 2: The base elements and the optional features of OS/390 V2R7 (continued on the next page)

⁴ Speak “*RAAK-EFF*”.

⁵ Speak “*KICKS*” or “*C-I-C-S*”.

OS Services	Base Elements	Optional Features
Application Enablement Services	<ul style="list-style-type: none"> DCE Application Support Encina Toolkit Executive GDDM (includes PCLK and OS/2 Link) Language Environment (LE) Application Enabling Technology SOMobjects Runtime Library VisualLift Runtime Library C/C++ IBM Open Class Library 	<ul style="list-style-type: none"> C/C++ with Debug Tool C/C++ without Debug Tool DFSORT GDDM-PGF GDDM-REXX High Level Assembler (HLASM) Toolkit Language Environment Data Decryption SOMobjects Application Development Environment VisualLift Application Development Environment for MVS, VSE, VM
Distributed Computing Services	<ul style="list-style-type: none"> DCE Base Services (OSF DCE level 1.1) Distributed File Service (OSF DCE level 1.2.2) Network File System 	<ul style="list-style-type: none"> DCE User Data Privacy (DES and CDMF) - OSF DCE 1.1 level DCE User Data Privacy (CDMF) - OSF DCE 1.1 level OS/390 Print Server <ul style="list-style-type: none"> OS/390 Print Interface Windows 95/NT client IP PrintWay NetSpool
eNetwork Communications Server	<ul style="list-style-type: none"> IP (formerly TCP/IP) SNA (includes AnyNet) (formerly VTAM) 	<ul style="list-style-type: none"> eNetwork Communications Server Security Level 1, 2, 3 (new) eNetwork Communications Server Network Print Facility (NPF)
Network Computing Services	<ul style="list-style-type: none"> WebSphere Application Server NetQuestion 	<ul style="list-style-type: none"> IBM HTTP Server Export Secure IBM HTTP Server France Secure IBM HTTP Server NA Secure
Softcopy Services	<ul style="list-style-type: none"> BookManager READ BookManager BookServer Softcopy Print (includes Softcopy Print for DBCS Languages) 	<ul style="list-style-type: none"> BookManager BUILD
UNIX System Services (X/Open UNIX 95 functions)	<ul style="list-style-type: none"> OS/390 UNIX System Services Application Services <ul style="list-style-type: none"> Shell Utilities Debugger OS/390 UNIX System Services Kernel 	
LAN Services	<ul style="list-style-type: none"> LANRES LAN Server OSA Support Facility 	
Security Server		<ul style="list-style-type: none"> Security Server <ul style="list-style-type: none"> RACF DCE Security Server at OSF DCE level 1.1 LDAP Server Firewall Technologies Security Server LDAP Server DES

Table 2: The base elements and the optional features of OS/390 V2R7

(according to [IRG99])

2 INTRODUCTION TO CICS

2.1 Introduction

Wherever today a day goes by, someone is involved in a transaction, somewhere in the world. It could be a private or business purpose – for example paying at the cash desk in a supermarket, taking money from a bank account using an automatic teller machine (ATM), delivering packages or checking and updating personal records in a business company, comparing customer contracts in an insurance company or taking a reservation in a car rental or airline company. Stored in a database, this information is retrieved when a business application program is started using a transaction that delivers the required data. Such transactions are business operations on behalf of a company. Today the market, whether it is traditional, E-business or mixed, lives or dies due to connected to On-Line Transaction Processing (OLTP) systems. CICS is such an OLTP product developed by IBM, that manages those business applications.

However, **on-line** should not be confused with the today meaning – using a terminal for doing all interactions on a server logically situated away from but connected with the terminal. Originally, on-line meant “*that a file could be read or manipulated in some manner other than a batch job.*” ([YOU01], page 43) In contrast, early on-line processes allowed only one user accessing one record at a time. Such a procedure has been usually called as a transaction. But, the more users wanted to access a record concurrently the more a system has been needed to manage such transaction traffic.

2.2 History of CICS

IBM introduced in 1968 for its mainframe computer system S/360 a transaction management system called Public Utility Customer Information Control System (PUCICS) to manage the increasing transaction processing. Surprisingly, this initial version of CICS became available as a free distribution. One year later, CICS was packaged as a “Class A Program Product” (Class A PPs provides software defect support), now no more free of charge. The first release of CICS for the OS/360 family supported only the ASSEMBLER programming language, however, in 1970, CICS supported also the programming languages COBOL and PL/I. In 1972, CICS supported the new technology of the IBM 3270 Display System, right away, including the Basic Mapping Support (BMS) as well as sending and receiving native 3270 data streams directly to application programs. CICS also supported from that year on the Virtual System (VS) environment introduced within the operating system VM/370 for S/370 computer systems. Within the next years *“a number of new technologies were added to CICS, including support for online update and recovery/restart”* [YEL01]⁶ as well as supporting the virtual storage and the Data Language/1 (DL/I). Furthermore, CICS got its command level programming interface in 1977. *“Command level program isolates the application from its physical environment and has enabled customers to implement distributed systems (client/server).”* [YEL01] Until 1980 CICS supported additionally the Multiple Region Operation (MRO) and the InterSystem Communication (ISC). Both support the easy distribution and running of user applications and data resources across multiple computer systems having multiple processors. During the 1980s CICS was ported onto the personal computer having installed IBM's operating system OS/2, as same as ported onto UNIX machines. Further, CICS was improved to run on the XA architecture to support the 31 bit addressing; hence, the virtual storage CICS could address increased now above the so-called 16 megabit line. RACF became more important as an external security manager for CICS to secure the access to CICS resources. The introduction of Resource Definition Online (RDO), the support for Advanced Program-to-Program Communication (APPC) which involved the use of LU6.2 protocols, and the Extended Recovery Facility (XRF) to enable users to achieve higher levels of system and application availability were another important features developed for CICS during the early 1980s. With the introduction of parallel computer systems in the 1990s CICS was upgraded to support these computers. CICS supports since 1992 IBM's Message Oriented Middleware (MOM) product MQSeries. *“By 1993, there were tens of thousands of CICS licenses for use of the product in MVS, ESA, AIX, AS/400 and OS/2 environments. CICS had become the most widely used transaction processing system.”* [YEL02] In 1996, the first version of the CICS Transaction Server (TS) for OS/390, for Windows NT, and for AIX resp. other UNIX systems became available. This new product supported Assembler, COBOL, C, PL/I, JAVA plus support of APPC and the Transmission Control Protocol/Internet Protocol (TCP/IP). Within this year, CICS resp. CICS TS was prepared for the Internet era supporting some new CICS-accessing methods, for example the CICS Internet Gateway, the CICS Gateway for JAVA, the CICS Gateway for Lotus Notes, or the CICS Web Interface (CWI). The next release of the CICS TS version 1.2 has included a major enhancement –

6 For an interesting homepage for CICS references and CICS related documents see “Follow The Yelavich Road”: <http://www.yelavich.com/>

the CICS 3270 bridge. Hence, CICS programmers were able to enable legacy CICS 3270 applications to access them through the Internet without rewriting the original code.

In 1998, the CICS TS v 1.3 for OS/390 was announced and delivered within 1999. Following enhancements and improvements were realised resp. developed:

- Supporting C++,
- CICS Transaction Gateway (CTG) containing the functions of the CICS Internet Gateway and the CICS Gateway for Java,
- Open Transaction Environment (OTE) to execute CICS JAVA applications in an own CICS region, but under an OTE Task Control Block (TCB) and not the primary CICS Quasi-Reentrant (QR) TCB, a special MVS TCB,
- Business Transaction Services (BTS) allow users to define an overall business process and its related transactions,
- Supporting the Common Object Request Broker Architecture (CORBA), and
- CICS Web Support (CWS), the restructured code of the CWI, to support the CICS domain architecture.

On the JEDI OS/390-server is installed the CICS TS 1.3 because this version is the last available one for OS/390. Therefore, the master thesis bases on this OLTP system.

In the next years until 2004, three new versions of CICS TS for z/OS were introduced – CICS TS 2.1, 2.2, and the last version 2.3. The most important enhancement of the CICS TS 2.1 for z/OS was the support of Enterprise JavaBeans (EJB). These three CICS versions improve each time the performance in using JVMs on z/OS. For example, more than one CICS JAVA program can be used within a CICS task.

Besides CICS, there exist today a variety of other OLTP systems running on a huge number of operating systems – mainframe, open, and also on personal computer systems. However, a major part of transaction processing takes still place on mainframe systems. For example, Siemens provides for its mainframe operating system BS2000 an own TP monitor called Universal Transaction Monitor (UTM). Other known TP monitors for open systems as openUTM from Siemens, Tuxedo from BEA Systems, or Encina from Transarc are used as for example on IBM AIX, DCE DC/OSx, Hewlett-Packard HP-UX, or Novell Unixware resp. Netware.

2.3 CICS in general

However, CICS is one of the most important and most known TP monitors running on z/OS, OS/390, MVS/ESA, OS/400, OS/2, Windows NT and 2000, and on the UNIX Systems AIX (IBM), Solaris (SUN), and HP-UX (Hewlett-Packard). It is used for procedural development organisations and in large-scale applications that expect to have many users and high transactions rates. That is why, CICS is also called a cross industry product. Supported by more than 5000 software packages from more than 2000 vendors, CICS still defends its leading position regarding to performance, reliability, and availability. This TP-monitor is used in business critical applications which demand a high grade of these requirements. A total outage of such applications would terminate the whole business process. Nothing may be lost, nothing may be falsified, and an unauthorised person must not see or change any parts of the data. That means, that transactions must be routed securely, reliably, and efficiently through the whole network of all involved computers. It takes care of the security and integrity of the data while looking after resource scheduling. Transaction processing has been evolved to a heterogeneous application and hence, “*CICS is an «application server».*” [YEL01] It integrates all the basic software services required by OLTP applications. However, CICS has never been used this term.

CICS' function to allow reliable, concurrent access and manipulation of data is still fundamentally. Each interaction between the user and the CICS TS is done by a client. Such a client/server scenario is commonly known as middleware. Middleware is described as a general purpose service between the heterogeneous computing platform (hardware and operating system) and its transaction-based applications and to support their distribution within the network. There are some different classifications of that what middleware is: Transaction Processing (TP) monitors, DataBase Access (DBA) modules, Message-Oriented Middleware (MOM), Object Request Brokers (ORB), Remote Procedure Calls (RPC), security management products, and web servers, too.

Following description of CICS is given in chapter 1.1.1 of [APP90]:

“CICS (Customer Information Control System) is a general-purpose data communication system that can support a network of many hundreds of terminals. You may find it helpful to think of CICS as an operating system within your own operating system ... In these terms, CICS is a specialized operating system whose job is to provide an environment for the execution of your online application programs, including interfaces to files and database products.

The total system is known as a database/data-communication system ...” (DB/DC system). “Your host operating system, of course, is still the final interface with the computer; CICS is «merely» another interface, this time with the operating system itself.”

CICS includes following features: End-to-End Integrity, Listener, Security, Scheduling, Naming, Performance, Exception Handling, Locking, Connectivity, Administration, Logging, Time Control, Multithreading, Recovery, and Authorisation. The TP monitor runs as a batch processing job in a separate virtual address space for instance on an OS/390-server (Figure 2). Such a virtual address space is also called region. CICS application pro-

grams run in the same virtual address space as the CICS kernel. In contrast, the database process runs in another separate virtual address space of OS/390. The CICS kernel consists of the following components: Terminal Control, Program Control, Storage Control, File Control, and Interval Control. Each of these modules has an associated table in the main storage of OS/390 (Figure 3). Besides, running CICS as a single copy on an S/390 computer, there can also be installed multiple CICS copies on a single S/390 computer, and further, multiple copies on different S/390 computer systems, which communicate freely with each other. That is, share data!

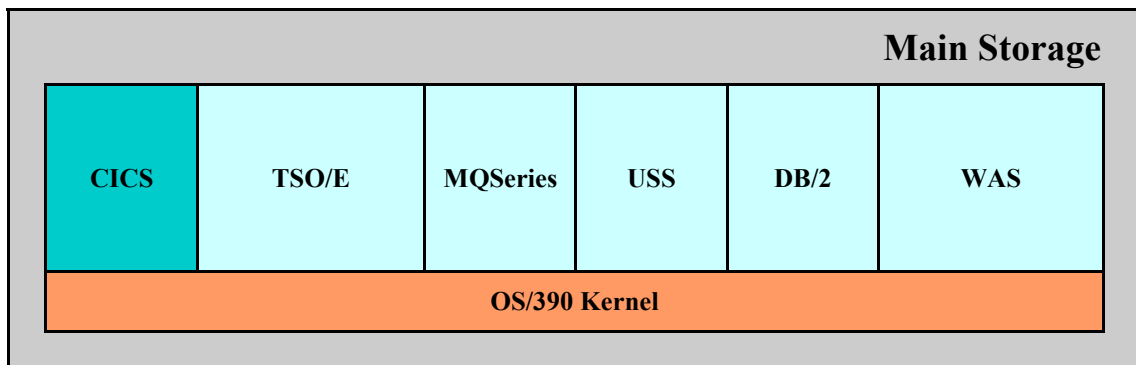


Figure 2: OS/390 – Basic architecture – Virtual address spaces (regions)

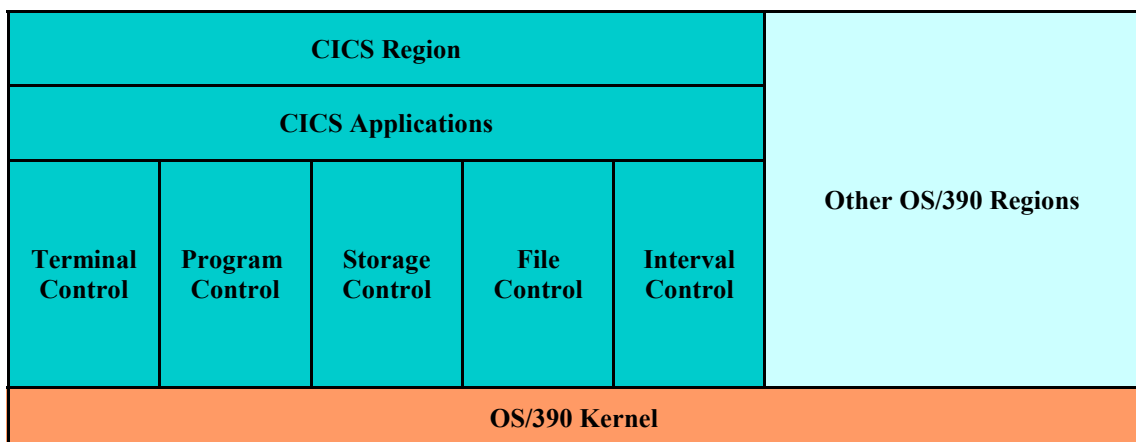


Figure 3: CICS – Basic architecture

Some more interesting facts about CICS are assembled from [HKS04] and [ES1011]:

- Installed on 70.000 servers in 15.000 companies worldwide it is used by almost one million CICS application engineers. Compared to this, about 30 millions CICS terminals are connected to these CICS servers. In contrast, there exist 500 millions personal computers and 200 millions Internet connections. About 90% out of the 2000 biggest companies use CICS.
- More than 150000 users can use a CICS application server concurrently at a time.
- CICS can serve up to 30 billion transaction a day and over 300 billion dollars are transferred in transactions each week.
- CICS can handle thousands of transactions per second.
- More than 1 billion US-dollars have been invested in CICS based applications.
- CICS transactions can run programs written in a variety of programming languages, for example JAVA, C, C++ COBOL, PL/I, Assembler, REXX, etc.
- CICS commands are the same on all platforms, beginning with an *EXEC CICS* statement.
- “*CICS changes, the user's applications need not.*” [YEL03]
- CICS works on basis of the ACID criteria (ACID = Atomicity, Consistency, Isolation, and Durability of the data).

For a more comprehensive understanding about CICS, see chapter 7 of [HKS04] and chapter 1.1 of [APP90].

3 THE INITIAL ARCHITECTURE OF THE CICS BUSINESS APPLICATIONS

Within the next two chapters we create two CICS business applications – describing two possibilities to use CICS as an OLTP system and as an application server (see Figure 4 on next page). As the key components of each application, a business logic component shared by both applications and a presentation logic component for each application are created. They represent a bank program for debit and cash card holders to manage their customer accounts stored to a database-like file by the clerical staff. The customer account file is stored on an OS/390-server and is accessed by the CICS TS. The applications provide procedures to update the customer information, to create and delete customer accounts, and to read them.

Chapter 4 “The CICS Business Application NACT” on page 41 describes in detail the contents of the business and presentation logic component of the CICS application NACT. All programs of the application are written in COBOL. The application is invoked by an associated CICS transaction. Executed on a 3270 terminal screen running on a WINDOWS2000 computer system, it inquires a customer record from the OS/390 database-like file and displays the result on the screen. The services of this CICS application are provided by the legacy 3270 interface. This interface is used to send and receive special 3270 data streams between the CICS terminal and the application programs where they are interpreted. To transport the data from the terminal to the CICS region, the 3270 interface uses the TCP/IP protocol.

A second method to inquire the customer records is explained in chapter 5 “The MQSeries CICS Business Application MQNACT” on page 81. The created business application MQNACT also uses the COBOL business logic created for the CICS application NACT, but has another presentation logic component written in JAVA. We take advantage of JAVA's principle: *Write once, run anywhere*. That means, that anywhere, where a JVM is installed, the MQSeries CICS business application can be executed. In case, the code is transformed into a JAVA applet or servlet, it can be included as part of a web-based application running in a web browser. Exchanging the inquired data between the presentation logic and the business logic is done by the Messaging and Queuing method also referred to as commercial messaging. IBM has developed a product called MQSeries. We use this product in our sample application to explain the mechanisms of sending and receiving messages which transport data streams from a client computer system (WINDOWS2000) to a server computer system (OS/390). On both systems, MQSeries is installed as a server version connected through the TCP/IP protocol. When the JAVA program inquires a customer record stored to the OS/390 database-like file, it sends the data to the MQSeries Server installed on the client computer system by using the Message Queue Interface (MQI). The data is then packaged in a message and send to the OS/390 MQSeries Server. Between this MQSeries Server and the CICS TS another

interface is used to transfer the inquire data to the business logic programs and to transfer the response data back to MQSeries. This interface is called as the MQSeries CICS Bridge, sometimes also called as the MQSeries CICS DPL Bridge. After the response data is transferred from the OS/390 MQSeries Server to the MQSeries Server on the client computer system, it is picked up by the JAVA program using the MQI, too, and the information is displayed.

In contrast to the CICS application NACT, the MQSeries CICS application MQNACT only read the information of the customer account!

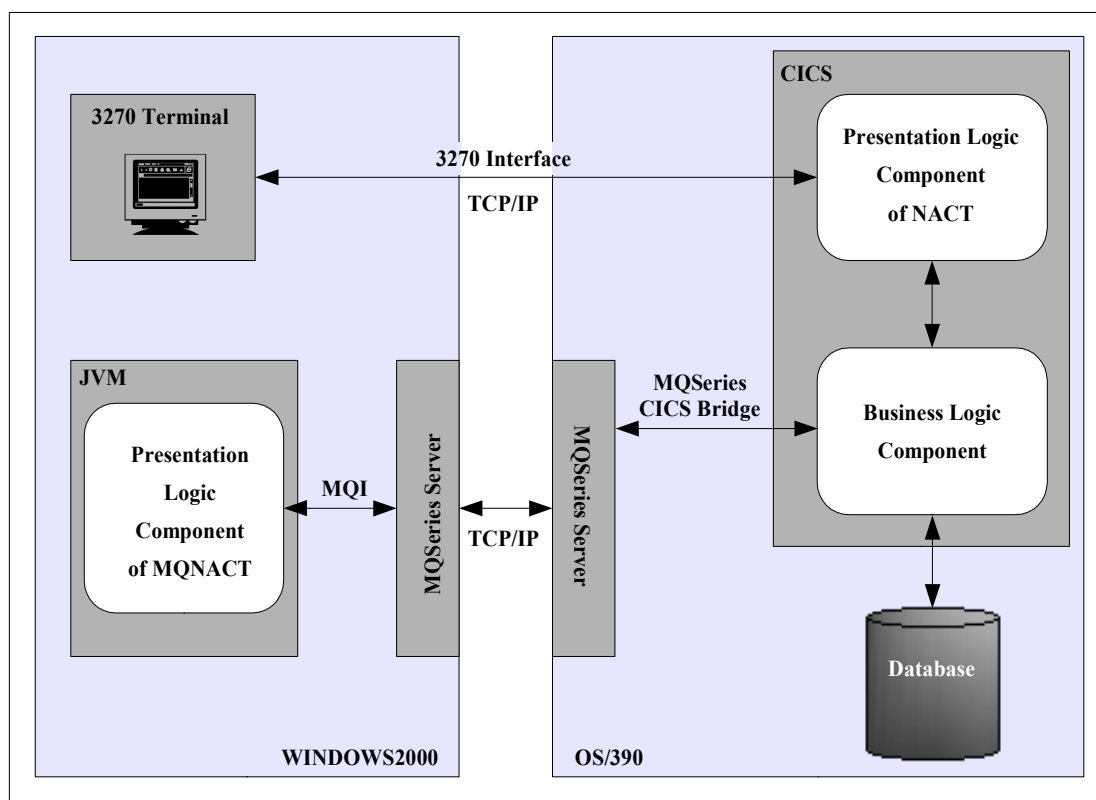


Figure 4: The initial architecture of the CICS business applications NACT and MQNACT

4 THE CICS BUSINESS APPLICATION NACT

A Bank Customer Account Program for the 3270 Terminal

4.1 Introduction

We want to create a CICS application for a bank that should perform operations on a customer account stored in a data base. All employees of the bank should be able to create, read, update, delete, and browse such an account. Furthermore, the customer accounts should be accessible through a menu-controlled program running on a CICS terminal supporting IBM's 3270 Display System, in that case the 3278 Display Station Model 2.

Such a CICS business application consists always of three key elements – components, transactions, and error handling. There are two key components of any business application – the business logic and the presentation logic. The presentation logic is an interface to use the business logic. In contrast, the business logic does the real work. Presentation and business logic can be written in any programming language the operating system understands and subsystems can call. The programs for the CICS application NACT are written in COBOL and use BMS and can be accessed by the CICS subsystem using transactions – the second element. Error handling is started if an error occurs during processing. This third key element is represented by a distinct COBOL program which is part of the business logic.

This chapter covers the description and the installation of both the business logic and the presentation logic. It explains data structures used for administration of the customer accounts and how to install these data on the OS/390-server. Furthermore, it explains how to deploy the application to CICS and how to display the result on a terminal screen when using the 3270 interface.

All data, the source code and the compiled code, are available as raw material on a CD as a part of Horswill's textbook [HOR00].

4.2 Uploading the files

The approach to transfer the files from the CD to the OS/390-server as described in Appendix A of [HOR00] does not work using the standard FTP-terminal included as part of Windows 2000. This terminal does not understand the suggested command *bin fixed 80* to transfer files that have a length of 80 bytes per record stored in fixed blocks. Partitioned data sets (PDS) are always consist of fixed record blocks with a length of 80 bytes per record, but data cannot be transferred directly into PDSs. Those files have to be firstly transferred into sequential data sets (SDS) to receive them later into PDS. Therefore, the SDS has to be set to fixed record blocks. Instead of this command, following command procedure can be used on the FTP-terminal to transfer the data onto OS/390. Firstly, the command *bin* has to be executed. Afterwards, an additional command is to be entered to create the fixed record block SDSs on the OS/390-server (Figure 5, page 44):

```
quote site recfm=fb lrec=80
```

The parameter *recfm* with the attribute *fb* specifies to create the fixed blocks. Within the parameter *lrec* is specified the length of 80 bytes per records. The whole block size is automatically set to 6160 bytes (refer to the messages shown in Figure 5). The file packages are copied from the CD (for folders stored to see Table 3) using the *put* command into a SDS template named as *TBUSSE.CICSADP.NEWSEQ* (Figure 5):

```
put cicsadp.loa cicsadp.newseq
```

It is not required to specify *tbusse.cicsadp.newseq*; the shorter form *cicsadp.newseq* can be used, because after logging on to the FTP-terminal, OS/390 always adds the user library name as high-level qualifier to a data set.

Windows2000		OS/390	
File name	Stored on the CD-ROM into folder: listings\chapter4\os390\cobol\compiled\	Data set name	Data set type
cicsadp.cpy	copybook	TBUSSE.CICSADP.COBCOPY	PDS
cicsadp.csd	csddefs	TBUSSE.CICSADP.CSDDEFS	PDS
cicsadp.jcl	vsam_jcl	TBUSSE.CICSADP.JCLLIB	PDS
cicsadp.loa	loadlib	TBUSSE.CICSADP.LOADLIB	PDS
cicsadp.mac	source	TBUSSE.CICSADP.COBSRCE	PDS
cicsadp.src	source	TBUSSE.CICSADP.COBSRCE	PDS
cicsadp.txt	vsam_data	TBUSSE.CICSADP.VSAMDATA	SDS

Table 3: Files transferred from the accompanied CD-ROM onto OS/390

After a file is successfully transferred into the template data set it is switched to the OS/390 terminal to receive the data into the correct PDS. Entering the command *P. 3. 4* in the CUSTOMPAC MASTER APPLICATION MENU (CMAM) leads to the Data Set List Utility (DSLUI) of the Interactive System Productivity Facility/Program Development Facility (ISPF)/(PDF) (Figure 6, page 44). Entering the user name *TBUSSE* into the field *Dsname Level* and pressing the enter key list the data sets owned by *TBUSSE* (Figure 7, page 45).

When placing the cursor on the first position of the line beginning with the data set name *TBUSSE.CICSADP.NEWSEQ*, the following command is entered to receive the data (Figure 8, page 45):

```
receive indsname(/)
```

The token */* in the emphasis marks the data set in this line. It is noticed that the INSERT key on the keyboard must be activated to overwrite the line. Afterwards, the message INMR901I indicates the data set is ready to be restored into a new data set. The next message INMR906A demands to enter the restore parameters – this refers to the data set in which the files should be copied (Figure 9, page 46):

```
dsn('TBUSSE.CICSADP.LOADLIB')
```

During executing the command a few messages are listed. After pressing the enter key and returning back to the DSLU the first data set has been successfully uploaded from *cicsadp.loa* into the data set *TBUSSE.CICSADP.LOADLIB*. Subsequently, the SDS template may be overwritten by the other files that have to be transferred to OS/390 (Table 3). For transferring and receiving the file the same procedure is used, starting with the package *cicsadp.cpy*. This is to be restored into its target data set as it is listed in Table 3.

All files are received into PDSs, except one file that remains as an SDS named as *TBUSSE.CICSADP.VSAMDATA* (Table 3). For it, the *quote site* command needs to be executed again on the FTP-terminal. A length of 383 bytes per record has to be set in the *lrec1* attribute:

```
quote site recfm=fb lrec=383
```

The records (account details) specified in the file *cicsadp.txt* have a length of 383 characters. Therefore, the file is uploaded into an SDS having 383 bytes per record in one block. At the end, six new PDSs and one SDS are listed in the Dslist Utility (Figure 10, page 46).

Following files are stored in the partitioned data sets:

```
TBUSSE.CICSADP.COBCOPY: NACCBRWS, NACCCRUD, NACCERRH, NACCTREC,  
                        NACTSET, NACWBRWS, NACWCRUD, NACWERRH,  
                        NACWLITS, NACWLOCK, NACWTREC  
TBUSSE.CICSADP.COBSRCE: NACTSET, NACT01, NACT02, NACT03, NACT04, NACT05  
TBUSSE.CICSADP.CSDDEFS: CICS0ADP, CICSJADP  
TBUSSE.CICSADP.JCLLIB:  VSAM  
TBUSSE.CICSADP.LOADLIB: NACTSET, NACT01, NACT02, NACT03, NACT04, NACT05
```

After all files are transferred and received correctly, the SDS *TBUSSE.CICSADP.NEWSEQ* may be deleted (Figure 11-Figure 14, page 47-48).

```

C:\>ftp 139.18.4.97
Connected to 139.18.4.97.
220-FTPD1 IBM FTP CS V2R7 at TIWS007, 04:46:13 on 2004-02-05.
220 Connection will close if idle for more than 5 minutes.
User (139.18.4.97:(none)): TBUSSE
331 Send password please.
Password:
230 TBUSSE is logged on. Working directory is "TBUSSE.".
ftp> bin
200 Representation type is Image
ftp> quote site recfm=fb lrec=80
200-BLOCKSIZE must be a multiple of LRECL for RECFM FB
200-BLOCKSIZE being set to 6160
200 Site command was accepted
ftp> lcd e:\neu
Local directory now E:\neu.
ftp> put cicsadp.10a cicsadp.newseq
200 Port request OK.
125 Storing data set TBUSSE.CICSADP.NEWSEQ
250 Transfer completed successfully.
ftp: 67680 bytes sent in 2.92Seconds 23.15Kbytes/sec.
ftp>

```

Figure 5: FTP session – Uploading a file into a SDS

```

Menu  RefList  RefMode  Utilities  Help
      ~~~~~
Data Set List Utility

blank Display data set list          P Print data set list
V Display VTOC information            PV Print VTOC information

Enter one or both of the parameters below:
Dsname Level . . . TBUSSE
Volume serial . . .

Data set list options
Initial View . . . 2  1. Volume          Enter "/" to select option
                     2. Space            / Confirm Data Set Delete
                     3. Attrib           / Confirm Member Delete
                     4. Total

When the data set list is displayed, enter either:
"/" on the data set list command field for the command prompt pop-up,
an ISPF line command, the name of a TSO command, CLIST, or REXX exec, or
"=" to execute the previous command.

Option ==>
F1=Help    F3=Exit    F10=Actions  F12=Cancel

```

Figure 6: DATA SET LIST UTILITY screen in ISPF/PDF

Figure 7: DSLIST-screen in ISPF/PDF

Figure 8: Receiving the files from the data set “TBUSSE.CICSADP.NEWSEQ”

```

Menu Options View Utilities Compilers Help
DSLIST - Data Sets Matching TBUSSE                                     Row 3 of 10
Command - Enter "/" to select action                                Message                                Volume
-----
receive indsnam(/)SADP.NEWSEQ                                     SMS002
      TBUSSE.DDIR                                              *VSAM*
      TBUSSE.DDIR.D                                           DAVR7A
      TBUSSE.DDIR.I                                           DAVR7A
      TBUSSE.ISPF.ISPPROF                                       SMS001
      TBUSSE.SPFLOG1.LIST                                       SMS002
      TBUSSE.SPFTEMP1.CNTL                                     SMS002
      TBUSSE.SPF1.LIST                                          SMS002
***** End of Data Set list *****

INMR901I Dataset CTS.V130CICSJC.LOADLIB from JCOUSIN on WINMVS28
INMR906A Enter restore parameters or 'DELETE' or 'END'+
dsn('TBUSSE.CICSADP.LOADLIB')

```

Figure 9: Receiving the files into the new data set "TBUSSE.CICSADP.LOADLIB"

```

Menu Options View Utilities Compilers Help
DSLIST - Data Sets Matching TBUSSE                                     Row 3 of 16
Command - Enter "/" to select action                                Message                                Volume
-----
      TBUSSE.CICSADP.COBCOPY                                     SMS002
      TBUSSE.CICSADP.COBSRCE                                    SMS002
      TBUSSE.CICSADP.CORLIB                                     SMS002
      TBUSSE.CICSADP.CSDDEFS                                    SMS002
      TBUSSE.CICSADP.JCLLIB                                     SMS002
      TBUSSE.CICSADP.LOADLIB                                    SMS002
      TBUSSE.CICSADP.NEWSEQ                                     SMS002
      TBUSSE.CICSADP.VSAMDATA                                   SMS002
      TBUSSE.DDIR                                              *VSAM*
      TBUSSE.DDIR.D                                           DAVR7A
      TBUSSE.DDIR.I                                           DAVR7A
      TBUSSE.ISPF.ISPPROF                                       SMS001
      TBUSSE.SPFLOG1.LIST                                       SMS002
      TBUSSE.SPFTEMP1.CNTL                                     SMS002
***** End of Data Set list *****

Option ==> _____
F1=Help    F3=Exit    F10=Actions  F12=Cancel

```

Figure 10: List all received data sets (in blue colour)

Menu Options View Utilities Compilers Help		
DSLIST - Data Sets Matching TBUSSE		
		Row 3 of 16
Command - Enter "/" to select action	Message	Volume

	TBUSSE.CICSADP.COBCOPY	SMS002
	TBUSSE.CICSADP.COBSRCE	SMS002
	TBUSSE.CICSADP.CORLIB	SMS002
	TBUSSE.CICSADP.CSDDEFS	SMS002
	TBUSSE.CICSADP.JCLLIB	SMS002
	TBUSSE.CICSADP.LOADLIB	SMS002
delete	TBUSSE.CICSADP.NEWSEQ	SMS002
	TBUSSE.CICSADP.VSAMDATA	SMS002
	TBUSSE.DDIR	*VSAM*
	TBUSSE.DDIR.D	DAVR7A
	TBUSSE.DDIR.I	DAVR7A
	TBUSSE.ISPF.ISPPROF	SMS001
	TBUSSE.SPFLOG1.LIST	SMS002
	TBUSSE.SPFTEMP1.CNTL	SMS002
***** End of Data Set list *****		
Comand ==> _____ Scroll ==> CSR		
F1=Help F3=Exit F5=Rfind F12=Cancel		

Figure 11: Deleting the SDS template "TBUSSE.CICSADP.NEWSEQ"

Confirm TSO Delete		
Data Set Name. : TBUSSE.CICSADP.NEWSEQ		
Volume : SMS002		
** Caution ** If TSO delete command was issued against an uncataloged data set, a cataloged version on a volume other than the one listed here may be deleted.		
Creation date. : 2002/09/15		
Command. . . . : DELETE 'TBUSSE.CICSADP.NEWSEQ'		
Instructions:		
Press ENTER key to confirm delete request.		
Press CANCEL or EXIT to cancel delete request.		
Command ==>		
F1=Help F3=Exit F12=Cancel		

```

                                Confirm TSO Delete
[]
[]
[] Data Set Name. : TBUSSE.CICSADP.NEWSEQ
[] Volume . . . . : SMS002
[]
[] ** Caution ** If TSO delete command was issued against an uncataloged
[]                  data set, a cataloged version on a volume other than the
[]                  one listed here may be deleted.
[]
[] Creation date. : 2002/09/15
[]
[] Command. . . . : DELETE 'TBUSSE.CICSADP.NEWSEQ'
[]
[]
[]
[] Instructions:
[]
[] Press ENTER key to confirm delete request.
[] Press CANCEL or EXIT to cancel delete request.
IDC0550I ENTRY (A) TBUSSE.CICSADP.NEWSEQ DELETED
***

```

```

Menu Options View Utilities Compilers Help
DSLIST - Data Sets Matching TBUSSE                                Row 3 of 16
Command - Enter "/" to select action                               Message                               Volume
-----
TBUSSE.CICSADP.COBCOPY                                           SMS002
TBUSSE.CICSADP.COBSRCE                                           SMS002
TBUSSE.CICSADP.CORLIB                                           SMS002
TBUSSE.CICSADP.CSDDEFS                                           SMS002
TBUSSE.CICSADP.JCLLIB                                           SMS002
TBUSSE.CICSADP.LOADLIB                                           SMS002
TBUSSE.CICSADP.NEWSEQ                                           DELETE      RC=0
TBUSSE.CICSADP.VSAMDATA                                           SMS002
TBUSSE.DDIR                                                      *VSAM*
TBUSSE.DDIR.D                                                    DAVR7A
TBUSSE.DDIR.I                                                    DAVR7A
TBUSSE.ISPF.ISPPROF                                              SMS001
TBUSSE.SPFLOG1.LIST                                              SMS002
TBUSSE.SPFTEMP1.CNTL                                             SMS002
***** End of Data Set list *****
Command ==> _____ Scroll ==> CSR
F1=Help   F3=Exit   F5=Rfind  F12=Cancel

```

Figure 14: Message also appeared in the DSLIST utility

4.3 The NACT COBOL programs and their commands

4.3.1 Overview

The business application programs running on a CICS Transaction Server v1.3 are *NACT01*, *NACT02*, *NACT03*, *NACT04*, and *NACT05* (Figure 15, next page). These CICS COBOL programs are transferred as compiled and as source versions onto the OS/390-server. Besides these five CICS COBOL programs, a compiled and a source file named *NACTSET*, containing one part of the presentation logic in BMS language, have also been transferred (refer to page 43).

A set of such application programs is also known as a Unit of Work (UoW) and can transfer an unlimited number of messages. The programs are not standard COBOL programs but so-called CICS COBOL programs. Differing from regular COBOL programs, the files to be accessed are not defined in the CICS COBOL programs themselves. They are stored in a CICS table – the File Control Table (FCT). This table links any access from the terminal to the right file stored on OS/390. In addition, some COBOL file processing verbs, console I/O verbs, statements, and compiler functions may not be used. A CICS COBOL program is usually short-running and processes only a few requests. All used program commands are explained in the next sections and are listed together in the Table 4 on page 56.

The COBOL copybooks, that belong to the COBOL programs, are also transferred onto the OS/390-server (refer to Table 3, page 42 and to the data set *TBUSSE.CICSADP.COBCOPY*, page 43). COBOL copybooks are libraries and act somewhat like functions or subroutines. They contain a segment of often used COBOL code for use by the complete application. During execution of the COBOL compiler these copybooks are introduced into COBOL programs like C and C++ include files into C or C++ programs.

4.3.2 The presentation logic component

When the transaction identifier (TRANSID or TRID) NACT is entered on the CICS terminal, the program *NACT01* is started. This program transfers data to the business logic, and, when it gets return data, it sends them to the map set *NACTSET*, which displays the matching screens on the terminal using the 3270 interface (Figure 15). There are three screens, called the **ACCOUNTS MENU** screen (Figure 16, page 51), the **ACCOUNTS DETAILS** screen (Figure 17, page 51), and the **ERROR REPORT** screen (Figure 18, page 52). Those screens are created using the **Basic Mapping Support (BMS)** services – the CICS terminal input/output services. These services constitute the native CICS presentation logic. The map set *NACTSET* contains for the each screen a map that contains multiple fields. The map set has been written in a special BMS language (which is in reality an S/390 assembler language macro facility). It is assembled with the help of the Job Control Language (JCL) into a physical map and into a symbolic description map. The physical map named as *NACTSET* is stored in the execution library *TBUSSE.CICSADP.LOADLIB* but contains no executable code. This part of the map set holds attrib-

utes, labels, and titles for the screen image and adjusts the variable data to display all information correctly on the screen (cf. Listing 11, page 227). The symbolic description map defines variable fields to refer them by name. It must have the same name as the physical map and is compiled as a COBOL copybook into the data set *TBUSSE.CICSADP.COBCOPY*. It is introduced into *NACT01* as an include structure (cf. Listing 12, page 227).

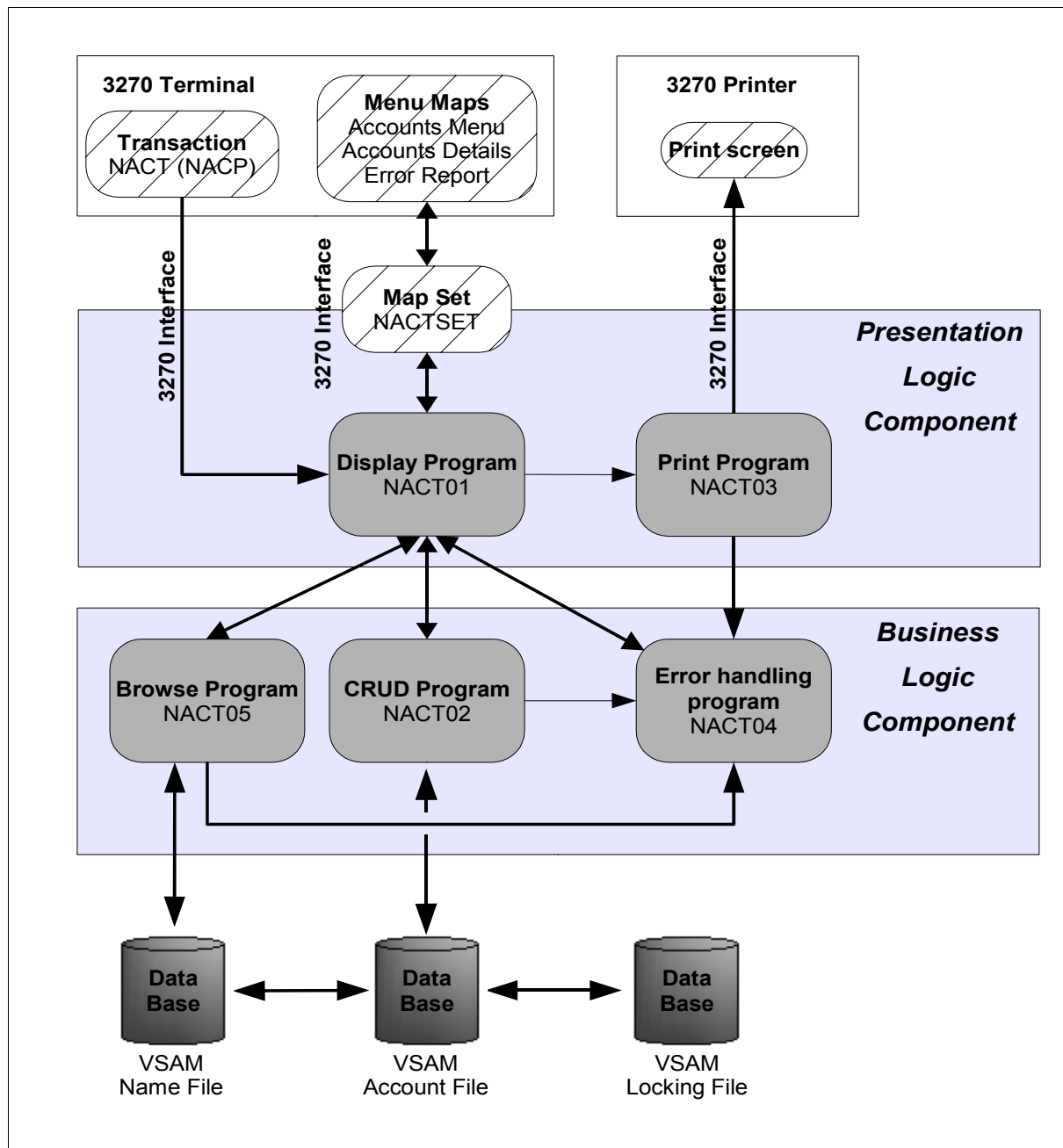


Figure 15: Summary of the components of the bank customer account application NACT

ACCOUNTS MENU

TO SEARCH BY NAME, ENTER SURNAME AND IF REQUIRED, FIRST NAME

SURNAME : (1 TO 18 ALPHABETIC CHRS)
 FIRST NAME : (1 TO 12 ALPHABETIC CHRS OPTIONAL)

TO PROCESS AN ACCOUNT, ENTER REQUEST TYPE AND ACCOUNT NUMBER

REQUEST TYPE: (D-DISPLAY, A-ADD, M-MODIFY, X-DELETE, P-PRINT)
 ACCOUNT : (10000 TO 79999)
 PRINTER ID : (1 TO 4 CHARACTERS (REQUIRED FOR PRINT REQUEST))

ENTER DATA AND PRESS ENTER FOR SEARCH OR ACCOUNT REQUEST OR PRESS CLEAR TO EXIT

Figure 16: ACCOUNTS MENU screen

ACCOUNTS

DETAILS OF ACCOUNT NUMBER 11100

SURNAME : BUSSE (18 CHRS) TITLE : Mr (4 CHRS OPTIONAL)
 FIRST NAME : TOBIAS (12 CHRS) MIDDLE INIT: (1 CHR OPTIONAL)
 TELEPHONE : 0000245756 (10 DIGS)
 ADDRESS LINE1: Hursley Park (24 CHRS)
 LINE2: Hants (24 CHRS)
 LINE3: UK (24 CHRS OPTIONAL)

CARDS ISSUED : 1 (1 TO 9) CARD CODE : C (1 CHR)
 DATE ISSUED : 01 12 01 (MM DD YY) REASON CODE: N (N,L,S,R)
 APPROVED BY : IBM (3 CHRS)

UPTO 4 OTHERS WHO MAY CHARGE (EACH 32 CHRS OPTIONAL)

01: FRAU ELSTER 02: RITTER RUNKEL
 03: PITTIPLATSCH 04: DIE DIGEDAGS
 SPECIAL CODE1: 1 CODE2: 2 CODE3: 3 (EACH 1 CHR OPTIONAL)
 NO HISTORY AVAILABLE AT THIS TIME CHARGE LIMIT 1000.00 STATUS N

NOTE:- DETAILS IN BRACKETS SHOW MAXIMUM NO. CHARACTERS ALLOWED AND IF OPTIONAL
 PRESS "CLEAR" OR "ENTER" TO RETURN TO THE MENU WHEN FINISHED

Figure 17: ACCOUNTS DETAILS screen (example)

```

ACCOUNT FILE: ERROR REPORT

ERROR AT 27/09/2002 12:40:18

Error in transaction NACT, program NACT05 .
Type is TRAP. Response is NOTOPEN      , Reason is 0060 - STARTBR      .

PLEASE ASK YOUR SUPERVISOR TO CONVEY THIS INFORMATION TO THE
OPERATIONS STAFF.

THEN PRESS "CLEAR". THIS TERMINAL IS NO LONGER UNDER CONTROL OF
THE "NACT" APPLICATION.

```

Figure 18: *ERROR REPORT* screen (example)

Three map-definition macros are needed to generate a particular map. One of these is the **BMS map definition for a field** introduced by the DFHMDF macro, for example (cf. Listing 11, page 227):

```

017      DFHMDF POS=(01,01),ATTRB=(ASKIP,BRT),LENGTH=13,      X
018      INITIAL='ACCOUNTS MENU'

```

This example defines that the characters '*ACCOUNTS MENU*' are to be displayed on the ACCOUNTS MENU screen using the attribute *INITIAL*. The string is 13 characters long, thus the attribute *LENGTH* is set to *13*. Furthermore, the string is to be displayed at the upper left position of the screen by setting *POS=(01,01)* (line no. 1 and column no. 1). There are also set predefined characteristics (*ASKIP, BRT*) in the *ATTRB* field. The map field macro may be prefixed with a field name (label) if it is needed to refer to it. An example that has the label *SUMTTLM* is shown in line 56 in the same listing:

```

056 SUMTTLM DFHMDF POS=(14,01),ATTRB=(ASKIP,BRT),LENGTH=79

```

The DFHMDF macros must be part of a **BMS map definition** introduced by the DFHMDI macro. It may also have a label, if more than one is defined. This is an example of such a macro:

```

016 ACCTMNU DFHMDI SIZE=(24,80),CTRL=(PRINT,FREEKB)

```

The macro starts with the identifier *ACCTMNU*. The parameter *SIZE(height, length)* defines the size of the screen, in this case, the map fills the whole displayable area of a CICS terminal with 24 lines (height 24) and 80

characters per line (length 80). Characteristics of the 3270 terminal are defined by the item *CTRL*. For example, the characteristic *PRINT* has to be specified if a printer is to be started to receive the data. The characteristic *FREEKB* unlocks the keyboard after data is written to the map. All maps are assembled in the **BMS map set definition** using the DFHMSD macro. This macro must be placed ahead of all the other macros. The DFHMSD macro is shown in line 1 of Listing 11:

```
001 NACTSET DFHMSD TYPE=MAP,MODE=INOUT,LANG=COBOL,TIOAPFX=YES,STORAGE=AUTO
```

A map set is always introduced by a required notation (here: *NACTSET*) to create the right map set. The attribute *TYPE=MAP* specifies that a physical map set is firstly to be created. After that, the symbolic map description is assembled when the parameter *MAP* is replaced by *DSECT*. Both compiled versions of a map set get always the same name – *NACTSET*. The physical map is stored in that data set into which all other installed programs are compiled to – in that case into *TBUSSE.CICSADP.LOADLIB*. In contrast, the symbolic map description is always stored into the copybook data set. Because the map set is used for both directions – input and output – the attribute *MODE* was set to *INOUT*. The *LANG* characteristic is needed to define the source language of the application program into which the symbolic description map should be introduced. Therefore, the map was assembled into a data definition for the COBOL program *NACT01* (*LANG=COBOL*).

After *NACT01* creates a menu map using BMS it sends the map, for instance the ACCOUNTS MENU map, to the CICS terminal with the COBOL command *EXEC CICS SEND MAP* (e.g. line 1217 in Listing 13). In the case of sending control information like erasing all unprotected fields or freeing the keyboard, the command *EXEC CICS SEND CONTROL* is executed (line 597 in Listing 13). Any data the program *NACT01* receives from a terminal is collected within the command *EXEC CICS RECEIVE MAP* (e.g. line 619 in Listing 13). Such data can be entered on the ACCOUNTS MENU screen and on the ACCOUNTS DETAIL screen. Before *NACT01* transfers data to the business logic programs, it validates the user account and all input data. If an error occurs the error handling program *NACT04* is called. In this case *NACT04* identifies the problem and sends an error message back to *NACT01*. An ERROR REPORT screen containing this error message is created and the map is transmitted to the CICS terminal. Input can also be transferred by pressing special keys on the terminal, for example, the ENTER key, the CLEAR key, or the PA/PF keys. Processing input from a terminal to a program is controlled by the EXEC Interface Block Attention Identifier (EIBAID). For a better understanding on how to use EIBAID it is suggested to browse the Appendix A in [APR03].

Furthermore, *NACT01* can start the program *NACT03* (the print presentation logic) when the transaction NACT has requested the NACP transaction (refer to Figure 15). A new task is started by using the command *EXEC CICS START TRANSID* (line 1040 in Listing 13). The data to be printed is retrieved from a storage area called communication area (COMMAREA) using the command *EXEC CICS RETRIEVE*. This program is not be used by the application since no printer is installed on the JEDI OS/390-server.

For more information about printing see Horswill's textbook [HOR00], chapter 11 “Local Printing (NACT03): Requests for Printing” on pages 241-242. All mentioned CICS COBOL commands are fully referenced in chapter 1 of [APR03]. Information about BMS, macros, items, and characteristics that can be set is available in [APG03], part 6 “Basic Mapping Support”. For BMS details see also [APR03] Appendix J, and K.

4.3.3 The business logic component

The programs *NACT02*, *NACT04*, and *NACT05* are the business logic component of the CICS application. The *NACT02* and *NACT05* programs act as stateless tasks on their own reacting to each request. *NACT04* is invoked if an error occurs during the program execution. An overview on how the business logic programs cooperate with the presentation logic programs is shown in Figure 15 on page 50.

NACT02 is named as the CRUD program (Listing 14, page 227). This abbreviation stands for its operations on a record of the account file (**CREATE**, **READ**, **UPDATE**, and **DELETE**). When the program is called it validates and analyses the request to decide to accept it or not. After *NACT02* accepts a request the CRUD-operations are performed. If a record is to be added to, or deleted from the account file, or the record is to be changed the file must be locked to prevent concurrent updates. The lock is freed if one of these operations (create, update, and delete) is successfully executed. In case of an error, a message is sent from the error handler to the caller. The operation is aborted.

The CICS COBOL command *EXEC CICS WRITE* listed in *NACT02* (e.g. line 359 in Listing 14) adds a new record to the account file (**CREATE**). If a record is to be updated the command *EXEC CICS REWRITE* (e.g. line 502 in Listing 14) is executed to overwrite this entry (**UPDATE**). However, at first, it is necessary to perform a “read for update” operation using the *EXEC CICS READ UPDATE* command (e.g. line 482 in Listing 14). This command searches the account file for the record that is to be updated. The CICS command *EXEC CICS DELETE* (e.g. line 438 in Listing 14) removes a record from the account file (**DELETE**). The **READ** operation *EXEC CICS READ* (e.g. line 408 in Listing 14) is only an inquiry function and does not initiate locking of the account file. In most cases the related command *EXEC CICS READ UPDATE* expects an update of the account file and thus requires locking the file.

NACT05 browses the account file for a matching record using the sequential method. It is searched by name, based on a user input (Listing 15, page 227). The browse process starts with the CICS command *EXEC CICS STARTBR* and terminates with the command *EXEC CICS ENDBR* (e.g. line 376 resp. Line 487 in Listing 15). After the start browse command was invoked only one match is reported, assuming a match exists in the file. *NACT05* however assumes that more than one match is stored in the account file. Therefore, the command *EXEC CICS READNEXT* (e.g. line 529 in Listing 15) is executed to search for additional matches. The results are displayed on the screen. If no record matches the search criteria, a message indicating this fact is displayed. *NACT05* does not require locking the account file because the browse process uses only the **READ** operation and expects no **UPDATE**, **CREATE**, or **DELETE** operation.

The error handler program *NACT04* is called when an error or problem occurs during executing the CICS application NACT (Listing 16, page 227). It must handle a comprehensive scenario that can happen or might happen in future. Nobody can predict every error but if such an unpredictable error occurs a message must be sent to the user to inform him or her. For example, problems could be caused by either the application or by CICS itself. Consequently, *NACT04* obtains any information about the current problem, builds and sends messages to the user appropriate to the type of the error, and terminates the task. In any event, to meet the ACID criteria, the intended modification is rolled back.

The first command *NACT04* executes is *EXEC CICS ASSIGN* (line 954 in Listing 16). It passes information from CICS about the environment and the problem back to the program. Besides, it determines which command was used to invoke the error handler. That can happen when a program, for instance *NACT01*, invokes the commands *EXEC CICS XCTL* or *EXEC CICS LINK* and a serious problem occurred thereby (e.g. line 2129 resp. line 2441 in Listing 13). As a result of a CICS abnormal end processing, the programs call *NACT04* using the command *EXEC CICS ABEND(NACT01)* (Listing 13, line 463). After *NACT04* receives the control it has to confirm that the program which called the error handler is the correct one, and if not, to find the program where the error occurred using the command *EXEC CICS INQUIRE PROGRAM* (e.g. line 1173 in Listing 16). When an error occurs a dump is taken with a code based on the type of the error using the command *EXEC CICS DUMP TRANSACTION DUMPCODE* (e.g. line 1343 in Listing 16). This excludes a conflict with the CICS dump codes. When a transaction fails and an error is produced, all updates on a record must be rolled back, and the previous version is restored with the command *EXEC CICS SYNCPOINT ROLLBACK* (e.g. line 1350 in Listing 16). Displaying the error message on the user's terminal screen is done with the command *EXEC CICS WRITEQ TD QUEUE* (e.g. line 1382 in Listing 16). It writes extra-partition transient data (the error message) to a predefined symbolic destination (the queue) and if possible the message is displayed at a terminal. Executing the command *EXEC CICS WRITE OPERATOR TEXT* (e.g. line 1400 in Listing 16) sends the error message to a system console and thus to a system operator according to the CICS system definition. Additionally, a date and a time stamp can be added to the error message header with command *EXEC CICS ASKTIME* resp. *EXEC CICS FORMATTIME*, (e.g. line 1358 or line 1362 in Listing 16). The command *EXEC CICS ISSUE DISCONNECT* (e.g. line 1467 in Listing 16) is invoked to terminate the session on the CICS terminal.

All commands used within these CICS COBOL programs are listed in Table 4 on the next page. The CICS COBOL commands used in the business logic programs are fully referenced in chapter 1 of [APR03].

Command	Extension	NACT01	NACT02	NACT03	NACT04	NACT05
EXEC CICS ASSIGN	PROGRAM NOHANDLE	X	X	X	X	X
EXEC CICS HANDLE	ABEND	X	X	X		X
EXEC CICS ABEND	ABCODE	X	X	X	X	X
EXEC CICS GETMAIN	LENGTH SET	X X				
EXEC CICS RETURN	TRANSID	X X	X	X	X	X
EXEC CICS XCTL	PROGRAM	X	X	X		X
EXEC CICS SEND	CONTROL MAP	X X		X	X	
EXEC CICS RECEIVE	MAP	X				
EXEC CICS START	TRANSID	X				
EXEC CICS LINK	PROGRAM	X				
EXEC CICS RETRIEVE				X		
EXEC CICS WRITE	FILE OPERATOR		X		X	
EXEC CICS READ			X			
EXEC CICS DELETE			X			
EXEC CICS READ	UPDATE		X			
EXEC CICS REWRITE			X			
EXEC CICS INQUIRE	PROGRAM PROGRAM START				X X	
EXEC CICS DUMP	TRANSACTION				X	
EXEC CICS SYNCPOINT	ROLLBACK				X	
EXEC CICS ASKTIME	ABSTIME				X	
EXEC CICS FORMATTIME	ABSTIME				X	
EXEC CICS WRITEQ	TD QUEUE				X	
EXEC CICS ISSUE					X	
EXEC CICS STARTBR						X
EXEC CICS ENDBR						X
EXEC CICS READNEXT						X

Table 4: CICS COBOL commands used in the application programs

4.3.4 Other commands that control the programs

There are additional CICS COBOL commands to control the programs of the CICS application. Two commands previously mentioned – *EXEC CICS LINK* and *EXEC CICS XCTL* – pass control from one program to another using the scratchpad facility COMMAREA. Such program calls are referred to as “synchronous”. Using this method returns the control to the calling program when the call is completed. The *LINK* command transfers data to another program in a synchronous manner using the COMMAREA and expects a return to continue the execution. The linked-to program, that is called through the *LINK* command, gives back the control to the start-

ing point – the instruction that resides after the *LINK* command. In our sample application, the *LINK* command is used by *NACT01*. On the other side, the *XCTL* command also transfers control in a synchronous manner from one program to another using the *COMMAREA*, but it expects no return to call another program. This method is very useful if an unexpected error is detected and the program cannot continue its work. This command is used by all programs except *NACT04*. In connection with the *LINK* and *XCTL* commands the command *EXEC CICS RETURN* used by all programs (e.g. line 523 in Listing 13) returns the control back to the previous program. In addition, the control is given to the next transaction with the command *EXEC CICS RETURN TRANSID* (e.g. line 2388 in Listing 13).

In case of terminating a transaction because of an abnormal situation the command *EXEC CICS HANDLE ABEND* (e.g. line 456 in Listing 13) is invoked by all programs except *NACT04* to establish the error handler program *NACT04*. The transaction is terminated by the command *EXEC CICS ABEND ABCODE* (e.g. line 463 in Listing 13). This command can give the control back to CICS or to the error handler *NACT04*. It causes to back out all changes made by this unit of work and the record file remains unchanged. Besides, it can produce a dump having the identifier given by the parameter *ABCODE*.

The command *EXEC CICS ASSIGN* is not only used in the *NACT04* program to collect information about the CICS system and the occurred error, it also collects the system information for all other programs.

All these additional CICS COBOL commands are fully referenced in chapter 1 of [APR03].

4.3.5 Excursion: Storing exchange data – When to use the *COMMAREA*?

4.3.5.1 Overview

The *COMMAREA* is a CICS standard area used by two CICS programs to exchange data within one transaction or between transactions. This data is saved temporary for a specific, mostly short, time.

Storage hierarchy on S/390 computers is subdivided into different storage levels; the highest at the top, the lowest on the bottom (refer to Table 5 on next page). Relevant for storing CICS exchange data are Processor Storage, consisting of Central Storage plus Expanded Storage, and External Storage. Processor Storage is also called Main Storage or Main Memory, and sometimes erroneously only Central Storage. However, Central Storage is a component of Processor Storage. External Storage is sometimes also called Auxiliary Storage. Processor Storage can be as large as 64 GB (z900), on the JEDI OS/390-server the size is 256 MB. External Storage on JEDI OS/390-server is provided by one internal disc with 18GByte and 16 external discs with 9.1GBytes per disc. The Processor Storage assigned to CICS is called CICS Main Storage, which is usually virtual storage. This virtual storage is subdivided into the CICS Dynamic Storage Area (CDSA) and the Extended CICS Dynamic Storage Area (ECDSA).

Storage place	Storage level	Access time
---------------	---------------	-------------

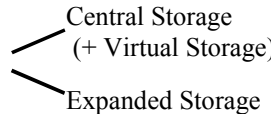
Inside Central Processor	Registers	few nanoseconds
	Level-1-Cache	nanoseconds
	2 nd -Level-Cache	nanoseconds
Inside Processor Unit	Processor Storage 	many nanoseconds
		microseconds
External Storage Devices	Cache Disk Storage on a Direct Access Storage Devices (DASD)	milliseconds
	DASD without Cache	milliseconds
	Optical Storage	milliseconds
	Tape Storage	seconds

Table 5: Storage hierarchy in S/390 computers

(see [HAC99], p.52)

There exist two storage services for storing exchange data from the execution of a CICS transaction resp. CICS program and to share it with other transactions/programs – the scratchpad facility and the queuing facility. Both storage services are used in the CICS business application NACT. Saving the state of an interaction between the terminal user and a program results in the use of such facilities. The scratchpad facility is used when the state of program data is to be saved during program execution (without a task exit). When data is store to a file or to a list, that are referenced later (for example for logging), queuing facility is used (a task exit is possible). CICS scratchpad facilities uses scratchpad areas, which can be one of the following: COMMAREA, Transaction Work Area (TWA), Common Work Area (CWA), and Terminal User Area (TUA). Display Screen can also be used as a scratchpad area to store data for a time. Scratchpads use only CICS Main Storage. The other storage service as already mentioned above is called queuing facility. As it, Temporary Storage and Transient Data can be used. Contrary to scratchpad areas, both can use CICS Main Storage and External Storage (Figure 19, next page).

The CICS storage services can further be subdivided into those associated with a single task or within shared tasks. These types are called Task-Private Storage (also known as Task-Private Pool), Task-Shared Storage (also known as Task-Shared Pool), and Private-Shared-Storage (also known as Region Pool) only owned by CICS. Task-Private Storage is private to the task and cannot be addressed by any other CICS task in the system. The COMMAREA and the TWA can use the Task-Private Storage. In contrast, the data stored in the Task-Shared Storage can be shared between all CICS tasks. This storage can be used by the CWA, the TUA, and by the COMMAREA, too. In the CICS Private-Shared-Storage is stored data private to CICS, only information from this area can be obtained.

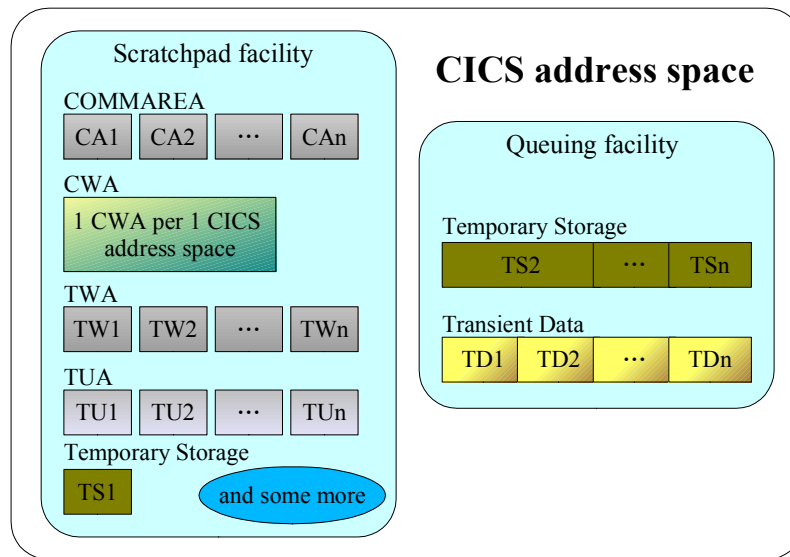


Figure 19: Scratchpad facility vers. Queuing facility

4.3.5.2 Temporary Storage – queuing and scratchpad facility

Temporary Storage is the primary CICS facility for storing data that must be available for more than one transaction. It can use both – CICS Main Storage and External Storage of the OS/390-server, but using CICS Main Storage requires much more storage for Temporary Storage than External Storage requires. CICS exchange data is kept in Temporary Storage Queues (TSQ) (Figure 19). When using CICS Main Storage the space for the queues is taken from the CDSA, part of the Virtual Storage; when using the External Storage the queue is written as a sequential file stored in a VSAM data set. Data stored in External Temporary Storage implies “*storing relatively large amounts of data that have a relatively long lifetime or are accessed infrequently.*” ([APG03], ch. 3.1.5) The Temporary Storage Data Sharing holds both TSQ-types in Temporary Storage Pools to supports concurrent access to the queues. TSQ stored in data sets can be recovered, in contrast to TSQs stored in CICS Main Storage and to shared TSQs. Temporary Storage requires not to be allocate until it is required and it is only available as long as it is required. Security for TSQs is also available. The name of TSQs can be up to 16 characters long. Each queue requires a CICS resource definition called the Destination Control Table (DCT) entry.

TSQs consist of items that can be thought as a record. For the items on both TSQ types, a CICS internal index is created, maintained in the CICS Main Storage. The items can be added to the queue, read, modified, and deleted from the queue by CICS programs within one task or more tasks. Furthermore, the items can be reread and can be read in any order. The TSQ must not store more than 32.767 items resp. bytes. When an item is longer than 1 byte, for example 12 bytes, the TSQ must not exceeded 32.755 bytes. If only one item is stored onto the queue, the queue can be treated as a scratchpad capability (Figure 19). However, TSQs of more than one item should only be used for direct or repeated access to the items, because Transient Data provides facilities for a

better and efficient handling of sequential files when accessed sometimes. Because the queuing facility is only used in the CICS application NACT to send sometimes error messages to the user's terminal, Temporary Storage has not been used for the CICS application, but Transient Data does.

4.3.5.3 Transient Data – queuing facility

Within the second queuing facility – Transient Data – the CICS exchange data is also stored as items/records onto queues (Transient Data Queues (TDQ)) external or internal to the CICS region (Figure 19). If data is stored onto an Intrapartition TDQ (ITDQ), it can only be accessed by a facility allocated to the CICS region. If data should be sent external to the CICS region, it is stored onto an Extrapartition TDQ (ETDQ). ITDQs are similar to External TSQ, they use also sequential files stored in VSAM data sets, but managed by the CICS region. ITDQs cannot be created dynamically, items can only be read sequentially and only once, and an item cannot be changed. After the item is read, it is removed from the queue. Therefore, intrapartition data can be used for message switching, broadcasting, and database access (if the database is connected to the CICS region). Advantageously, ITDQs can be physically or logically recoverable.

In contrast to ITDQs, EDTQs can also reside on any external sequential devices, such as a DASD, terminal, tape, printer, and so on. Programs can access those queues outside or within the CICS region through the standard Sequential Access Method (SAM). Logging data, statistics, and transaction error messages are examples of data that can be written to EDTQs. Within our sample CICS application (*NACT04*), extrapartition data is used to display error messages on the terminal screen. The command *EXEC CICS WRITEQ TD*, as mentioned in chapter 4.3.3 “The business logic component” on page 54, sends the error information to an EDTQ named CSSL.

Both TDQs require a CICS DCT entry and a queue definition. The name of Transient Data queues may only be 4 characters long. Items, as on ITDQs, cannot be reread and modified and they can only be read in order as they were added onto the queues. Read and write operations on ETDQs cannot be done concurrently.

For more information on Temporary Storage and Transient Data please refer to [APG03], for a good explained storage hierarchy and for a complete storage history refer to [HAC99].

4.3.5.4 COMMAREA – a scratchpad facility

As part of the scratchpad facility, the COMMAREA stores temporary data to pass it to a called program within or of the next transaction (refer to Figure 19). A COMMAREA is a special form of user storage. With the use of COMMAREAs, CICS can store the exchange data in DSAs and Extended DSAs to provide them for the same CICS region, for different CICS regions, or for other address spaces external to CICS. When the COMMAREA is used in the *EXEC CICS LINK* and *EXEC CICS XCTL* commands, exchange data is transferred between programs of the same transaction or between transactions from the same terminal. Exchange data can be passed between different terminals when the COMMAREA is used in the *EXEC CICS RETURN* command. When us-

ing this command only the first program of the next transaction is called. CICS ensures, that any COMMAREA is addressable by the program, that receive the data. In our sample CICS business application NACT, all programs except *NACT04* use the COMMAREA.

Each COMMAREA must not exceed a limit of 32.763 bytes including an additional header. However to be safe, it should not be exceeded a 24KB limit because of some factors that can reduce the limit from the maximum ([APG03], ch. 3.3.3.1). The length of the COMMAREA is stored in the EIBCALEN-variable (Execute Interface Block COMMAREA Length). The header may have a length of up to 18 bytes, consisting of an identifier of the target system (bytes 1-4), a program identifier for the called program name (bytes 5-12), a decimal return code (bytes 13-16), and the COMMAREA length inclusive of the header (bytes 17-18). For example, such a header applies to the COMMAREA in the *XCTL* and *LINK* command. Of course, the header of the COMMAREA used in the *RETURN* command consists of the transaction identifier (4 bytes) instead of the program name (8 bytes).

When a CICS COBOL program calls a COMMAREA, it sets a pointer to the address of the COMMAREA known to the system, and receives the data which was transferred from another program to it previously. Because the COMMAREA is freed before the next program starts, a copy of the data area is created and a pointer to the copy is passed to the called program.

Passing exchange data to a DPL program using a COMMAREA is the recommended method. In CICS COBOL programs, the command *DFHCOMMAREA* creates the COMMAREA.

A COMMAREA is used as a Task-Private-Storage, when information is passed between one program and the next in the same task. When information is passed in a pseudo-conversational sequence between one transaction and the next, the COMMAREA is used as Task-Shared-Storage.

In Figure 20 on the next page it is shown, that the program PR1 of the transaction TR1 transfers data to the program PR2 using the COMMAREA1. For example, the command *EXEC CICS LINK PROGRAM('PR2')* has been executed. After PR2 has received the data, the data is processed and sent to the COMMAREA2 executing the command *EXEC CICS RETURN TRANSID('TR2')*. PR3 receives the data because this program is the first program of the transaction TR2. When the data is executed, PR3 sends it to PR4 using the *EXEC CICS LINK PROGRAM('PR4')* command. PR5 also uses the *EXEC CICS LINK* command to pass data to PR4.

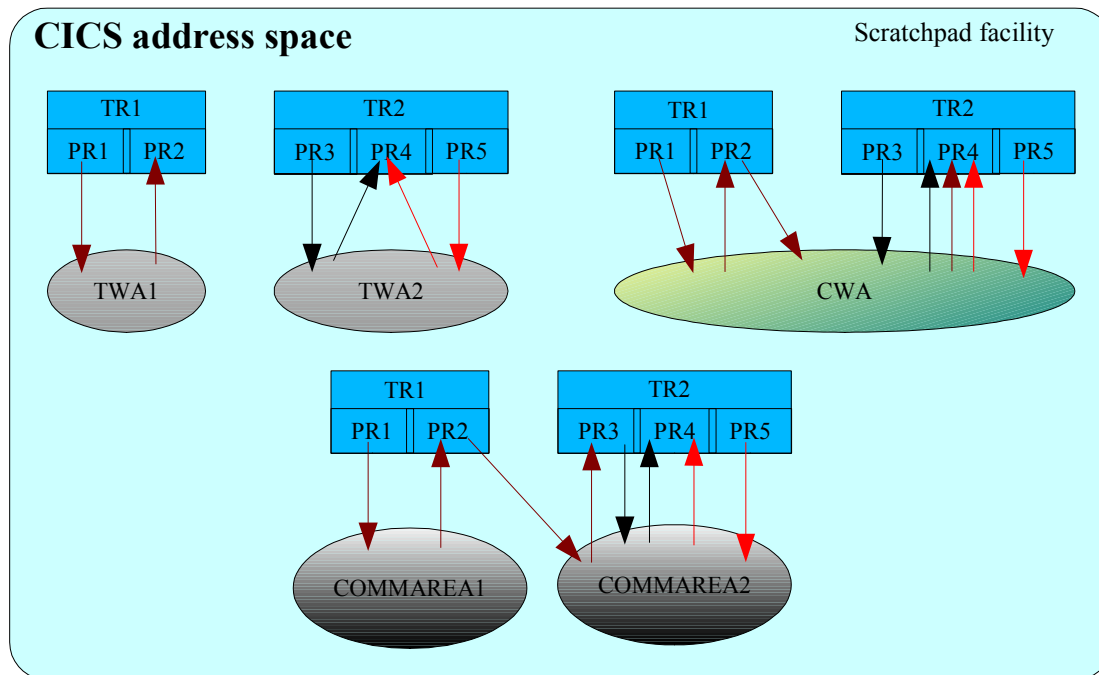


Figure 20: The Scratchpad facilities CWA, TWA, and COMMAREA in comparison

Example: Using the COMMAREA in the CICS business application NACT

As an example, we describe, how a communication area is created and used, when *NACT02* is called for a read request from *NACT01*. Within the COBOL copybook *NACWCRUD* a logical record storing data has been defined (cf. Listing 17, page 228). From this record, also called working storage, the COMMAREA is built by the called program. The copybook defines a 25 bytes header and a 383 bytes buffer for the record. The name of the working storage – *WS-CRUD-COMMAREA* – is only set to refer to it from *NACT01* (line 21, Listing 1, next page). All variables are only used to refer to them from *NACT01*. In the working storage there are only defined pure data.

The program name to be called captures the first 8 bytes of the data area. Because a CICS COBOL program can have maximal 8 characters and *NACT02* consists only of 6, 2 blank characters have been inserted at the end of the program name ('*NACT02__*'; cf. Lines 100-103, Listing 2, next page). This entry is automatically created, when the COBOL command *EXEC CICS LINK* is executed within the keyword *PROGRAM*. As next, a few entries have been created that hold some specific information. The first data item *WS-CRUD-VER* is set to 3 spaces (line 25, Listing 1). This item is filled with the data description entry *WS-CRUD-CORRECT-VERSION* to '1A', if *NACT01* sets this entry (line 26, Listing 1 & line 2127, Listing 2). The field *WS-CRUD-FUNCTION* is set to one space to store the request type which is sent to *NACT02*. The request type describes an associated operation (line 36, Listing 1). For example, the user wants to read an account without locking the file, the request type *E* is set within the variable *WS-CRUD-REQ-ENQUIRE* (line 41, Listing 1). The variable *WS-CRUD-VALID-*

```

...
21      05  WS-CRUD-COMMAREA.
...
25      10  WS-CRUD-VER          PIC XXX VALUE SPACES.
26      88  WS-CRUD-CORRECT-VERSION VALUE 'V1A'.
...
36      10  WS-CRUD-FUNCTION      PIC X   VALUE SPACES.
...
41      88  WS-CRUD-REQ-ENQUIRE  VALUE 'E'.
...
44      88  WS-CRUD-VALID-REQUEST VALUE 'C' 'R' 'U' 'D'
45      'E' 'L' 'F'.
...
56      10  WS-CRUD-RESP          PIC 9(4) VALUE ZERO.
...
59      88  WS-CRUD-NO-ERROR      VALUE '0000'.
60      88  WS-CRUD-BAD-FORMAT    VALUE 'FRMT'.
...
76      10  WS-CRUD-REAS          PIC 9(4) VALUE ZERO.
...
81      88  WS-CRUD-REQUEST-ERROR VALUE 'REQE'.
...
90      10  WS-CRUD-CICS-FUNCTION  PIC 9(5) VALUE ZERO.
...
97      10  NACTREC-DATA.
98      COPY NACWTREC.

```

Listing 1: Extract from the COBOL copybook NACWCRUD (cf. Listing 17, page 228)

Note: COBOL uses different level numbers to indicate the name, the functions, and the fields of the COMMAREA. Such level numbers indicate the hierarchical position of the data items (level numbers 1-49) or the special properties of a data description entry (level numbers 66, 77, and 88). For example, the level number “05” sets the name of the data area, “10” indicates a field, and “88” refer to a variables having a value.

```

...
100     05  WS-PROGRAM-NAME          PIC X(8) VALUE SPACES.
101     05  CRUD-PROGRAM.
102     10  WS-CRUD-PROGRAM-PREFIX    PIC X(4) VALUE SPACES.
103     10  FILLER                    PIC X(4) VALUE '02 '.
...
306     COPY NACWCRUD.
...
2127    SET WS-CRUD-CORRECT-VERSION TO TRUE.
2128*
2129    EXEC CICS LINK
2130           PROGRAM(CRUD-PROGRAM)
2131           COMMAREA(WS-CRUD-COMMAREA)
2132           RESP(RESPONSE)
2133           RESP2(REASON-CODE)
2134    END-EXEC.
...

```

Listing 2: Extract from the CICS COBOL program NACT01 (cf. Listing 13, page 227)

REQUEST points to the same value as specified previously to validate the request type. For example, it points to the value *E* that is set for the read-access and allows the reading (line 44&45, Listing 1). Four more bytes are reserved for the response code values, set within the item *WS-CRUD-RESP* (line 56, Listing 1). There are also reserved four bytes for the reason code within *WS-CRUD-REAS* (line 76, Listing 1). These codes will set during passing the data to *NACT02*. For example, the entry *WS-CRUD-NO-ERROR* is set to '0000' in the field *WS-CRUD-RESP*, in case the request was successful (line 59, Listing 1), or *WS-CRUD-BAD-FORMAT* is set to 'FRMT', if there was an interface error (line 60, Listing 1). Furthermore, the reason code variable *WS-CRUD-REQUEST-ERROR* can be set to 'REQE' in the field *WS-CRUD-REAS*, if there was a request error (line 81, Listing 1). However, this reason code is only stored, if an interface error happened previously. The last 5 bytes of the header have been reserved for a numeric value containing the character representation of the EIBFN value giving rise to the exception condition (line 90, Listing 1). The EIBFN is of particular interest, because it shows the type of the last EXEC command to be issued by *NACT01*. In our case, the decimal number 3586 resp. the hex number E02 indicates the last performed command *EXEC CICS LINK* (EIBFN codes can be found in [CUH00]). At the end, the 5 bytes account number plus an empty 378 bytes buffer is added to the working storage to store the requested account record data. The variables of all these empty record fields have been defined within the copybook *NACCTREC* (line 97 & 98; for the copybook *NACCTREC* refer to Listing 18, page 228).

All in all, *NACT01* creates the logical record for the COMMAREA, consisting of 408 bytes, when the COBOL copybook *NACWCRUD* is loaded within the COBOL command *COPY* (line 306, Listing 2). This record named as *WS-CRUD-COMMAREA* is passed to *NACT02*, when the COBOL command *EXEC CICS LINK* is executed using the keyword *COMMAREA* plus the name of the record (lines 2129-2134, Listing 2). For example, following record could be sent to *NACT02* to build the COMMAREA (underlined blanks indicate the empty bytes):

```
NACT02__V1AE000000000358611100_____
_____
_____
_____
```

where the values mean:

NACT02__	Program name to be called
V1A	“Eyecatcher” sent in this string to <i>NACT02</i>
E	Request type sent in this string to <i>NACT02</i>
0000	Fields for response code sent to <i>NACT02</i>
0000	Fields for reason code sent to <i>NACT02</i>
03586	Indicates the last performed command – EXEC CICS LINK
11100	The requested account number

From this data the COMMAREA is created, when the COBOL command *DFHCOMMAREA* is executed from the LINKAGE SECTION of the called program (line 192, Listing 3). This command only applies to CICS COBOL programs, if not specified, the compiler creates a default communication area consisting of 1 byte. The COMMAREA is built within the masks set in the COBOL copybook *NACCCCRUD* and has the same format as it did in the passing program *NACT01* (line 193, Listing 3; for the copybook *NACCCCRUD* refer to Listing 19, page 228). The name of the communication area is set to *CA-CRUD-COMMAREA* (line 22, Listing 4). This name is only used to call the data area from *NACT02* as same as calling all other fields defined by the copybook *NACCCCRUD*. These variables have been introduced to assign correct names for the COMMAREA-fields to point them from *NACT02*. Before *NACT02* can built the COMMAREA from the record, it must know the address of the working storage. Within the COBOL command *SET* the system provides the address of the record (line 249 referring to line 96, Listing 3).

The first 3 bytes of the record behind the 8 byte program name refer to the first mask set in the copybook *NACCCCRUD* – *CA-CRUD-CORRECT-VERSION* in the *CA-CRUD-VER* field (line 26 & 27, Listing 4). The value of *CA-CRUD-CORRECT-VERSION* has not been set by *NACT02* to 'V1A'. It is only used to compare the passed value with the one specified in the mask (line 261, Listing 3). If the values are the same, it is checked whether the request type is valid or not (line 262, Listing 3 and lines 45 & 46, Listing 4). If it is valid, for example it points to the value 'E' to read an account, a function is executed that indicates some fields to lock an account (line 263, Listing 3). After the request type has been transmitted it is evaluated which request type has been

```

...
96      05  DEBUG-COMMAREA-ADDR  USAGE IS POINTER.
...
191 LINKAGE SECTION.
192 01  DFHCOMMAREA.
193    COPY NACCCCRUD.
...
249      SET DEBUG-COMMAREA-ADDR TO ADDRESS OF DFHCOMMAREA.
...
261      IF  CA-CRUD-CORRECT-VERSION
262          IF  CA-CRUD-VALID-REQUEST
263              PERFORM A-ANALYZE-REQUEST
264              EVALUATE TRUE
...
273                  WHEN CA-CRUD-REQ-ENQUIRE
274                      PERFORM C-READ-THE-RECORD
...
279          END-EVALUATE

408      EXEC CICS READ
409          FILE(WO-LITS-FILES-ACCOUNT)
410          RIDFLD(ACCTDO IN NACTREC-DATA)
411          INTO(NACTREC-DATA)
412          RESP(CA-CRUD-RESP)
413          RESP2(CA-CRUD-REAS)
414      END-EXEC
415      MOVE EIBFN      TO WORK-FN-X
416      MOVE WORK-FN    TO CA-CRUD-CICS-FUNCTION
...

```

Listing 3: Extract from the CICS COBOL program *NACT02* (cf. Listing 14, page 227)

```

...
22      05  CA-CRUD-COMMAREA.
...
26      10  CA-CRUD-VER          PIC XXX.
27      88  CA-CRUD-CORRECT-VERSION VALUE 'V1A'.
...
37      10  CA-CRUD-FUNCTION      PIC X.
...
42      88  CA-CRUD-REQ-ENQUIRE  VALUE 'E'.
...
45      88  CA-CRUD-VALID-REQUEST VALUE 'C' 'R' 'U' 'D'
46      'E' 'L' 'F'.
...
57      10  CA-CRUD-RESP          PIC 9(4).
58      10  CA-CRUD-RESP-X REDEFINES CA-CRUD-RESP
59      PIC X(4).
60      88  CA-CRUD-NO-ERROR      VALUE '0000'.
61      88  CA-CRUD-BAD-FORMAT    VALUE 'FRMT'.
...
77      10  CA-CRUD-REAS          PIC 9(4).
78      10  CA-CRUD-REAS-X REDEFINES CA-CRUD-REAS
79      PIC X(4).
80      88  CA-CRUD-VERSION-ERROR VALUE 'VERE'.
...
91      10  CA-CRUD-CICS-FUNCTION PIC 9(5).
92      10  CA-CRUD-CICS-FUNCTION-X
93      REDEFINES CA-CRUD-CICS-FUNCTION
94      PIC X(5).
...
98      10  NACTREC-DATA.
99      COPY NACCTREC.

```

Listing 4: Extract from the COBOL copybook NACCCRUD (cf. Listing 19, page 228)

passed into the COMMAREA (line 264-279, Listing 3). Because the request type 'E' has been passed referring to the COMMAREA-field *CA-CRUD-REQ-ENQUIRE* (line 42, Listing 4), a function called *C-READ-THE-RECORD* is performed to read the account record (lines 273 & 274, Listing 3).

Before passing the data through the COMMAREA to *NACT01* back, the values for the response and reason codes will also be set as same as they was set for the record which was sent to *NACT02*. For example, in the field *CA-CRUD-RESP* entry *CA-CRUD-NO-ERROR* is set to '0000' because the request was successful (line 60, Listing 4). Furthermore, the reason code has also been set to '0000' because no error occurred. The EIBFN value stores the decimal number 1538 resp. the hex number 602 to indicate the last executed EXEC CICS command, in that case *EXEC CICS READ*.

At the end, the account record data is copied in the masks specified within the copybook *NACCTREC* (line 98 & 99, Listing 4). All data stored in the COMMAREA are received by *NACT01* as a record consisting of the pure data, for example (for the terminal display please refer to Figure 17 on page 51):

NACT02__V1AE000000000153811100BUSSE	TOBIAS	Mr	0000245756Hursley Park
Hants	UK	FRAU ELSTER	RITTER
RUNKEL	PITTIPLATSCH	DIE DIGEDAGS	
1011201NCIBM123N	1000.00	0.00000000	0.00000000
0.00000000	0.00	0.00000000	0.00000000

4.3.5.5 Common Work Area, Transaction Work Area, and Terminal User Area – other scratchpad facilities

The Common Work Area (CWA) is a fixed size data area created at CICS startup that exists only for one CICS address space during a CICS session. *“The whole system, the format, and use of this area must be agreed upon by all transactions in all applications that use it.”* ([HOR00], page 84) Because changing transaction definitions or program contents in future, affinities could cause major problems. Using the CWA is not regulated by CICS, all programs using the CWA must agree the rules for shared access. Data stored in the CWA is unrecoverable if a transaction or the system fails and it cannot be secured by the CICS resource level security. After creation, the CWA is always allocated; hence, it is not suitable for large data or short-time data. However, it is suitable for small amounts of data, that is read or updated by multiple programs, for example status information. The CWA must be prevented from any overload, that will corrupt all storage areas created in the CICS Task-Shared Storage.

As same as in the example for the COMMAREA, it is shown, that the program PR1 of the transaction TR1 transfers data to program PR2 using the CWA in the same address space (refer to Figure 20, page 62). After PR2 has received the data, it is processed, and is also sent to the CWA. PR4 of the transaction TR2 receives the data and executes it. The CWA uses only the *EXEC CICS XCTL PROGRAM* and *EXEC CICS LINK PROGRAM* commands to call the programs.

The Transaction Work Area (TWA) is used to pass data among programs executed in the same transaction not between programs of different transactions. Therefore, only one transaction with its program(s) can use this area. Because the TWA exists for the entire transaction, a large fixed size area (up to 32.767 bytes) has a greater benefit for the conversational than for pseudo-conversational transactions. The TWA uses the *EXEC CICS XCTL PROGRAM* and *EXEC CICS LINK PROGRAM* commands to call the programs. In the example shown in Figure 20, data can only be transferred within the one transaction TR1 or TR2. For example, the data can be exchanged between program PR1 and PR2 using the TWA1, or the programs grouped in the transaction TR2 use the TWA2 to exchange the data among each other.

As another scratchpad facility the Terminal User Area (TUA) is allocated at log on to CICS for both, autoinstalled and non-autoinstalled terminals (please refer to Figure 19 on page 59). It is similar to the CWA, but this area is only shared among the transactions using that terminal until log out. It can be used by pseudo-conversational transactions for small amount of data that should only be exchanged during a terminal session.

The TWA, CWA, TUA, the Temporary Storage, and Intrapartition Transient Data have not been used for the CICS application NACT. Contrary, the COMMAREA and the Extrapartition Transient Data have been chosen.

4.4 Storing the data – account file, locking file, and name file

4.4.1 File description

The account file stored on OS/390 saves the customer information into data records. Each customer has an assigned account number. This number has to be entered into the ACCOUNT MENU screen on the CICS terminal by the employee of the bank to get an access to the data. Subsequently, the transaction NACT sends the data to *NACT01* which sends this request over *NACT02* to the account file *TBUSSE.CICSADP.ACCTFILE* (cf. Figure 15, page 50). The account file is stored as a Key-Sequenced Data Set (KSDS) organised with the Virtual Storage Access Method (VSAM KSDS). This method was introduced by IBM in the 1970s for systems having virtual storage and to use this storage. A VSAM is created with the VSAM definition language Access Method Services (AMS). The data of a VSAM data set is managed in a VSAM catalogue – the central information point. In this catalogue are stored the physical properties of the data set, for instance, the maximal record length, or the position of the key within the record. This simplifies programs because they can take the information from the catalogue to process the data and not from the application program itself. VSAM data sets are referred to as clusters. A VSAM KSDS cluster consists of two physical parts, a data component, and an index component. Other VSAM data sets are Entry-Sequenced Data Sets (ESDS) and Relative-Record Data Sets (RRDS). They are also referred to as clusters but use other access methods. ESDS and RRDS clusters consist of only of the data component.

Each record in the data component of a KSDS cluster contains a key field, which must be the same length and occurs in the same relative position in each record. Based upon their key field values the records are stored in logical sequence in the data component. The index component of the KSDS cluster contains the list of key values for the records in the cluster with pointers to the corresponding records in the data component. Usually, a KSDS was used as a database by IMS. For more information about VSAM and non-VSAM data sets and how to use AMS see [UDS00], [SPR77], and [MOS03].

The account file is accessed through the Keyed Access Method using the account number as key. Because all CRUD operations can be executed on the account file a separate external data base is not needed. Consisting of 22 fields/entries the account file is distinguished into some fields with read access and a few to be modified. Important data fields to be read and modified are the account number, the surname, and first name, address, and a debit card code. Data fields with only read access are account status and charge limit. Fields for future use, in case the debit card is used, are balance, bill date, bill amount, date, and amount paid. It is not necessary to define these record fields because the format of the entries are provided by the KSDS.

The account file must be prevented from concurrent updating a record field. When a user modifies an account record other users must be detained from a concurrent update, so long as the first user frees the transaction/record (“Isolation” of ACID). To prevent this, an account locking file is created. The file called *TBUSSE.CICSADP.ACTINUSE* notices the account number of the record that is being updated and the user ID

with the associated terminal ID. The locking file is also a VSAM KSDS. In contrast to the account file, it only consists of six data fields.

When a user wants to update an account record it is firstly checked whether the file is in use by another process. The *NACT02* program searches the locking file for the stored account number. If found, an error message is sent to the user terminal with the information that the modifying is not allowed. At the end, the process is aborted. But it is conceivably that a record is locked for an unlimited time. The ACID criteria implies that transactions may not wait for any user input. They should only be in use for a “short” time. Therefore, an account record has to be updated in a specified period of time. After this time is elapsed, the account record is freed, and other users can modify it. It does not care whether the first user has ended the update process. Another user who is waiting owns now the record and can modify it. The current time and date of the update are also stored into the locking file.

Unfortunately, freeing an account record after the time has expired, dislodge the business application a bit from the main property “Isolation” of the ACID criteria for transactions. The record is only isolated in the specified time. For the application it is decided to rate the property “short” slightly more than the property “Isolation”. Because in an environment, where multiple users modify records, the locking scheme for this problem is a better solution than abiding the ACID criteria absolutely. An example:

When user Barbie tries to update a record, which is updating by user Ken, she gets a message to try again later and her update process is declined. Why? The program scanned the locking file and detected that the record is in use by Ken. He has a short period of time to complete his update process. As soon as he has modified the record it is freed and the account number is deleted from the locking file. After that, Barbie may modify the same record.

Supposed, that Ken is modifying a record and he is going to lunch for an hour in the meantime. He forgets to finish the update. Since he stays too long away, his owning time is elapsed and the update process is abandoned and backed out. Ken loses his possession right of the account record and the account number is erased from the locking file. Thus the record is freed. Meanwhile, Barbie wants to update the same account record which is now locked by her. The account number is again stored into the locking file until the record is freed again. At this point, Ken can only read the account data. But, when Ken comes back he sees the same screen displaying all changes he made as he left. He finishes his update process but the changes are not saved to the account file because he does not own the record at this time. Don't worry, his changes are not loss, they are stored to the transient data.

All in all, the record updates of Barbie are saved to the account file. Ken's update does not change the record. In case of recovery, Ken can salvage his changes and can add these to the account file later.

Calling the account file by the CICS program *NACT02* means calling the appropriate file entry ACCTFIL in the CICS FCT. The FCT forwards the request to the account file to execute it. This method keeps CICS programs

independent of the access to the data files. If the locking file *TBUSSE.CICSADP.ACTINUSE* is called in case of an update, delete, or create process, *NACT02* calls the FCT entry *ACINUSE*.

The browse program *NACT05* calls entry *ACCTNAM* in the CICS FCT to make a request on the VSAM file *TBUSSE.CICSADP.ACCTNAME* – the name file. That file is a path via an alternate index (*TBUSSE.CICSADP.ACCTNAIX*) to the account file. An alternate index (AIX) is a CICS facility that sorts the account file, for instance, by the customer's surname. The account number can also be queried through the index. Hence, browsing a file is possible through an AIX without any extra intervention by an application. The AIX creates a new account file, in that case the name file.

4.4.2 Installing the storing data

The JCL script called *VSAM*, uploaded into the data set *TBUSSE.CICSADP.JCLLIB*, defines the account, locking, and name file used for the CICS business application (for a complete listing see Listing 20, page 228). In contrast to the CICS COBOL programs and the map set this script has to be compiled on OS/390 during the install procedure.

The script starts with an absolute necessary jobcard, where *ACCTJCL1* is the name of the job indicated by the parameter *JOB* (Listing 5). For instance, this name refers to a log created during execution of the script. The parameter is followed by parameters set for the script, for example, who is to be informed in case of a successful or failed compilation (*NOTIFY*). If the jobcard is globally set, it can be omitted. The program *IDCAMS* creates VSAM data sets and stores the data set information automatically into the default VSAM catalogue *OS390.MASTER.CATALOG.IDCAMS* manages all of the housekeeping needs of VSAM data sets. The print out for the procedure protocol is set in line 19, in that case the it is the user system output, accessible from the System Display and Search Facility (SDSF) program. The *SYSIN* statement introduces the job control data. Listing 5 shows the commands and attributes used:

```

01 //ACCTJCL1  JOB ( ),CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1),NOTIFY=&SYSUID,
02 //          TIME=1440
...
18 //SETUP     EXEC PGM=IDCAMS,REGION=2M
19 //SYSPRINT  DD SYSOUT=*
20 //SYSIN     DD *
```

Listing 5: Extract from the member VSAM stored in TBUSSE.CICSADP.JCLLIB (part 1)

The account file *TBUSSE.CICSADP.ACCTFILE* and the locking file *TBUSSE.CICSADP.ACTINUSE* are created using the AMS *DEFINE* command (Listing 6, page 72). If these files are previously defined they are firstly deleted (line 24 and 25) before defining them new. Actually, the account file, which is a KSDS, is organised as a VSAM cluster consisting of a data component and an index component (lines 30 – 41). The AMS command *DEFINE CLUSTER* creates and the parameter *NAME* names the VSAM cluster which must be unique in the

VSAM catalogue. *KEYS* is only used in a KSDS and sets the length (five-digit account number) and position of the key fields in the VSAM catalogue (counting begins at position 0). The length of the key corresponds to the account numbers specified in the input data file *TBUSSE.CICSADP.VSAMDATA*, which fills up the account file. Since the keys are numeric, only 99.999 customer accounts can be created. In case of future expansion, alphanumeric keys may be used “*and with just one letter in the (record) key can grow to 359.964.*” ([HOR00], p.42) *INDEXED* indicates the key-sequenced data, the first number of *RECORDSIZE* specifies the average length (*383*) and the second the maximal length (*383*) of the data records, in that case the length of one customer entry in the input data file:

Account number (5 records)	Date issued (3*2 records)
Surname (18)	Reason issued (1)
First name (12)	Card code (1)
Middle initial (1)	Approver – initials (3)
Title (4)	Special codes (3*1)
Phone number (10)	Account status (2*1)
Address line (24*3)	Charge limit (8)
Other charge name (32*4)	Payment history: Balance (8), Bill date (6), Bill amount (8), Date paid (6), Amount paid (8)
Cards issued (1)	
Total: 383 records	

Indeed, the account numbers and the customer entries are fixed, a variable record length is a better solution and can be simple added in future. The parameter *RECORDS* (shortcut *REC*) sets “*the amount of space to allocate for the cluster.*” ([UDS00], ch. 2.2.2.3) *80* records (1 track) are allocated as primary space, a secondary space is not set. Sharing the VSAM data set is defined with the option *SHAREOPTION* (shortcut *SHR*). The first number refers to the Cross-Region Sharing (CRS) and the second refers to the Cross-System Sharing (CSS). Because Record Level Sharing (RLS) is not activated between the CICS region and the OS/390 region on the JEDI-server the first number of the CRS-parameter is set to *2*. RLS is used to share VSAM data for many applications between many CICS regions in an MVS parallel sysplex. With this option, any non-RLS user is allowed to access the data set for read processing. Additionally, it can also be accessed by one non-RLS user for write processing. “*VSAM ensures write integrity by obtaining exclusive control for a control interval when it is to be updated.*” ([UDS00], ch. 2.7.2.1) The CSS-*SHAREOPTION* is set to number *3* – the data set can be fully shared. This option is only important if the CRS-*SHAREOPTION* fits number *3* or *4*, which means, “*each user is responsible for read and write integrity for the data.*” ([UDS00], ch. 2.7.2.1) For more information about sharing VSAM data sets refer to “Chapter 13 – Sharing VSAM Data Sets” in [UDS00]. The data set recovery option is set within the parameter *LOG* to *UNDO* for backout only. This parameter applies only when the file is accessed in RLS mode, otherwise VSAM ignores this attribute. The *VOLUMES* parameter allocates space for the file cluster on the volume serial number *SMS002*. The *DATA* and *INDEX* parameters are only specified when subparameters are explicitly required for the data and index component. Within the *NAME* parameter are defined separately names for the components. Both components are created on the specified volume (*SMS002*) with the parameter *UNIQUE*. If *UNIQUE* is specified, free space must exist on the volume *SMS002*.

```

24 DELETE TBUSSE.CICSADP.ACCTFILE
25 DELETE TBUSSE.CICSADP.ACTINUSE
...
30 DEFINE CLUSTER(NAME(TBUSSE.CICSADP.ACCTFILE)      -
31           KEYS(5 0)                                -
32           INDEXED                                   -
33           RECORDSIZE(383 383)                       -
34           REC(80)                                    -
35           SHR(2 3)                                   -
36           LOG(UNDO)                                 -
37           VOLUMES(SMS002))                          -
38           DATA(NAME(TBUSSE.CICSADP.ACCTFILE.DATA) -
39           UNIQUE)                                    -
40           INDEX(NAME(TBUSSE.CICSADP.ACCTFILE.INDEX) -
41           UNIQUE)
...
45 DEFINE CLUSTER(NAME(TBUSSE.CICSADP.ACTINUSE)      -
46           KEYS(5 0)                                -
47           INDEXED                                   -
48           RECORDSIZE(25 25)                         -
49           REC(80)                                    -
50           SHR(2 3)                                   -
51           LOG(UNDO)                                 -
52           VOLUMES(SMS002))                          -
53           DATA(NAME(TBUSSE.CICSADP.ACTINUSE.DATA) -
54           UNIQUE)                                    -
55           INDEX(NAME(TBUSSE.CICSADP.ACTINUSE.INDEX) -
56           UNIQUE)
...
62 REPRO                                           -
63 IDS(TBUSSE.CICSADP.VSAMDATA)                   -
64 ODS(TBUSSE.CICSADP.ACCTFILE)

```

Listing 6: Extract from the member VSAM stored in TBUSSE.CICSADP.JCLLIB (part 2)

The locking file locks currently accessed records of the account file to prevent concurrent updates on them. Therefore, the properties in the locking file cluster are copied from the account file cluster (lines 45 – 56). Only the *RECORDSIZE* parameter is changed to a smaller amount (25) because only six data fields are noticed in the locking file:

Account number (5 records)	
Owner: user name (8) + terminal identifier (4)	
Date (4)	
Time (4)	
<hr/>	
Total (25)	

The account file is replenished with the source data set *TBUSSE.CICSADP.VSAMDATA* using the *REPRO* command (Listing 6, lines 62 – 64). All records in the data file must be in ascending order by non-duplicated account numbers as keys. *INDATASET* (shortcut *IDS*) specifies the source data set, and *OUTDATASET* (shortcut *ODS*) the output data set – the account file. With the AMS command *DEFINE AIX* the alternate index is created (Listing 7, lines 71 – 82). It is named by the *NAME* parameter as *TBUSSE.CICSADP.ACCTNAIX* and relates to the account file within the *RELATE* parameter. A space of 80 records for the AIX is also allocated; *SHARE-OPTION* and *VOLUMES* are set as same as in the file cluster definitions. However, the alternate index uses other

```

71      DEFINE AIX(NAME(TBUSSE.CICSADP.ACCTNAIX)      -
72              RELATE(TBUSSE.CICSADP.ACCTFILE)      -
73              VOLUMES(SMS002)                      -
74              KEYS(18 5)                          -
75              NONUNIQUEKEY                        -
76              UPGRADE                             -
77              REC(80)                              -
78              SHR(2 3))                          -
79      DATA(NAME(TBUSSE.CICSADP.ACCTNAIX.DATA)      -
80              UNIQUE)                             -
81      INDEX(NAME(TBUSSE.CICSADP.ACCTNAIX.INDEX)      -
82              UNIQUE)                             -
83      ...
86      DEFINE PATH(NAME(TBUSSE.CICSADP.ACCTNAME)      -
87              PATHENTRY(TBUSSE.CICSADP.ACCTNAIX)      -
88              UPDATE)                             -
89      ...
95      BLDINDEX IDS(TBUSSE.CICSADP.ACCTFILE)          -
96              ODS(TBUSSE.CICSADP.ACCTNAIX)          -
97              INTERNALSORT

```

Listing 7: Extract from the member VSAM stored in TBUSSE.CICSADP.JCLLIB (part 3)

KEYS attributes. The first attribute is set to **18** because the alternate index is build on the customer's surname, which has maximal 18 characters. Since the surname begins on the sixth position in the account file, the second attribute is set to 5 (the five-digit account number starts at position 0). **NONUNIQUEKEY** (shortcut **NUNQK**) is set to specify that unique keys are not needed because same surnames could be exist in the customer database. With the **UPGRADE** (shortcut **UPG**) parameter VSAM updates the alternate index whenever there is a change to the associated account file. The alternate index should not be called by the CICS application itself but by the name file **TBUSSE.CICSADP.ACCTNAME**, that has still to be created. This file is defined as a path using the AMS command **DEFINE PATH**. It is filled up with the AIX specified within the **PATHENTRY** (shortcut **PENT**) parameter. Hence, when the alternate index is updated, the name file is also updated (**UPDATE** parameter). At the end, the AMS command **BLDINDEX** (shortcut **BIX**) is used to build the internal keys for the alternate index from the account file specified on the **IDS** parameter (shortcut for **INDATASET**). The keys are sorted within the parameter **INTERNALSORT**.

After the JCL script is successfully submitted, the file clusters (account & locking file), the AIX and the path (name file) are created on OS/390.

4.5 The CICS resource definitions

4.5.1 Overview

Since the employees of the bank should access the business application through a CICS terminal there has to be defined some CICS resources. “(CICS resource) *Definitions are stored on the CICS system definition (CSD) file, and are installed into an active CICS system from the CSD file.*” ([RDG03], ch. 1.1) The CSD can be created on-line using the CEDA/B/C⁷ transaction or off-line within the CSD update utility *DFHCSDUP*. Besides, there exist three more methods to define resource definitions – within automatic installation, within system programming using *EXEC CICS CREATE* commands, and within macro definition. The resource definitions for the sample CICS application are created off-line with the help of a JCL surrounded script calling the *DFHCSDUP* program. For details on how to create resource definitions using these five methods see [RDG03].

During the upload process two CSD update scripts – *CICS0ADP* and *CICSJADP* – are transferred into the data set *TBUSSE.CICSADP.CSDDEFS* (refer to Table 3, page 42). The script *CICS0ADP* is renamed to *CICSCSD*. The other script *CICSJADP* is not required; it defines CICS resources for the JAVA interface.

4.5.2 Setting up the CICS resources

There are defined 11 CICS resource definitions – three file objects, one map set object, five program objects, and two transaction objects. All these definitions have been installed into the CICS group *CICS0ADP*. The script begins with a definition of the file objects (cf. Listing 21, page 228). For example, the account file *TBUSSE.CICSADP.ACCTFILE* stored on OS/390 is accessed by the following CICS resource definition:

```

07 DEFINE FILE(ACCTFIL) GROUP(CICS0ADP)
08     DESCRIPTION(MAIN ACCOUNT FILE)
09     DSNAME(TBUSSE.CICSADP.ACCTFILE) RLSACCESS(NO) LSRPOOLID(1)
10     READINTEG(UNCOMMITTED) DSNSHARING(ALLREQS) STRINGS(1)
11     RECORDSIZE(383) KEYLENGTH(5) STATUS(ENABLED) OPENTIME(FIRSTREF)
12     DISPOSITION(SHARE) DATABUFFERS(2) INDEXBUFFERS(1) TABLE(NO)
13     MAXNUMRECS(NOLIMIT) UPDATEMODEL(LOCKING) LOAD(NO)
14     RECORDFORMAT(F) ADD(YES) BROWSE(NO) DELETE(YES) READ(YES)
15     UPDATE(YES) JOURNAL(NO) JNLREAD(NONE) JNLSYNCREAD(NO)
16     JNLUPDATE(NO) JNLADD(NONE) JNLSYNCSWRITE(YES) RECOVERY(NONE)
17     FWDRECOVLOG(NO) BACKUPTYPE(STATIC)

```

When the CICS account file object *ACCTFIL* is created using the *DEFINE FILE* command the CICS group *CICS0ADP* specified on the parameter *GROUP* is immediately created. In this group the CICS file object is stored. Some important parameters are described in detail, for a full description of all parameters used see Part 5 of [RDG03].

⁷ CEDA is the abbreviation of CICS Execute-level Dynamic Add; CEDB and CEDC consist of a few transactions CEDA contains. They got the endings B and C solely CEDA ends with an A.

The parameter *DSNAME* refers to the associated account file on OS/390. Since RLS is not supported on the JEDI OS/390-server, the option *RLSACCESS* has to be set to *NO*. Since the VSAM file is not accessed through RLS it has to be accessed using a local shared pool (LSR) or not. An LSR having number 1 is set within the *LSRPOOLID* parameter. On *RECORDSIZE* has to be specified the same length as on the eponymous AMS parameter specified for the VSAM KSDS account file cluster (*383*). *KEYLENGTH(5)* sets the length of the characters used for the account number. The amount of concurrent updates allowed on the account file is set with the *STRINGS* parameter, in that case one user can update the account file; concurrent updates are permitted. Buffers to be used for the data component are set within the *DATABUFFERS* parameter. The minimum value that must be specified is one more than the number specified in *STRINGS*. Additionally, buffers has also to be set for the index component of the account file within the *INDEXBUFFERS* parameter. The minimum number to be specified for this parameter is the same as set in *STRINGS*. The *STRINGS*, *DATABUFFERS*, and *INDEXBUFFERS* parameters are required because RLS mode access is not activated. These parameters are set globally, but usually, it is recommended to define these parameters in an LSR resource definition that corresponds to the *LSRPOOLID*. The attribute *ENABLED* on the *STATUS* parameter specifies that the CICS file object may be used. Because the records in the account file have a fixed length the *RECORDFORMAT* parameter is set to *F*.

The CICS locking file object ACINUSE has few parameters different from the parameters defined in the CICS account file object. The format of the records is set to variable length within the *RECORDFORMAT* parameter. Hence, only the required characters up to 25 are to be stored. The records may not be longer as specified in the VSAM file definition for the locking file *TBUSSE.CICSADP.ACTINUSE*.

For the CICS name file object ACCTNAM are specified the same parameters as for the CICS account file object except the missing parameters *RECORDSIZE* and *KEYLENGTH*. The CICS name file object accesses the VSAM name file for browsing on the surnames but this file is only a path to the alternate index file which gets the records from the account file. Therefore, record size and key length are not needed for the CICS name file object.

Five important parameters are not mentioned yet – *ADD*, *BROWSE*, *DELETE*, *READ*, and *UPDATE*. The CICS file objects declare the restrictions on how the VSAM file on OS/390 can be accessed by the CICS COBOL programs as shown in Table 6.

<i>CICS file object</i>	<i>CICS Resource definition parameters</i>				
	<i>ADD</i>	<i>BROWSE</i>	<i>DELETE</i>	<i>READ</i>	<i>UPDATE</i>
ACCTFIL	YES	NO	YES	YES	YES
ACCTNAM	NO	YES	NO	YES	NO
ACINUSE	YES	YES	YES	YES	YES

Table 6: Allowed operations on the CICS file objects

The map set *NACTSET* stored on OS/390 has also to be linked to CICS to display the screens of the application. This CICS map set object for the CSD, also named as *NACTSET*, is created and stored in the CICS group CICS0ADP using the *DEFINE MAPSET* command (Listing 21):

```

40 DEFINE MAPSET(NACTSET) GROUP(CICS0ADP)
41     DESCRIPTION(DISPLAYS THE MENUS)
42     RESIDENT(NO) USAGE(NORMAL) USELPACOPY(NO) STATUS(ENABLED)

```

For a detailed description of the parameters see Part 5 of [RDG03].

The five CICS program objects are created as the example for *NACT01* shows:

```

43 DEFINE PROGRAM(NACT01) GROUP(CICS0ADP)
44     DESCRIPTION(PRESENTATION LOGIC FOR THE TERMINAL)
45     LANGUAGE(COBOL) RELOAD(NO) RESIDENT(NO) USAGE(NORMAL)
46     USELPACOPY(NO) STATUS(ENABLED) CEDF(YES) DATALOCATION(BELOW)
47     EXECKEY(USER) CONCURRENCY(QUASIRENT) DYNAMIC(NO)
48     EXECUTIONSET(FULLAPI) JVM(NO)

```

The same parameters are set for the other four CICS program objects, of course, the name of the program has to be changed for each program and *DESCRIPTION* can also be changed to a proper description of the program. The important parameter of this resource definition is *LANGUAGE*. This parameter designates the programming language in which the program is written, in that case *COBOL*. Other languages that could be specified are *ASSEMBLER*, *LE370*, *C*, and *PLI* resp. *PL/1*. A detailed description of all other parameters specified could also be found in Part 5 of [RDG03].

As last objects, the script defines the CICS transaction objects *NACT* and *NACP*. *NACT* is the transaction ID that the user needs to run the application on the CICS terminal, *NACP* is the transaction ID to print the display. *NACP* is defined but not used yet. The *NACT* transaction is defined by following parameters:

```

82 DEFINE TRANSACTION(NACT) GROUP(CICS0ADP)
83     DESCRIPTION(NACT TRANSACTION)
84     PROGRAM(NACT01) TWASIZE(0) PROFILE(AAACICST) STATUS(ENABLED)
85     TASKDATALOC(BELOW) TASKDATAKEY(USER) STORAGECLEAR(NO)
86     RUNAWAY(SYSTEM) SHUTDOWN(DISABLED) ISOLATE(YES) DYNAMIC(NO)
87     ROUTABLE(NO) PRIORITY(1) TRANCLASS(DFHTCL00) DTIMOUT(NO)
88     RESTART(NO) SPURGE(NO) TPURGE(NO) DUMP(YES) TRACE(YES)
89     CONFDATA(NO) ACTION(BACKOUT) WAIT(YES) WAITTIME(0,0,0)
90     RESSEC(NO) CMDSEC(NO)

```

The transaction *NACT* is defined within the command *DEFINE TRANSACTION*. Some important parameters are described, for all other parameter see Part 5 of [RDG03]. The parameter *PROGRAM* specifies the program which is executed when the transaction *NACT* is issued on the terminal. *PROFILE* sets the name of the profile definition (*AAACICST*) that specifies the processing options used in conjunction with the terminal that initiated the transaction. This profile has been used to convert all entered letters into capitals. How to define such a profile is described in chapter 6.6 “Adjust the LOGIN terminal to pass capital letters to RACF” on page 207. The paramet-

er *SHUTDOWN* specifies whether a transaction can be used during a CICS shutdown, furthermore. The transaction itself has no own security options defined (*RESSEC(NO)* and *CMDSEC(NO)*) because the application should be accessible for all users in any way.

These CICS resource definitions are installed to the CSD file by using the *DFHCSDUP* job. There has to be inserted some JCL code around the definitions before the script can be executed:

```

01 //CSDADP   EXEC PGM=DFHCSDUP,REGION=0M,
02 //        PARM='CSD(READWRITE),PAGESIZE(60),NOCOMPAT'
03 //STEPLIB  DD DSN=CICSTS13.CICS.SDFHLOAD,DISP=SHR
04 //DFHCSD   DD UNIT=SYSDA,DISP=SHR,DSN=CICS.COMMON.DFHCSD
05 //SYSPRINT DD SYSOUT=A
06 //SYSIN    DD *
  ..
91 /*

```

In the first line the item *PGM* refers to the program *DFHCSDUP* using the parameters specified in the next line. To update the CSD file the parameter *CSD* is set to *READWRITE*. The program is stored in the data set *CICSTS13.CICS.SDFHLOAD* specified by the item *STEPLIB*. The item *DFHCSD* links to the data set where the CSDs are stored. When submitting this script, all resource definitions are installed into the CICS group *CICS0ADP*. Attention, the CSD file must be closed before updating it because the off-line update utility *DFHCSDUP* is used. This utility only performs its operations on a closed CSD! The CSD file is closed either no user is logged on to CICS, or CICS has been shut down. If it is open, an error is indicated (level 12) and the log notes following message:

```

DFH5128 S PROCESSING TERMINATED. PRIMARY CSD ACCESSED BY ANOTHER USER AND COULD
NOT BE SHARED. DDNAME: DFHCSD
DFH5103 I ERROR(S) OCCURRED WHILE PROCESSING DEFINE COMMAND.
DFH5104 W SUBSEQUENT COMMANDS ARE NOT EXECUTED BECAUSE OF ERROR(S) ABOVE.

```

If the script is successfully executed (level 0), the log notes success messages. For example, the *DEFINE FILE* command that creates the CICS object file *ACCTFIL* is successfully executed:

```

DFH5120 I PRIMARY CSD OPENED; DDNAME: DFHCSD
DFH5143 I GROUP CICS0ADP CREATED.
DFH5159 I FILE ACCTFIL DEFINED IN GROUP CICS0ADP
DFH5101 I DEFINE COMMAND EXECUTED SUCCESSFULLY.

```

At the end of the log, a brief information is listed:

```

DFH5107 I COMMANDS EXECUTED SUCCESSFULLY: 11      COMMANDS GIVING WARNING(S): 0
DFH5108 I COMMANDS NOT EXECUTED AFTER ERROR(S): 0
DFH5109 I END OF DFHCSDUP UTILITY JOB. HIGHEST RETURN CODE WAS: 0

```

As next step, the new CICS group *CICS0ADP* has to be added to one of the scripts for the CICS System Initialisation Table (SIT) to load the group during the CICS region startup. In the SIT are stored CICS system ini-

tialisation parameters that specify CICS system attributes. For more information about the SIT definition scripts refer to chapter 6.3.1 “The CICS region's SIT” on page 169.

C001 is one of those three scripts that sets the CICS transaction server definition. It is stored in the data set CICS.COMMON.SYSIN (cf. Listing 22, page 228). The SIT-parameter *GRPLIST* set in the script *C001* contains 4 lists which are loaded during CICS starts up – *DFHLIST*, *C001LIST*, *PPLIST*, and *DEMOLIST*. To add the group CICS0ADP to one of these lists it is chosen to create a new list named DEMOADP. Besides the group CICS0ADP, this new list should also contain all the groups DEMOLIST previously contained. The entry *DEMOLIST* is then replaced by *DEMOADP* on the *GRPLIST* SIT-parameter (cf. Listing 22, page 228):

```
23 GRPLIST=(DFHLIST,C001LIST,PPLIST,DEMOADP),      RDO GROUP LISTS
```

After that, CICS has to be started to copy the groups of the list DEMOLIST into the new list DEMOADP. The CEDA transaction lists all groups DEMOLIST contains (see Figure 21 on next page):

```
CEDA DISP LI(DEMOLIST)
```

The groups of the list DEMOLIST have been copied into the new list DEMOADP with this command:

```
CEDA Append List(DEMOLIST) To (DEMOADP)
```

The CICS group CICS0ADP that stores the resources for the CICS business application is also added to the new list:

```
CEDA Add Group(CICS0ADP) List(DEMOADP)
```

At the end, all objects of the group CICS0ADP has to be installed dynamically on CICS to make the resource definitions available to an active CICS system.

```
CEDA INSTALL GROUP(CICS0ADP)
```

Before executing the transaction NACT, the CICS startup JCL script *CICSC001* located in the data set *SYS1.PROCLIB* must be completed by an entry in the DFHRPL concatenation (cf. Listing 23, page 229) :

```
30 //          DD DISP=SHR,DSN=TBUSSE.CICSADP.LOADLIB          ADP-SAMPLE
```

The library *TBUSSE.CICSADP.LOADLIB* contains the compiled CICS COBOL programs to which CICS connects the CICS program objects ACCTFIL, ACINUSE, and ACCTNAM during startup. The DFHRPL concatenation works like a load path. After these settings are made CICS needs to be restarted to accept the changes of the DFHRPL concatenation (refer to chapter C.1 “Restarting the CICS region”, page 239).

After CICS is restarted the transaction ID NACT can be issued and the CICS business application NACT will start (cf. Figure 16, page 50).

DATE	TIME
01.346	18.04.50
01.346	18.05.05
01.346	18.06.11

Figure 21: CEDA DISP LI(DEMOLIST)

5 THE MQSERIES CICS BUSINESS APPLICATION

MQNACT

Another Bank Customer Account Program for the JVM

5.1 Introduction

The CICS business application NACT runs on the CICS TS. It consists of a set of programs to gather information about a customer, changes customer details, or deletes customer accounts. For instance, details of a customer account can be displayed on the screen using the CICS transaction NACT on a CICS terminal. But there are many reasons a company could say: 'Is there another method to use the and display the data?'. For one reason, the company decides, that the customer should not use a terminal program to display the details because the connection to the terminal is probably not available through all the time or the GUI is not attractive enough for him. For another reason, the customer wants a billing receipt after an order is made and wants to print this receipt on the client printer at home. Or the printing of the billing receipt requires an additional check on a non-CICS application. For all cases, the company wants to provide an assured and unattended access to the data stored on the OS/390-server using the existing CICS business logic with a high degree of network independence. Furthermore, the bank wants to provide a high availability of the GUI application over a range of operating systems and hardware platforms wherever and whenever the customer wants to access the data. What possibilities the company has?

The company decides to use a middleware system for connecting and transporting data to and from the existing CICS business logic component on the OS/390-server. Either getting the information from programs and transactions running within CICS on one or more OS/390-servers, or getting the information from transaction monitors running on non-mainframe platforms, for example an AIX machine, MQSeries (new: WebSphere MQSeries) – the commercial middleware product introduced by IBM 1992, can be used to solve this problem. MQSeries is part of a generic group called Message Oriented Middleware (MOM). IBM presents it as a “*family of products for cross-network-communication*” ([AMQ95], S.7), consisting of the MQSeries Server and the MQSeries Client, the MQSeries Integrator, and the MQSeries Workflow. Across a network of unlike components (CPU, operating systems, communication protocols), the user/company gets with MQSeries a simple and consistent GUI-application-to-program/transaction communication. As a result, it exists an indirect program-to-program communication that handles data using messaging and queuing. For example, queries can be queued from one branch to another or within a branch of the bank company.

This thesis uses the existing CICS business logic programs *NACT02* and *NACT04* of the CICS business application NACT to create a new MQSeries CICS application called MQNACT. On the OS/390-server the IBM MQSeries Server v2.1, as one part of the message queuing product, has been installed. On the Windows2000 client the IBM MQSeries Server v5.2.1, including the MQSeries support pack MA88⁸, has been installed. This support pack provides the JAVA classes for the Message Queue Interface (MQI) which establishes a connection between the JVM and the MQSeries server. Furthermore, a connection called MQSeries CICS Bridge has to be created and started on the OS/390-server that runs the CICS TS. This bridge links the CICS TS with the OS/390 MQSeries Server. The presentation logic and the MQSeries communication logic for the WINDOWS2000 client is programmed in JAVA (*MQClient.java* and *MQCommunicator.java*). JAVA makes it possible to display the customer accounts on every system on which a JVM is installed. A programmer of the JAVA application requires no knowledge of the business logic running on the CICS region. There is no need to restructure the CICS business logic programs on the OS/390-server, and other client applications can also use these programs, e.g. the CICS business application NACT. The JAVA Runtime Environment (JRE) version 1.3.1_02 including the SWING package has to be installed on the WINDOWS2000 computer system to run the JAVA application.

8 For downloading this package, please point to:
<http://www-306.ibm.com/software/integration/support/supportpacs/individual/ma88.html>
or point to the CD: additions\Windows2000\MQSeries_v5.2.1\MA88

5.2 Messaging and Queuing

5.2.1 Overview

Messaging and Queuing, or **Message Queuing (MQ)**, is one of four program-to-program communication models defined in the IBM Open Blueprint [OBP96] published in 1996. Other alternatives are the Application Programming Interfaces (API) for conversation, remote procedure calls (RPC), and HyperText Transfer Protocols (HTTP). MQ can be used by any application or application-service to obtain appropriate communication support, which may be TCP/IP-oriented, OSI-oriented, or SNA-oriented.

The following definition for MQ is given in [AMQ95], chapter PREFACE:

- Messaging: *“Programs communicate by sending each other data in messages rather than by calling each other directly.”*
- Queuing: *“The messages are placed on queues in storage, so that programs can run independently of each other, at different speeds and times, in different locations, and without having a logical connection between them.”*

In principle, MQ is not more than putting messages on message queues and taking messages from them. [AMQ95] mentions three main characteristics of MQ:

1. *“Communicating programs can run at different times.”*

The program-to-program communication is handled by MQSeries. Programs do not communicate directly with each other, they use message queues. When a sender program sends a request to a receiver program, MQSeries creates a message and forwards it to the receiver program. If this program is currently unavailable, MQSeries stores the message until the program is activated. The receiver program executes the request and sends the response back to MQSeries. This data is again stored in a message to be sent to the sender program when it is available. Both programs continue their work without waiting for a response of each other. MQSeries ensures that messages are sent and received without requiring programs to run concurrently. This method is known as asynchronous program-to-program communication. Synchronous communication implies, an application waits for a response to come back before starting the next request.

2. *“There are no constraints on application structure.”*

Messages can be transferred between two or more applications, also known as one-to-one, many-to-one, or one-to-many connections. Programs may be *“on the same processor in a single environment, on the same processor in different environments, or on different processors in different environments.”* ([AMQ95], ch. 2.0)

3. “Programs are insulated from network complexities.”

Programs do not communicate directly through a network, they use a middleware that distribute the messages to the right destination. These applications are freed from understanding how the network works and how it is maintained. A network connection is only controlled by MQSeries and not by the programs themselves. Furthermore, program execution is not impacted by a network error or restart.

These three key principles implies four important characteristics:

- time-independent communication
- connectionless communication
- conversational communication
- parallel processing.

MQ distinguishes two different communication models – *Point-to-Point* and *Publish-and-Subscribe*. When applications communicate through the Point-to-Point method, messages are delivered from exactly one sender to one receiver. Other applications have no access to the queue or message. When the Publish-and-Subscribe method is used, a few applications (producer) can produce messages to store them into a message queue. Other applications (consumer) can be registered on specific topics and when a message for such a topic is stored onto the message queue it is immediately transferred to the consumer. Such a message is also called as an *event*, the communication is event-driven.

MQ provides assured “only once” delivery of the message onto the queue. Optionally, it can start the target application to handle the message (called triggering). When no more requests are available for the application it is deactivated until a new trigger message arrives. This optimises resource utilisation.

One characteristic is important for a company. When using MQ, existing business code needs not to be updated or thrown away. The company can use its existing programs for requests and a new one for another request – together without changing the existing one. The new communication code is easy to use and to implement because programs using MQ “*have clearly defined inputs and outputs (messages) and a standard interface to other programs that does not vary as the programs themselves are changed and moved.*” ([AMQ95], ch. 3.0)

5.2.2 Excursion: MQSeries is the UK Post Office

This example describes how MQSeries is represented by the UK Post Office. All Post Office items are tried to paraphrase by MQSeries items.

One of the Post Office main jobs is to deliver letters, cards, and parcels. The method is in MQSeries' point of view **Message Queuing** and the objects are **messages**. The Post Office consists of Post Offices branches that manage the delivery of all postings. Those Post Offices branches are called **queue managers**.

Imaginary, an invitation letter (**request message**) is written by a customer (**sender program**) and should be delivered to his/her friend (**receiver program**). Such a letter expects an answer. An addressee written on the envelope (**message descriptor**) and the invitation card (**request data**) built the invitation letter. An addressee is usually stored in the brain of a human, in MQSeries it is stored in the **remote queue**. After putting the letter into a postbox (**transmission queue**) it is transferred by a postman (**channel sender**) of the home Post Office branch (**client queue manager (QM)**) to another Post Office branch (**server QM**). Even if the postbox is outside of a Post Office branch, it is also managed by the branch as same as the postman is an employee of the branch! The postman of the home Post Office branch knows to which branch the letter has to be shipped to. However, from the addressee inscription he gets the name, street, town and postcode. The postcode refers to a unique Post Office branch the letter should be delivered to. After the letter arrived the other Post Office branch, another postman (**channel receiver**) delivers the letter to the addressee. The letter is put by the postman into the mailbox of the addressee (**request queue**). The addressee opens the letter and replies to the invitation (receiver program).

The addressee (sender program) writes a confirmation back (**reply data**) and becomes now the sender. The sender knows the address where to send the letter to (**reply message/response message**) because it stands on the invitation letter's back. When the letter is complete, consisting of the answer (reply data) and the new addressee (message descriptor), it is again put into a postbox (transmission queue). The postman (channel sender) of the Post Office branch (server QM) delivers the letter to the Post Office branch of the new addressee (client QM). There, the letter is shipped by another postman (channel receiver) to the mailbox of the originator (**reply-to queue**). At the end, either the request is confirmed by the invited person or not, the whole process is successfully closed. In MQSeries this method is known as the two-way communication.

In the next sections all mentioned MQ catchwords are described in MQ's view.

5.2.3 Messages

MQSeries consists of a number of components to handle message queuing. The most important object is the message itself. It stores application data to be transferred from one MQ-system to another. The message itself is stored in a specific data structure – the message queue. Additionally, this data structure contains a **message descriptor** (also called message header). It stores control information required for the message, for example the message type (MsgType). Message type *datagram* is specified, when the sender does not need a reply from the receiver. *Request* is specified when the sender requires a reply from the receiver. *Reply* or *report* can also be specified. Each message can have its own 24-byte string called a message identifier (MsgId) which identifies uniquely a particular message. A message may also contain a 24-byte string called a correlation identifier (CorrelId) that usually matches exactly the message identifier of another message that relates to the current message. For example, it stores the message identifier of the request message to refer to the correct message. Furthermore, it can also set attributes for sending messages in First in, First out (FIFO) or Priority order, for expiring messages after a specified time (*expiry*), or for assuring the application data in the messages by using the *persistence* attrib-

ute. If a message is sent using the assured delivery attribute it is stored in a secondary dump until it is successfully delivered to the receiver program. Additional information may be specified in the message descriptor; please refer to [MQI94], ch. 2.2.

Messages can be transferred using a one-way (unidirectional) or a two-way (bidirectional) communication. Unidirectional communication means, sending a message from one program to another using one queue manager without waiting for a response. When using a bidirectional communication, as described in chapter 5.2.2 “Excursion: MQSeries is the UK Post Office” on page 84, two message queues need to be defined per QM because message queues work always unidirectional. Figure 22 shows the two-way communication that is used for our MQSeries CICS application. When Program A (sender program) wants to request a program B it firstly transfers the request data to its QM. The request data is stored in a request message on the specified message queue **Queue1** from which it is sent to the program B (receiver program). Program B picks up the request data, executes and answers it, and creates the reply data. The reply data is also stored in a message – the reply message (response message). This is filed on another message queue called **Queue2** from which the starting program A receives the reply data. **Queue1** and **Queue2** are actually generic terms for the transmission queue and the reply-to/request queue.

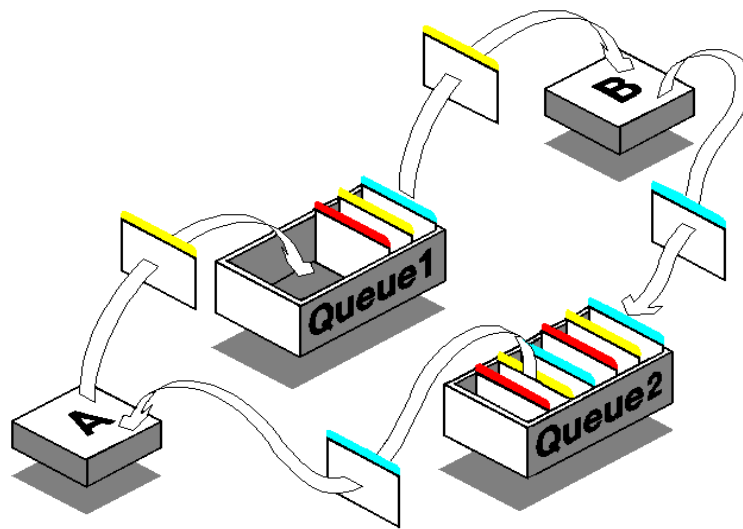


Figure 22: The two-way communication model for the MQNACT application (image taken from [AMQ95], ch. 2.0)

The main component of the message is the application data. There are no constraints on the content of the data because MQSeries does not interpret this part of the message. Messages can store data up to 100 MB (MQSeries for WINDOWS2000 v5). In case the data is bigger, MQSeries can split the data into a few messages organised by a message group. A message can also be stored on a message queue for a specified time in case many programs want the message data. Hence, each program gets a message copy.

For more information about messages and message descriptors see [AMQ95], [MQI94] and [HKS04].

5.2.4 Queue manager

“A queue manager is the system service that provides the message queuing facilities used by applications.” ([MQI94], ch. 1.3) The queue manager manages all MQ objects, for example message queues, channels, name lists, and process definitions. Other queue manager objects are only required on specialised platforms, such as buffer pools, storage classes, or client connections. As a minimum, one QM with a unique name has to exist on a processor. Applications using MQSeries as middleware communicate with each other only through QMs. For a simple set up, only one QM and one message queue are required (one-way communication). This is realised, when a MQSeries Server is installed on the server computer system, whereas on the client computer system the MQSeries Client as part of the MQSeries family is installed. However, the MQSeries CICS application MQNACT uses the two-way communication which requires at least two QMs. One QM resides on the OS/390-server (server queue manager) and the other on the WINDOWS2000 client (client queue manager) set up within the MQSeries Server product installed on both sides. Using two QMs improves the robustness of the sample business application MQNACT. In case, the OS/390-server is unavailable for any reason, the messages to be sent are kept until the OS/390-server is available again. Referring to as assured delivery, it ensures that the message is delivered once and only once when the broken OS/390-server is available. The QMs in our sample application are named MQA1 for the OS/390-server queue manager and TBUSSE.NACT for the WINDOWS2000 client queue manager. In this scenario, messages are created on a local QM and are transferred to another QM (remote QM) using different message queues. Additionally, there are required transport channels to transfer the messages from one QM to the another.

Queue managers manage the network, look for remote queue managers, and communicate with them. The communication between QMs is handled by TCP/IP. Each QM insures that changes of MQ objects are logged. Messages are built inside a queue manager; an application sends only pure data to it. If messages are too long they are segmented and grouped by the QM. Messages can be sent as copies to different QMs. The QM also insures to deliver the messages. For improved administration, QMs can be grouped into QM Clusters (QMC). For more information about QM objects and QMCs see [HKS04] and [QMC00].

5.2.5 Queue manager objects

5.2.5.1 Local and remote queues

Queues are MQ objects that store messages until they are picked up, for instance by applications. They are classified into local and remote queues. All queues are administered by a queue manager. Each queue has an own name unique to each QM. Messages are added onto a queue at the end and removed from the front. This FIFO-method is set per default. In case of priority storing, the messages are stored on their priority level. Each queue is specified with its own attributes. The following queue types are used in the MQSeries CICS application MQNACT:

a) Reply-to queue

This queue is a local queue stored on the local queue manager and is connected with a local program. The reply-to queue stores messages sent by a remote program and provides the received data for the local program. On the OS/390-server this queue is called as request queue, or in connection with its task, it is also called as the MQSeries CICS Bridge queue. This queue receives the request messages. On the WINDOWS2000-client the queue is named as the reply-to queue receiving response messages.

b) Remote queue definition (remote queue)

The remote queue definition is usually simple called remote queue. However, this “queue” works not like a normal queue. It stores only control information for a message to be sent and not the message itself. Therefore, the complete name “remote queue definition” is used in this thesis, however, “definition” is written in italic style. The message consists of this copied information (message descriptor) and the application data. The remote queue *definition* stores the name of the local queue at the remote location (reply-to resp. request queue), the name of the remote queue manager, and the name of the local transmission queue.

c) Transmission Queue

Before sending messages to a remote queue manager they are transmitted onto a special kind of a local queue called a transmission queue. For our sample-application MQNACT, one transmission queue exists for each QM. Transmission queues are only required when two QMs communicate with each other. Messages are sent to the remote queue manager by a channel sender which is connected with the transmission queue. One default transmission queue can be predefined for the QM. Usually, an own transmission queue is to be created. Furthermore, the transmission queue is connected with the remote queue definition.

The OS/390 MQSeries v2.1 product contains a particular limitation. The OS/390-server queue manager always assigns automatically the transmission queue with the same as the remote queue manager. In other words, the transmission queue on the OS/390-server queue manager must have the same name as the WINDOWS2000-client queue manager. If the transmission queue on the OS/390-server queue manager has another name as the WINDOWS2000-client queue manager, the OS/390-server queue manager assigns the default transmission queue as the transmission queue instead of the specified one. When a message is created, it gets control information from the remote queue definition of the OS/390-server queue manager and is normally put onto the transmission queue specified in the remote queue definition. But the OS/390-server queue manager wants to put the message on a queue named as the WINDOWS2000-client queue manager. If this queue is not found by the OS/390-server queue manager, the message is put onto the default transmission queue. However, the default transmission queue cannot forward the message to the WINDOWS2000-client queue manager because the default transmission queue is linked to another channel sender and not to the channel sender originally specified in the specification of the correct trans-

mission queue. If a default transmission queue is not specified the message is stored on the dead-letter queue.

d) Dead-Letter Queue

A dead-letter queue stores messages, that cannot be delivered. For example, the destination queue is not defined on the remote QM, or the destination queue cannot receive messages. The dead-letter queue must be a local queue. Each QM should have a dead-letter queue. In the Post Office, this dead letter queue is represented by a Dead Letter Office.

There are some more queue types that can be specified, for example an alias queue or model queue. For information see [MQI94] and [HKS04].

5.2.5.2 Message Channels

The QM transfer transfer messages to another QM via channels. There are two channel types – one to connect QMs (message channel) and the other to connect a QM with a MQSeries application (MQI-channel). They are unidirectional and consist always of two parts – the channel sender and channel receiver. IBM calls them also as sender channel resp. receiver channel. However, this notation can be confusing. Therefore, only the notations channel sender and channel receiver are used in this thesis. The channel sender is always located on the local queue manager, the channel receiver always on the remote queue manager. Both channel parts must have the same name⁹ and thus build together a single channel. The MQSeries CICS application requires a two-way communication between the two queue managers. Hence, two message channels are created, having one channel sender and one channel receiver per message channel (Figure 23, next page).

Both channel parts communicate with each other using a communication protocol such as TCP/IP or LU6.2. Each channel part has a Message Channel Agent (MCA), for the channel sender a sender MCA and for the channel receiver a receiver MCA (Figure 23). This software controls the sending and receiving of messages. A message is taken from the transmission queue by a sender MCA and is put to the communication link. The receiver MCA gets the message and delivers it to the remote QM resp. to the reply-to/request queue. In another view, an MCA that initiates the communication is called a caller MCA, otherwise, it is a responder MCA.

The sender MCA needs to be initiated by a channel initiator program. The receiver MCA is initiated by a channel listener program. This program detects incoming network requests and starts the associated channel receiver. Usually, both programs are started automatically during the startup of the QM. In some situations they can be started manually.

For more information about message channels and Distributed Queue Management see [ICM00].

⁹ Channel names must not have more than 20 characters!

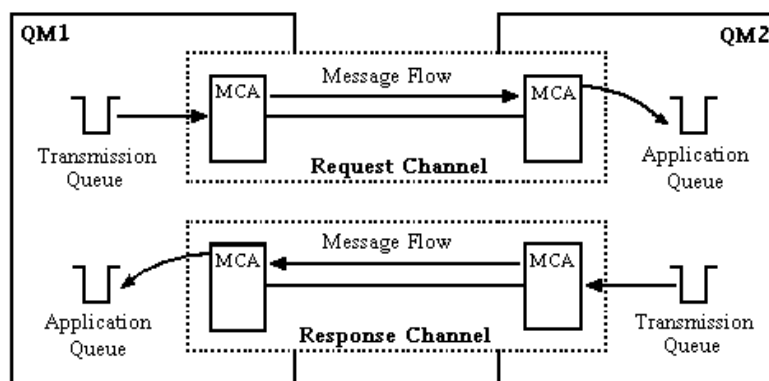


Figure 23: Bidirectional communication ([ICM00], ch. 1.1.1.1.3)

5.2.5.3 MQI Channels

MQI channels connect MQSeries Clients with a queue manager on an MQSeries server. This one channel sets up a two-way link (bidirectional) to transfer MQI calls and responses. One part of this MQI channel is called the server-connection channel, the other one is called the client-connection channel. The notation “channel” is omitted because both parts build together the channel. A server-connection has been created to connect the JAVA application with the WINDOWS2000-client queue manager. The client-connection is created automatically when a server-connection is used. This feature is a new function added to MQSeries Server v5.2.1. The MQI channel does not transfer messages between the WINDOWS2000-client queue manager and the MQNACT application but pure request resp. response data. Such an MQI channel is only required on the WINDOWS2000-client. On the OS/390-server queue manager it is used another method to transfer the request/response data to the CICS COBOL application. For more details on MQI channels see [CLI00].

5.2.6 Message Queuing Interface

Queue managers communicate with each other using the MQI. It consists of only a few function calls, is easy to use and consistent in every environment. Hence, it is not required to write complex communication code; the programmer can concentrate on programming presentation and business logic.

There are only two important basic calls – MQPUT and MQGET. One for putting messages on a message queue and the other for getting messages from the message queue. This is the “e-mail for applications” part. All in all, 11 calls are provided by the MQI used for MQSeries v2.1, but approximately 90 percent of all calls used in MQSeries applications are MQPUT and MQGET. The MQCONN call, for example, is used to enable a connection between the application and MQSeries, MQDISQ terminates it. MQOPEN opens the message queue to get ready for an MQPUT call. After getting messages for a message queue using MQGET, the MQCLOSE call closes the message queue. These calls are also known as **major** calls. **Minor** calls are used for special purpose.

For instance, MQINQ provides information of message queues to manage them. Some queue attributes can be modified by application programs using the MQSET call. If an application encounters problems or errors during executing MQPUT or MQGET calls, it can back out all operations performed on the message queue using the MQBACK call. Operations performed on a queue can be committed by the MQCMIT call. The last call – MQPUT1 – simplifies putting messages on a queue. It represents a sequence of MQOPEN, MQPUT, and MQCLOSE calls. In MQSeries v.5 are introduced 2 new API-calls – MQBEGIN and MQCONN. More information about these 2 calls and the MQI in general provides [MQI94] and [HKS04].

Programmers who does not want to use the functions provided by the MQI can use another simple interface to connect applications with MQSeries – the MQSeries Application Messaging Interface (AMI). This interface “*is more abstract in nature than MQI, but provides less flexibility because not all features available through MQI are available in AMI.*” ([YOU01], page 170) Still another interface is the JAVA Message Service (JMS). This interface is based on an object-oriented method rather than a procedural interface as the MQI. For more information about the AMI see [AMI00] and about the JMS see [MUJ00].

5.3 The architecture of the MQSeries CICS application

The MQSeries CICS application consists of two program parts – the JAVA presentation and MQSeries communication logic on the WINDOWS2000-client and the CICS business logic on the OS/390-server. The MQSeries communication logic of the WINDOWS2000-client is only used to create a connection to the MQSeries queue manager on the WINDOWS2000-client. The actual business logic is the OS/390 CICS COBOL program *NACT02*. The JAVA program *MQClient.java* requests information from a customer account and access the CICS COBOL program *NACT02*. Both programs communicate through MQSeries; they put messages on and receive messages from message queues. Using MQ is a simple and elegant way to send requests to and to get responses from the CRUD program. The functionality of such a procedure is shown in Figure 24 on page 94 in general and in Figure 25 on page 95 where each object is named. The numbers of the following descriptions refer to both – Figure 24 and Figure 25.

Firstly, the JAVA program connects itself to the WINDOWS2000-client queue manager TBUSSE.NACT using the MQI channel called the server connection channel TBUSSE.NACT.CLIENT (No.1). Within this channel the request data is transported to the remote queue *definition* TBUSSE.NACT.REMOTEQ (No.2). The remote queue *definition* provides necessary information to create the request message. This message is immediately put on the transmission queue TBUSSE.NACT.XMITQ (No.3). From this queue the message is transmitted to the OS/390server queue manager MQA1 using the channel sender TBUSSE.NACT.WIN.OS (No.4a). The channel sender is connected with the eponymous channel receiver specified on the OS/390-server queue manager and builds the channel called request channel (No.4b). When the channel receiver gets the request message, it reads the message descriptor that contains the request queue name SYSTEM.COMMAND.CICS.BRIDGE among other object names, and puts the request message onto this queue (No.5).

<i>Queue manager objects</i>	<i>OS/390-Server Queue Manager MQA1</i>	<i>WINDOWS2000-Client Queue Manager TBUSSE.NACT</i>
<i>Reply-to/Request Queues</i>	SYSTEM.COMMAND.BRIDGE.QUEUE	TBUSSE.NACT.REPLYQ
<i>Transmission Queues</i>	TBUSSE.NACT	TBUSSE.NACT.XMITQ
<i>Remote Queue Definitions</i>	TBUSSE.NACT.REPLYQ	TBUSSE.NACT.REMOTEQ
<i>Channel Senders</i>	TBUSSE.NACT.OS.WIN	TBUSSE.NACT.WIN.OS
<i>Channel Receivers</i>	TBUSSE.NACT.WIN.OS	TBUSSE.NACT.OS.WIN
<i>Server Connection</i>	---	TBUSSE.NACT.CLIENT

Table 7: Named queue manager objects used for the MQSeries CICS application *MQNACT*

The CICS Bridge Monitor Task consecutively checks the request queue if a “start UoW” message has arrived (No.6). After some relevant authorisation checks, the CICS DPL Bridge Task is started (No.7). This task removes the message from the request queue and builds a COMMAREA from the data delivered within the message (No.8). Afterwards, the *NACT02* program is called (No.9). The program executes the request and sends the

response back to the COMMAREA (No.10). The response data is carried to the remote queue *definition* TBUSSE.NACT.REPLYQ stored on the OS/390-server queue manager (No.11). The control information of the remote queue *definition* is added to the response data and the response message is built and put onto the transmission queue TBUSSE.NACT (No.12). The channel sender TBUSSE.NACT.OS.WIN connected with the transmission queue transfers the response message to the WINDOWS2000-client queue manager (No.13a). The WINDOWS2000 channel receiver (No.13b) builds together with the eponymous OS/390 channel sender the response channel. The channel receiver reads the message descriptor containing the reply-to queue name TBUSSE.NACT.REPLYQ among other object names and puts the response message onto the queue (No.14). After the message is stored on this queue the MQI channel TBUSSE.NACT.CLIENT wakes up and transmits the response data to the JAVA program where the information is displayed (No.1).

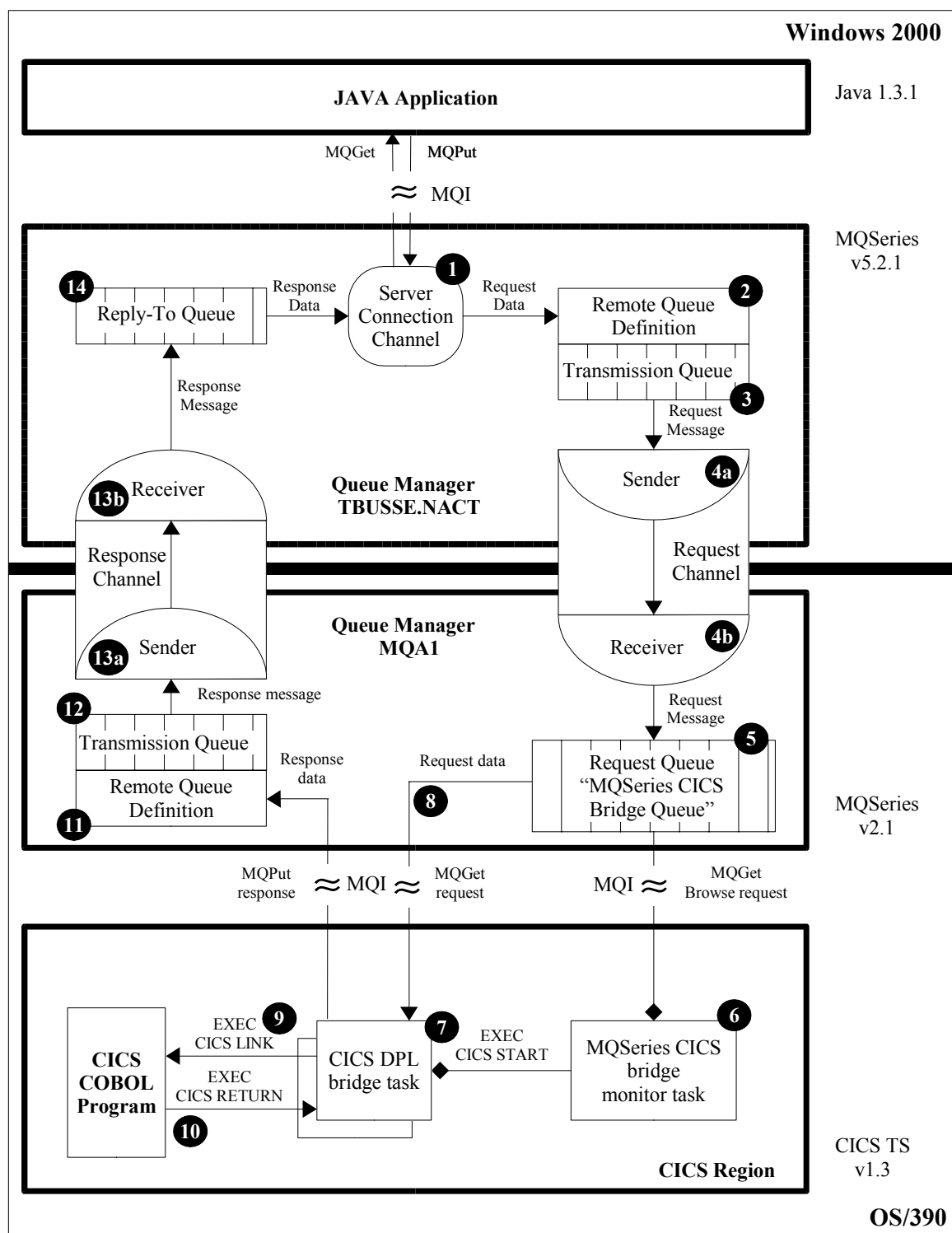


Figure 24: The architecture of the MQSeries CICS application MQNACT

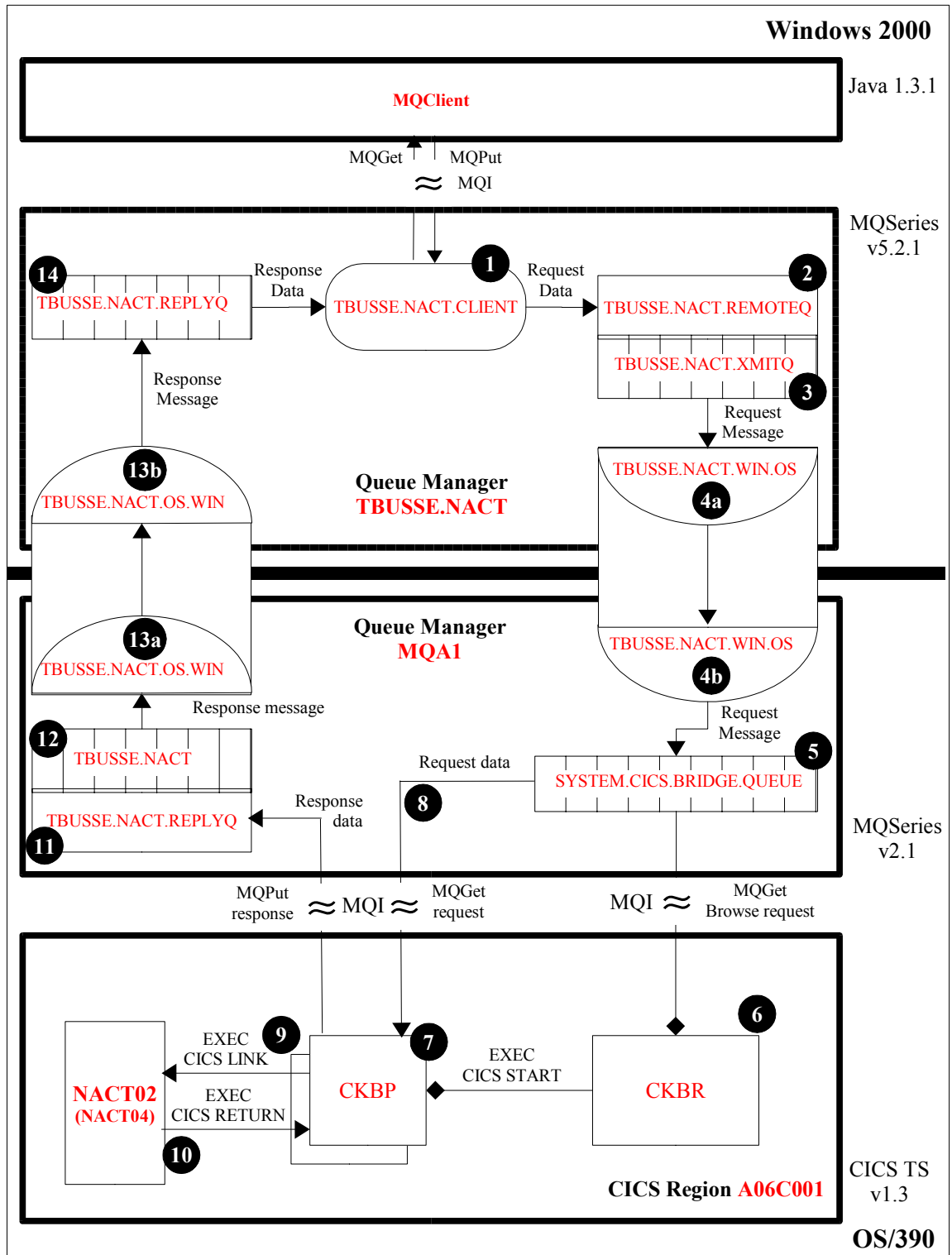


Figure 25: The architecture of the MQSeries CICS application MQNACT with named MQSeries objects

5.4 Setting up MQSeries on the OS/390-server

5.4.1 The OS/390-server queue manager MQA1

On the MQSeries server on the JEDI OS/390-server runs only one queue manager called MQA1. It is started when following command is entered in the command line in any panel of the SDSF program:

```
/!MQA1 START QMGR10
```

The SDSF program can be reached from the CUSTOMPAC MASTER APPLICATION MENU entering *SD* in the command line. Each queue manager on OS/390 may consist of maximal four characters because its name is also the name of the MQSeries subsystem which may be only four characters long. Such a MQSeries subsystem is a formal defined OS/390 subsystem and must be defined to the subsystem name table of OS/390. A queue manager can only be started if the assigned MQSeries subsystem is created and loaded previously. For instance, an MQSeries subsystem can be manually created with the *SETSSI* command:

```
/SETSSI ADD,S=ssid,I=CSQ3INI,P='CSQ3EPX,cpf,scope'
```

where *ssid* is the name of the subsystem ('MQA1'). *cpf* is the command prefix that must precede an MQSeries command to identify the OS/390 subsystem for which the commands are intended for, for instance '!MQA1'. The last parameter *scope* is only important if the subsystem is created in an OS/390 sysplex, if not, 'M' has to be specified. However, the command that creates the MQSeries subsystem MQA1 reads as follows:

```
/SETSSI ADD,S=MQA1,I=CSQ3INI,P='CSQ3EPX,!MQA1,M'
```

It is suggested to include an entry into the *IEFSSNxx* member of *SYS1.PARMLIB*. Hence, it is not required to input this command after every IPL. On the JEDI OS/390-server there exist two of such members, *IEFSSN00* and *IEFSSN02*; executed one after another. Following entry is entered in *IEFSSN00* (cf. Listing 24, page 234):

```
10 SUBSYS SUBNAME(MQA1) INITRTN(CSQ3INI) INITPARM('CSQ3EPX,!MQA1,M')
```

There are created four more MQSeries subsystems on the JEDI OS/390-server – MQA2, MQA3, MQA4, and MQA5. Of course, the associated entries are also written into the *IEFSSN00* member. These subsystems should be used for further practise. Additional information on how to create an MQSeries subsystem and an MQSeries queue manager is given in [SMQ99].

Using the *START QMGR* command the MQSeries executes the startup script *MQAIMSTR* stored in the dataset *SYS1.PROCLIB* (Listing 25, page 234). This script is also called the MQSeries started task procedure. The name of the script always consists of the queue manager name, here *MQA1*, plus the string *MSTR*. After a subsystem has been created, such a script has to be defined to load and start the queue manager. During the startup of

¹⁰ Any command entered from the command line of SDSF must be prefixed by a slash "/". If the slash is entered alone the *System Command Extension* panel appears. The advantage is that more command strings as on the command line can be entered.

the queue manager MQA1 a few queue manager objects have been created using the *CSQINP1* and *CSQINP2* steps (line 42-47). Within these both steps following scripts are loaded:

```

42 //CSQINP1 DD DSN=MQM.MQA1.SCSQPROC(CSQ4INP1),DISP=SHR
43 //CSQINP2 DD DSN=MQM.MQA1.SCSQPROC(CSQ4INSG),DISP=SHR
44 //        DD DSN=MQM.MQA1.SCSQPROC(CSQ4INSX),DISP=SHR
45 //        DD DSN=MQM.MQA1.SCSQPROC(CSQ4INYG),DISP=SHR
46 //        DD DSN=MQM.MQA1.SCSQPROC(CSQ4CKBM),DISP=SHR
47 //        DD DSN=MQM.MQA1.SCSQPROC(CSQ4STRT),DISP=SHR

```

The script *CSQ4INP1* loaded within the *CSQINP1* step creates non-recoverable objects for the queue manager (Listing 26, page 234). Within the script *CSQ4INSG* some system objects are defined. They must be created the first time the queue manager MQA1 is started (Listing 27, page 234). For the non-CICS distributed queuing and clustering facility some more objects are defined within the script *CSQ4INSX* (Listing 28, page 234). These three scripts are required for each OS/390-server queue manager and may not be changed.

Additional general objects for the queue manager MQA1 have been defined using the script *CSQ4INYG* provided within the MQSeries installation. For instance, this script defines the default transmission queue and the default dead-letter queue. Enabling the communication between CICS and MQSeries requires creating the initiation queue *CICS01.INITQ*. This queue is used by the MQSeries CICS adapter and enables the CICS applications to use the MQI to communicate between MQSeries and CICS. The script *CSQ4CKBM* defines the request queue resp. MQSeries CICS Bridge queue and a trigger for this queue. But, triggering is not used for our sample application MQNACT, however, the trigger definition is created for future use.

The last loaded script *CSQ4STRT* starts the channel initiator and the channel listener programs for the OS/390-server queue manager (cf. Listing 29, page 234). Within the command *START CHINIT* the channel initiator is started. On the *PARM* keyword is specified the data set in which the definitions for the channel initiator are stored (line 11). The command *START LISTENER* starts the channel listener program on the specified port *PORT(1414)*. The TCP/IP method has been chosen as transport type *TRPTYPE(TCP)*, however, port and the transport type can be omitted because these are the default parameters (line 15):

```

11 START CHINIT PARM(CSQXPARM)
...
15 START LISTENER PORT(1414) TRPTYPE(TCP)

```

Both programs can also be started manually using the command line of the SDSF application or the MQSeries panels. For starting both services from the command line execute the following commands, subsequently:

```

/!MQA1 START CHINIT
/!MQA1 START LISTENER

```

When starting these programs from the MQSeries panels, open the “Main Menu” panel and enter in the field *Action* the number 6 as a shortcut for *Start*. Furthermore, fill in the field *Object type* the entry *SYSTEM* and press Enter.

An entry in the field *Name* is not required (Figure 26). Pressing the ENTER key opens the “Start a System Function” panel. Firstly, choose the number 1 to start the channel initiator (Figure 27). When the channel initiator has been started successfully, the listener can be started choosing number 3 in the “Start a System Function” panel. Both services can be stopped in the same way as they were started. The commands to stop them from the command line of the SDSF application read as follows:

```
#!/MQA1 STOP CHINIT
```

```
#!/MQA1 STOP LISTENER
```

In case, the channel initiator and the channel listener need to be stopped, it is only required to stop the channel initiator. This stops the listener automatically. When both services should be stopped from the MQSeries panels, enter number 7, the shortcut for *Stop*, instead number 6 in the field *Action* on the MQSeries “Main Menu” panel. This opens the “Stop a System Function” panel (Figure 28). Choose the numbers to stop the service and press Enter.

IBM MQSeries for OS/390 - Main Menu

Complete fields. Then press Enter.

Action	6	1. Display	5. Perform
		2. Define	6. Start
		3. Alter	7. Stop
		4. Delete	

Object type	SYSTEM	+
Name	TBUSSE.*	
Like	<hr style="border: 0.5px solid black;"/>	

Connect to queue
manager : MQA1
Target queue manager : MQA1
Response wait time . : 30 seconds

(C) Copyright IBM Corporation 1993,1999. All rights reserved.

Command ==>	
F1=Help	F2=Split
F10=Messages	F12=Cancel

F3=Exit
F4=Prompt
F6=QueueMgr
F9=Swap

Figure 26: MQSeries for OS/390 on CICS – Main Menu panel

Start a System Function	
Select function type, complete fields, then press Enter to start system function.	
Function type 1	1. Channel initiator 2. Channel listener for LU6.2 3. Channel listener for TCP/IP
Channel initiator	
Parameter module name . .	_____
JCL substitution	_____
Listener for LU6.2	
LU name	_____
Listener for TCP/IP	
Port number	1414
Command ==> _____	
F1=Help	F2=Split F3=Exit F9=Swap F10=Messages F12=Cancel

Figure 27: MQSeries for OS/390 on CICS – Start a System Function panel

Stop a System Function	
Select function type, then press Enter to stop system function.	
Function type 1	1. Channel initiator 2. Channel listener for LU6.2 3. Channel listener for TCP/IP
Command ==> _____	
F1=Help	F2=Split F3=Exit F9=Swap F10=Messages F12=Cancel

Figure 28: MQSeries for OS/390 on CICS – Stop a System Function panel

If it is needed to stop the queue manager MQA1, following command has to be executed from the command line of the SDSF application:

```
/!MQA1 STOP QMGR MODE(option)
```

The attributes for *option* in the optional keyword *MODE* can be one of the following: *QUIESCE*, *FORCE*, and *RESTART*. *QUIESCE* allows programs currently being executed to finish processing. This is the default option; if the keyword *MODE* with its parameter is omitted, this option is always used to shut down the queue manager. The *FORCE* option terminates the queue manager without ending the programs in their normal way. Both options deregister MQSeries from the MVS automatic restart manager. The option *RESTART* allows an automatic restart. All three options exclude starting of new programs during terminating the queue manager. If the queue manager is terminated it can be restarted because the OS/390 subsystem MQA1 is not terminated. It waits for an reactivation call of the queue manager. Following message is written to the system log to indicate the complete termination:

```

fHASP395 MQA1MSTR ENDED
CSQ3104I !MQA1      CSQ3EC0X - TERMINATION COMPLETE
CSQ3100I !MQA1      CSQ3EC0X - SUBSYSTEM MQA1 READY FOR START COMMAND

```

5.4.2 The MQSeries CICS Bridge

5.4.2.1 Overview

The Java-GUI front end on the WINDOWS2000-client wants to access the CICS COBOL program *NACT02* with the help of MQSeries. *NACT02* should only be called by the MQSeries CICS application and may not be modified because an application programmer should not need to know about the mainframe programming. The programmer has only to know the name of programs and of the MQ objects which process the request. Therefore, it is required to use a method that connects CICS with MQSeries to work in the background. For this situation, IBM offers to use the MQSeries CICS Bridge. It solves the problem of transferring data between the interfaces of MQSeries and CICS using the MQI. Hence, any application outside of CICS can run a single program or a set of programs (UoW) on CICS. Additionally, the MQSeries CICS Bridge queue supports the synchronous and the asynchronous processing of data.

NACT02 is executed by the MQSeries CICS application when a request within a message is sent to the CICS Bridge Monitor Task of the MQSeries CICS Bridge. Firstly the message has to be put on the request queue – the MQSeries CICS Bridge queue – which is constantly browsed by the CICS Bridge Monitor Task. When the task recognises that a message has arrived, it checks the authentication, and it starts the CICS DPL Bridge Task executing the *EXEC CICS START* command. It collects the request data from the MQSeries CICS Bridge queue and deletes the message from the queue. From the data is build the COMMAREA and an *EXEC CICS LINK* command is issued to call *NACT02*. The CICS COBOL program processes the data and returns the response back

into the COMMAREA. From this area, the CICS DPL Bridge Task reads the response data using the *EXEC CICS RETURN* command and transmits it to the remote queue *definition* of the OS/390-server.

On the one hand, the MQSeries CICS Bridge is an application consisting of the CICS Bridge Monitor Task started by the CICS transaction CKBR and consisting of the CICS DPL Bridge Task started by the transaction CKBP. But on the other hand, it is defined as a local queue on the OS/390-server queue manager MQA1. Until these both tasks have been installed to the CICS TS and the local queue is created to MQSeries, the bridge can be successfully started, and data can be transferred between the OS/390-server queue manager and the CICS region. Every CICS region having an installed CICS Bridge Monitor Task and a CICS DPL Bridge Task can run a MQSeries CICS Bridge, if an assigned local queue exists on a OS/390-server queue manager – same or different queue managers. However, using the MQSeries CICS Bridge requires, that both, the OS/390-server queue manager and the CICS region, run in the same OS/390 region.

5.4.2.2 Configuring CICS to use the MQSeries CICS Bridge

The MQSeries CICS adapter must be started at first before the MQSeries CICS Bridge tasks can run on CICS. The adapter provides control functions to manage the connection between CICS and MQSeries, for example, starting and stopping the connection to the OS/390-server queue manager. As second functionality, the adapter implements the MQI support used by CICS programs. For example, it “*can handle up to eight MQI calls concurrently.*” ([SMQ99], ch. 3.1.1.2)

The MQSeries CICS adapter is started by the CKTI transaction during CICS startup. This transaction and its assigned programs have been defined within the script *CSQ4B100* stored in the library *CICS.COMMON.CSDDEFS*. This script also defines all other objects required by the MQSeries CICS adapter to the CICS region A06C001 (cf. Listing 30, page 235). These objects have been installed into an own CICS group called CSQ (line 232). A complete specification of *CSQ4B100* is omitted because the script is provided within the CICS TS installation and needs only to be executed. However, at the end of the script one command has been inserted. It adds the CICS group CSQ to one of the four CICS startup lists. These lists works like a search path to find the necessary objects to start the MQSeries CICS adapter during CICS startup. The CICS group list PPLIST has been chosen (line 242):

```
232 DEFINE TRANSACTION(CKTI) GROUP(CSQ)
...
242 ADD GROUP(CSQ) LIST(PPLIST)
```

The objects specified in *CSQ4B100* have been added to the CICS region using the Update Resource Definition Utility *DFHCSDUP*. The script *DFHCSD01* stored in *CICS.COMMON.JCL* executes the utility and loads as input the script *CSQ4B100* (line 8, and 14, cf. Listing 31, page 235):

```
08 //CSDUP      EXEC PGM=DFHCSDUP,REGION=4M
...
14 //SYSIN      DD DISP=SHR,DSN=CICS.COMMON.CSDDEFS(CSQ4B100)
```

In order to use the MQSeries CICS adapter, an initiation queue has to be created on the OS/390-server queue manager. This queue is automatically created during each queue manager startup executing the script *CSQ4INYG* (cf. Listing 32, page 235). The initiation queue is named as *CICS01.INITQ*:

```
223 DEFINE QLOCAL( 'CICS01.INITQ' ) REPLACE +
```

Additionally, it is required to add the parameter *INITPARM* to the CICS SIT definition script *C001* to declare the initiation queue to the CICS region (line 5, Listing 22):

```
05 INITPARM=(CSQCPARM='SN=MQA1,TN=001,IQ=CICS01.INITQ')
```

where the parameters mean:

SN– The MQSeries queue manager name to which the MQSeries CICS adapter should be connected to,

TN– The trace number to identify the MQSeries CICS adapter in the CICS trace entries,

IQ– The name of the initiation queue on the queue manager provided for the MQSeries CICS adapter.

Note: Attributes of *INITPARM* must not be more than 60 characters long; counted from '*SN=...*' until '*...INITQ*':

Furthermore, there are added some required MQSeries libraries to the *STEPLIB* and to the *DFHRPL* concatenation in the CICS startup procedure *CICSC001* (lines 13-38, Listing 23):

```
13 //STEPLIB DD DISP=SHR,DSN=&CICSHLQ..SDFHAUTH CICS
...
17 // DD DISP=SHR,DSN=MQM.SCSQANLE MQSERIES
18 // DD DISP=SHR,DSN=MQM.SCSQAUTH MQSERIES
...
25 //DFHRPL DD DISP=SHR,DSN=CICS.COMMON.TABLIB CICS TABLES
...
35 // DD DISP=SHR,DSN=MQM.SCSQANLE MQSERIES
36 // DD DISP=SHR,DSN=MQM.SCSQCICS MQSERIES
37 // DD DISP=SHR,DSN=MQM.SCSQAUTH MQSERIES
38 // DD DISP=SHR,DSN=MQM.SCSQLOAD MQSERIES
```

At last, the SIT-parameter *MQCONN* in the CICS SIT definition script *C001* has to be activated to auto-connect MQSeries and CICS (line 5, cf. Listing 33, page 235):

```
05 MQCONN=YES
```

```
AUTO-CONNECT TO MQ
```

Hence, the MQSeries CICS adapter is started and the connection between the CICS region and the OS/390-server queue manager is established. That can be checked when the CICS transaction CKQC is started on the CICS terminal. After the initial panel appears, point the cursor under “Connection”, press the enter key, and choose option number *4* to display the connection status (Figure 29). The “Display Connection” panel shows the name of the CICS region, the name of the queue manager connected to, and that a connection persists between both (Figure 30, next page).

After the successful installation and running of the MQSeries CICS adapter it is possible to set up the MQSeries CICS Bridge on the CICS region. The MQSeries CICS Bridge usually consists of three tasks. However, running CICS DPL programs requires only two of these – the CICS Bridge Monitor Task and the CICS DPL Bridge Task. The CICS Bridge Monitor Task consists of the transaction CKBR calling the program *CSQCBR00* whereas the CICS DPL Bridge Task consists of the transaction CKBP calling the program *CSQCBP00* and the abend handler program *CSQCBP10*. The error messages program *CSQCBTX* relates to both tasks. The third task – the MQSeries CICS Bridge Exit Task – consists of the 3270 CICS Bridge Exit and of the Data Conversion Exit. The 3270 CICS Bridge Exit program *CSQCBE00* is only used if 3270 transactions should be run within MQSeries. *CSQCBDCI*, the program for the Data Conversion Exit, drives conversion of 3270 map data.

CKQCM2		Display Connection panel			
Read connection information. Then press F12 to cancel.					
CICS Applid = A06C001		Connection Status = Connected		QMgr name= MQA1	
Trace No. = 001		Tracing = On		API Exit = Off	
Initiation Queue Name = CICS01.INITQ					
----- S T A T I S T I C S -----					
Number of in-flight tasks = 2		Total No. of API calls =		516505	
Number of running CKTI = 1					
APIs and flows analysis		Syncpoint		Recovery	

Run OK	547	MQINQ	3	Tasks	181
Futile	0	MQSET	0	Backout	0
MQOPEN	184	----- Flows -----		Commit	180
MQCLOSE	0	Calls	517047	S-Phase	180
MQGET	516138	SyncComp	1268	2-Phase	0
GETWAIT	515958	SuspReqd	0	-----	
MQPUT	0	Msgwait	515779	InitTCBs	8
MQPUT1	180	Switched	517046	StrtTCBs	8
				BusyTCBs	0
F1=Help F12=Cancel Enter=Refresh					

Figure 29: MQSeries for OS/390 on CICS – Display Connection panel

CKQCM2 Display Connection panel											
Read connection information. Then press F12 to cancel.											
CICS Applid =		A06C001		Connection Status =		Connected		QMgr name= MQA1			
Trace No. =		001		Tracing		= On		API Exit = Off			
Initiation Queue Name =		CICS01.INITQ									
----- S T A T I S T I C S -----											
Number of in-flight tasks =				2		Total No. of API calls =				516505	
Number of running CKTI =				1							
APIs and flows analysis				Syncpoint				Recovery			

Run OK	547	MQINQ	3	Tasks	181	Indoubt	0				
Futile	0	MQSET	0	Backout	0	UnResol	0				
MQOPEN	184	----- Flows -----		Commit	180	Commit	0				
MQCLOSE	0	Calls	517047	S-Phase	180	Backout	0				
MQGET	516138	SyncComp	1268	2-Phase	0						
GETWAIT	515958	SuspReqd	0	-----							
MQPUT	0	Msgwait	515779	InitTCBs	8	StrtTCBs	8	BusyTCBs	0		
MQPUT1	180	Switched	517046								
F1=Help F12=Cancel Enter=Refresh											

Figure 30: MQSeries for OS/390 on CICS – Display Connection panel

All these three tasks have been defined to the CSD using the script *CSQ4CKBC* stored in the library *CICS.COMMON.CSDDEFS* (cf. Listing 35, page 235). When the off-line update resource definition utility *DFHCSDUP* is executed, all MQSeries CICS Bridge objects are added to the CICS region. As known, this utility program is loaded within the script *DFHCSD01* (cf. Listing 31, page 235). But now, its *SYSIN* step refers to *CSQ4CKBC* (line 14, Listing 31):

```
14 //SYSIN DD DISP=SHR,DSN=CICS.COMMON.CSDDEFS(CSQ4CKBC)
```

All MQSeries CICS Bridge objects have been installed into the CICS group CSQCKB as same as the transaction CKBP (line 24, Listing 35):

```
24 DEFINE TRANSACTION(CKBP) GROUP(CSQCKB)
```

After all objects have been defined, the CICS group CSQCKB has also to be added to any of the four CICS group startup lists; it is again chosen to use PPLIST (line 84, Listing 35):

```
84 ADD GROUP(CSQCKB) LIST(PPLIST)
```


5.4.2.3 Configuring MQSeries to use the MQSeries CICS Bridge

The MQSeries CICS Bridge queue must be defined as a local queue on the OS/390-server queue manager MQA1. Additionally, this queue must be connected to the CICS Bridge tasks to enable the MQSeries CICS Bridge. Provided within the dataset *MQM.MQA1.SCSQPROC* the sample script *CSQ4CKBM* is used to create the MQSeries CICS Bridge queue (cf. Listing 34, page 235). Within the MQSeries command (MQSC) **DEFINE QLOCAL** the queue with its name has been defined – '*SYSTEM.CICS.BRIDGE.QUEUE*' (line 32). The attributes set in line 36 to 39 are common queue attributes for a local queue. The queue has the lowest priority (**DEFPRTY(0)**, line 36) and can process persistent messages (**DEFPSIST(YES)**, line 37). To recover messages in case of errors, they are set persistently on the queue. Furthermore, to put messages sent from the CICS DPL Bridge Task onto the queue the keyword **PUT** is set to '*ENABLED*' (line 39). Because the CICS Bridge Monitor Task gets messages from the MQSeries CICS Bridge queue, **GET** has also to be enabled within the keyword **GET** (line 49). These options are set in the local queue attributes section that spread from line 43 until line 56. Instead of priority sequence message delivery there is chosen to use per default the FIFO method. This allows an efficient answering to the messages in the sequence as they are catered to the bridge; the oldest request message is the first to process (**MSGDLVSQ(FIFO)**, line 54). The keyword **HARDENBO** is set to maintain an accurate back out for this queue (line 55). This ensures that messages are not reprocessed erroneously after an emergency restart. As well as, both, the CICS Bridge Monitor Task and the CICS DPL Bridge Task, read messages stored on the MQSeries CICS Bridge queue, shared access onto the queue has to be permitted (**SHARE**, line 56):

```

32  DEFINE QLOCAL('SYSTEM.CICS.BRIDGE.QUEUE') REPLACE +
...
36      DEFPRTY(0) +
37      DEFPSIST(YES) +
38      DESCR('MQSERIES CICS BRIDGE QUEUE') +
39      PUT(ENABLED) +
...
43  *      BOQNAME(' ') +
44      BOTHRESH(0) +
45      CLUSNL(' ') +
46      CLUSTER(' ') +
47      DEFBIND(OPEN) +
48      DEFSOPT(SHARED) +
49      GET(ENABLED) +
50      INDXTYPE(NONE) +
51      INITQ('CICS01.INITQ') +
52  *      MAXDEPTH(5000) +
53  *      MAXMSGL(4 194 304) +
54      MSGDLVSQ(FIFO) +
55      HARDENBO +
56      SHARE +

```

For future extensions, a trigger and a trigger process have also been created. Since the script *CSQ4CKBM* should be worked off automatically during every OS/390-server queue manager start up, it has to be pointed within the queue manager startup script *MQA1MSTR* as described in 5.4.1 “The OS/390-server queue manager MQA1” on page 96 (line 46, Listing 25). After each restart of the OS/390-server queue manager, this queue is always created new.

Tu sum up, on the CICS region there are installed and activated the required MQSeries CICS adapter, the CICS Bridge Monitor Task, and the CICS DPL Bridge Task. On the OS/390-server queue manager has been created the MQSeries CICS Bridge queue also known as request queue. As next, both – the CICS region and the MQSeries queue manager – are connected to activate the MQSeries CICS Bridge.

5.4.2.4 Running the MQSeries CICS Bridge

The CICS transaction CKBR entered on a CICS terminal establishes the connection between the CICS Bridge Monitor Task/CICS DPL Bridge Task and the MQSeries CICS Bridge queue. The complete transaction command is specified as:

```
CKBR Q = <queue name>, AUTH = <option>, WAIT = nnn
```

For instance, the command could be read as:

```
CKBR Q = SYSTEM.CICS.BRIDGE.QUEUE, AUTH = LOCAL, WAIT = 30
```

The parameter *Q* specifies the name of the MQSeries CICS Bridge queue. The security parameter *AUTH* is set to the option *LOCAL*; security is not used. The last parameter *WAIT* is set to 30 seconds. The following message is displayed within the CICS log MSGUSR, part of the CICS started procedure *CICSC001*, when the MQSeries CICS Bridge is successfully started (for reaching this log refer to B.1, page 231):

```
CSQC700I CKBR 0000043 IBM MQSeries for OS/390 v2.1 - CICS bridge. Copyright(c) 1997,1999 IBM, All rights reserved
CSQC702I CKBR 0000043 Monitor initialization complete
CSQC703I CKBR 0000043 Auth=LOCAL, waitInterval=30000, Q=SYSTEM.CICS.BRIDGE.QUEUE
```

Setting the *WAIT* parameter to 30 seconds implies that the CICS Bridge Monitor Task waits this time until a second subsequent request message arrives. When no more requests are outstanding on the queue, the MQSeries CICS Bridge terminates. For each request on the CICS programs *NACT02* and *NACT03* the MQSeries CICS Bridge can be started manually, but this is not recommended. As another possibility, omitting the *WAIT* parameter implies that the bridge is ever running. The log displays *waitInterval = -1* instead *waitInterval = 30000*. However, if the bridge is started as ever running task from a CICS terminal, the terminal is not freed until the CICS Bridge Monitor Task ends. No more entries could be written on the terminal (Figure 31, next page). The CICS terminal can only be freed using three different procedures. First method: changing the queue parameter *GET* of the MQSeries CICS Bridge queue and sets *GET(DISABLED)*. Following command is entered on SDSF's command line:

```
/!MQA1 ALTER QL(SYSTEM.CICS.BRIDGE.QUEUE) GET(DISABLED)
```

Changing this parameter in a sub panel of the OS/390 MQSeries program is another possibility. The MQSeries MAIN MENU is started from the CMAM when an *M* is entered on the command line. In this menu the parameters, that alter the queue, are set as shown in Figure 32 on the next page. In the sub panel “Alter a Local Queue” the parameter *GET* has to be set to *NO* (Figure 33, next page).

Of course, a shutdown of the MQSeries queue manager MQA1 or a CICS shutdown also terminate the MQSeries CICS Bridge. Following message is written, after a successful shutdown of the MQSeries CICS Bridge, in the CICS log part *MSGUSR* of *CICSC001*:

```
CSQC712I CKBR 0000027 Bridge quiescing  
CSQC713I CKBR 0000027 Bridge terminated normally
```

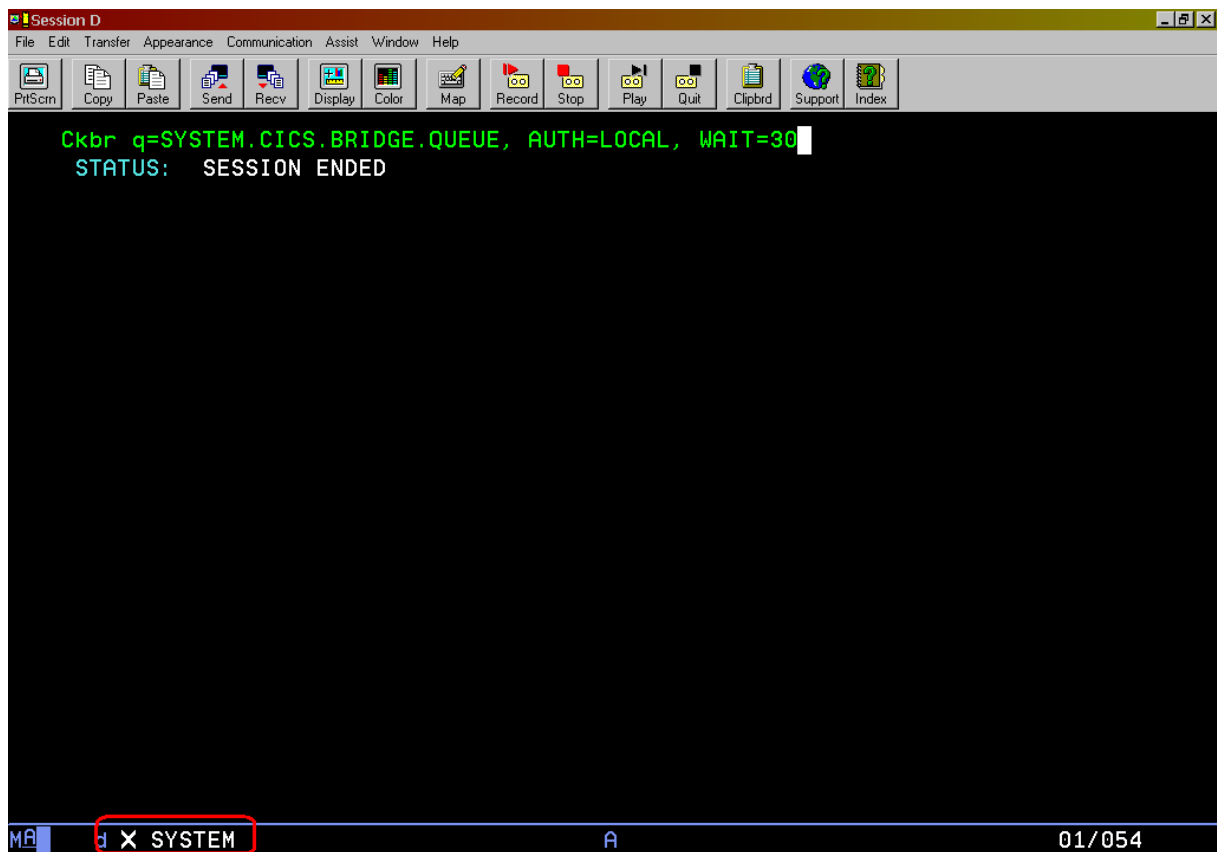


Figure 31: After starting the CKBR transaction the monitor is locked, system is in wait status

```

                                IBM MQSeries for OS/390 - Main Menu

Complete fields. Then press Enter.

Action . . . . . 3          1. Display   5. Perform
                             2. Define    6. Start
                             3. Alter     7. Stop
                             4. Delete

Object type . . . . . QLOCAL      +
Name . . . . . SYSTEM.CICS.BRIDGE.QUEUE
Like . . . . . _____

Connect to queue
manager . . . . . : MQA1
Target queue manager : MQA1
Response wait time . : 30 seconds

(C) Copyright IBM Corporation 1993,1999. All rights reserved.

Command ==> _____
F1=Help      F2=Split    F3=Exit      F4=Prompt    F6=QueueMgr  F9=Swap
F10=Messages F12=Cancel

```

Figure 32: Shutting down the MQSeries CICS Bridge manually – 01

```

                                Alter a Local Queue

Complete fields, then press F8 for further fields, or Enter to alter queue.

More:      +

Queue name . . . . . : SYSTEM.CICS.BRIDGE.QUEUE
Description . . . . . : MQSERIES CICS BRIDGE QUEUE
_____

Put enabled . . . . . Y   Y=Yes,N=No
Get enabled . . . . . N   Y=Yes,N=No
Usage . . . . . N   N=Normal,X=XmitQ
Storage class . . . . . DEFAULT
Creation method . . . . . : PREDEFINED
Output use count . . . . . : 0
Input use count . . . . . : 1
Current queue depth . . . . . : 0

CSQ9022I !MQA1 CSQMMSGP ' ALTER QLOCAL' NORMAL COMPLETION
Command ==> _____
F1=Help      F2=Split    F3=Exit      F6=Cllusinfo F7=Bkwd      F8=Fwd
F9=Swap      F10=Messages F12=Cancel

```

Figure 33: Shutting down the MQSeries CICS Bridge manually – 02

5.4.2.5 An automatic start job for the MQSeries CICS Bridge

In contrast to start and stop the MQSeries CICS Bridge manually, a permanent process of the bridge, running in the background, is a better and pleasant way to get the MQSeries CICS Bridge operated. Of course, when the transaction CKBR is entered on a terminal, the bridge never ends, but the terminal is locked as long as the bridge is shut down. The following procedure shows, how to implement the automatic start and the “background” run of the MQSeries CICS Bridge at CICS startup without using a terminal.

The new created COBOL program *STRTCKBR* starts the bridge during CICS startup (Listing 36, page 236). The script consists of COBOL statements surrounded by JCL code. Such a script is also called a **COBOL stub**. It is stored in the data set *CICS.COMMON.CICSSRC*. One part of the COBOL stub – the JCL-statements – can be found in the lines 1-15 and the others in the lines 54-56 of the script, whereas in line 19 the COBOL parameters are introduced by the parameter *TRN.SYSIN*. From this point the data, that will start the transaction CKBR, is passed to another script called *DFHYITVL* (Listing 37, page 236). This procedure is stored in the data set *CICSTS13.CICS.SDFHPROC*. CICS provides it for the COBOL translate, compile, and link-edit jobs.

Firstly, *DFHYITVL* passes the data to the COBOL translator *DFHECP1£* stored in *CICSTS13.CICS.SDFHLOAD* (cf. Listing 37, page 236, lines 16-24). As next, the data is sent to the COBOL compiler *IGYCRCTL* stored in the data set *IGY.V2R1M0.SIGYCOMP* to compile the script (cf. Listing 37, page 236, lines 29-46). All these three script and load modules are provided within the installation of the CICS Transaction Server (*DFHYITVL*, *DFHECP1£*) resp. IBM COBOL for OS/390 (*IGYCRCTL*). Compiling the *STRTCKBR* script creates the program *STRTCKBR* that is placed into one of the CICS program load libraries, for example *CICS.COMMON.CICSLOAD*. Such a load library has to be specified in the CICS region startup script *CICSC001* (cf. Listing 23, page 229, line 34). A load library works like a path to the programs stored in it. When the program *STRTCKBR* is called during CICS startup all load libraries are searched to find this program. Hence, the transaction CKBR resp. the MQSeries CICS Bridge is started during the CICS region startup.

The *STRTCKBR* script starts in line 1 with the name of the compile job *AUTCKBR1* and with options set for it:

```

01 //AUTCKBR1 JOB (0),RACF,MSGCLASS=X,REGION=3M,TIME=1439,
02 //  CLASS=A,NOTIFY=&SYSUID
...
09 //JCLLIB   JCLLIB ORDER=CICSTS13.CICS.SDFHPROC
10 //COMPILE  EXEC DFHYITVL,                                     X
11 //        INDEX='CICSTS13.CICS',                             CICS      X
12 //        PROGLIB='CICS.COMMON.CICSLOAD',                     TARGET FOR LMOD X
13 //        AD370HLQ='IGY.V2R1M0',                             COBOL COMPILER  X
...
19 //TRN.SYSIN DD *
```

In line 9 of the *STRTCKBR* script is written the library where to find the script *DFHYITVL* called in line 10. Line 12 points to the program load library where the program *STRTCKBR* is placed to after the compilation. The lib-

rary of the CICS COBOL compiler is set in line 13. Line 19 refers to the JCL stepname *TRN* in the procedure *DFHYITVL* to execute the COBOL translator and compiler.

The CICS COBOL program code is introduced by the language statement *CBL* (or *COBOL*) in line 20 and ends in line 52 with the COBOL statement *GOBACK*. Behind the language statement there are listed two translator options within the *XOPT* option. *CICS* indicates that the COBOL translator is to process EXEC CICS commands and *EDF* starts the Execution Diagnostic Facility during compilation. The CICS COBOL program code is subdivided as follows:

```
IDENTIFICATION DIVISION
DATA DIVISION
    WORKING STORAGE SECTION
PROCEDURE DIVISION
```

Within the IDENTIFICATION DIVISION (line 22) is defined the COBOL program name *STRCKBR* (line 23) and a few program data. The DATA DIVISION comprises the data to use in the program (line 28-31). The WORKING STORAGE SECTION of this division defines the parameter *CKBRPARM* (line 30):

```
20 CBL XOPTS(CICS,EDF)
21     ***
22     IDENTIFICATION DIVISION.
23     PROGRAM-ID.      STRCKBR.
24     . . .
28     DATA DIVISION.
29     WORKING-STORAGE SECTION.
30     01  CKBRPARM                                PIC X(37) VALUE
31         'Q=SYSTEM.CICS.BRIDGE.QUEUE,AUTH=LOCAL'.
```

The parameter declares the name of the MQSeries CICS Bridge queue '*SYSTEM.CICS.BRIDGE.QUEUE*'. The bridge is accessed by CKBR with the authority provided by the default CICS user ID. That is the default specified by *AUTH=LOCAL* (see ch. 6.4.4.6 "Securing the MQSeries CICS transactions used for the NACT application" on page 195 for more information). The *WAIT* attribute has been omitted to start an ever running MQSeries CICS Bridge. In the PROCEDURE DIVISION the parameter *CKBRPARM* is used to execute the CICS transaction CKBR starting the CICS command *EXEC CICS START TRANSID* (line 48). The COBOL statement *GOBACK* specifies the logical end of the COBOL program (line 52):

```
48     EXEC CICS START TRANSID('CKBR')
49         FROM(CKBRPARM)
50         LENGTH(37)
51         END-EXEC.
52     GOBACK.
```

The last JCL statement *LKED.SYSIN* links to the step *LKED* in the script *DFHYITVL* to place the compiled CICS COBOL program *STRCKBR* into the right program load library, in this case *CICS.COMMON.CICSLOAD* using the parameter *PROGLIB* (cf. Listing 37, line 12):

```
54 //LKED.SYSIN DD *
55     NAME STRCKBR(R)
```

After the *STRCKBR* script is written, it is compiled, when *sub* is entered on the command line in the editor. If the status report appears including the message part '*MAXCC=0*' the job is well done. In case, a problem occurs during the compilation, the SDSF program needs to be started to view the log of the compile job. In the SDSF program the status of the finished job (by typing '*ST*') gives an error message back. The printout of the compile job *AUTCKBR1* (spelled in line 1 of *STRCKBR*) can be opened by entering an '*S*' before the job name. Looking for the word pattern '*STMT NO. MESSAGE*' shows an error report with a detailed description of the failure and lists the line number where the failure appeared. It should be no problem to solve this, for example, there is written a wrong parameter, a COBOL statement is not set or written wrong, or the library entries links to the wrong one.

In the last step, the CICS Program List Table (PLT) that holds CICS programs to be started during the CICS region initial start has to be adapted. But beware, there are two different PLTs – one is loaded during the CICS region initial start and one is executed during the termination of this CICS region. Within the CICS SIT definition script *C001* (stored in the data set *CICS.COMMON.SYSIN*) both tables are loaded using the SIT-parameters *PLTPI* (PLT Program Initialisation) resp. *PLTSD* (PLT ShutDown):

```
16 PLTPI=IT,          PGMS AT CICS INIT (USE TOR PLT)
17 PLTSD=ST,          PGMS AT CICS TERM (USE TOR PLT)
```

IT and *ST* are suffixes for the PLT scripts. Completely, they are named as *DFHPLTIT* for the initial table and *DFHPLTST* for the system termination table. Because the string *DFH* is automatically added during compilation in front of the script name, their real script names consists of the string *PLT* plus the suffixes *IT* resp. *ST* – *PLTIT* resp. *PLTST*. These scripts are stored in the dataset *CICS.COMMON.TABSRC*. The compiled tables are placed into the dataset *CICS.COMMON.TABLIL* from where they are loaded.

A new entry in the table *PLTIT* is required to start the COBOL program script *STRCKBR* to initiate the MQSeries CICS Bridge queue during the initial start of the CICS region (cf. also Listing 38, page 236):

```
09 //S1    EXEC DFHAUPL
10 //ASSEM.SYSUT1 DD *
...
18          DFHPLT TYPE=ENTRY, PROGRAM=STRCKBR    ENABLE CICS BRIDGE
```

PLTIT is compiled using the procedure *DFHAUPLE* (Listing 39, page 236) that is also stored in the dataset *CICS.COMMON.TABSRC*. Therefore, a concatenation is not required to refer to another library. *DFHAUPLE* is called in line 9. The JCL step *ASSEM.SYSUT1* in line 10 links to the step *ASSEM* in the *DFHAUPLE* script (Listing 39, line 31):

```
31 //ASSEM EXEC PGM=IEBGENER
```

After the successful compiling of the table PLTIT, the MQSeries CICS Bridge is automatically started during every initial start of the CICS region A06C001. However, to load the initial PLT and to start the MQSeries CICS Bridge, the CICS region has to be restarted firstly. It should be considered, that, before starting the CICS region, the OS/390-server queue manager MQA1 has also to be terminated. Afterwards, the queue manager must be started at first because the CICS region may only be started after the queue manager is up. Whilst the queue manager is started, it executes the script *CSQ4CKBM* to create the MQSeries CICS Bridge queue *SYSTEM.CICS.BRIDGE.QUEUE* to MQA1. When the CICS region A06C001 is started afterwards, the compiled CICS COBOL program *STRCKBR* is executed to connect the CICS region to the MQSeries CICS Bridge queue. The successful connection is reported in the CICS *MSGUSR* log as follows:

```
DFHPG0209 03/01/04 02:04:29 A06C001 STCCICS CPLT PPT entry for STRCKBR has been autoinstalled using model DFHPGAPG.
CSQC700I CKBR 0000027 IBM MQSeries for OS/390 v2.1 - CICS bridge. Copyright(c) 1997,1999 IBM, All rights reserved
CSQC702I CKBR 0000027 Monitor initialization complete
CSQC703I CKBR 0000027 Auth=LOCAL, waitInterval=-1, Q=SYSTEM.CICS.BRIDGE.QUEUE
```

Note: An ever running MQSeries CICS Bridge queue can decrease the performance of the system. Therefore, it is suggested to enable triggering the MQSeries CICS Bridge in future.

5.4.3 The required queue manager objects

5.4.3.1 The transmission queue TBUSSE.NACT

Besides the MQSeries CICS Bridge queue, the request queue, four more objects has to be defined to the OS/390-server queue manager: the transmission queue, the remote queue *definition*, the channel sender of the response channel, and the channel receiver of the request channel. All objects are created using the panels of the MQSeries product on OS/390. The first panel, the MQSeries “Main Menu”, can be reached from the CMAM when an *M* is entered on the command line of the first screen appearing after log on to the OS/390-server.

Firstly, the transmission queue TBUSSE.NACT for the OS/390-server queue manager MQA1 is to specify (Figure 34, page 114). Into the field *object type* of the MQSeries “Main Menu” panel is entered the type of the queue which must always be *QLOCAL*, because only a local queue can be transformed into a transmission queue. Pressing the PF4 key opens a selection of all object types. When number 2 is chosen, shortcut for *QLOC-*

AL, and the enter key is pressed, this object type is filled into the field *Object type*. In the field *Name* has to be entered the name of the queue. It is again alluded, that the name of this transmission queue must have the same name as the WINDOWS2000-client queue manager.

The transmission queue is created, when the field *Action* is set to *2* as synonym for '*Define*'. As next screen the sub panel "Define a Local Queue" appears. When the parameter *Usage* is set to *X* the transmission queue is created. Both parameters, *Put enabled* and *Get enabled*, have to be set to *Y*. With it, the transmission queue can get response messages from the MQSeries CICS Bridge queue and can transfer these messages onto the reply-to queue on the WINDOWS2000-client queue manager. Furthermore, a description for the transmission queue is added (Figure 35, page 114). All next panels for defining additional queue parameters can be reached when pressing the PF8 key. On the second panel, the parameter *Message delivery sequence* is changed from *Priority* to *FIFO* to retrieve messages in order of "First in, First out" method. As a future aspect, shared access to the transmission queue is permitted and more than one application could retrieve messages; the parameter *Permit shared access* is set to *Y*. If shared access is forbidden, only one specified application can communicate with the queue. Coherently with the parameter *Permit shared access*, the parameter *Default share option* has to be set to *S*. In case of an illicit access, the *Exclusive* option (*E*) has to be set (Figure 36, page 115).

On the next panel a trigger process can be defined (press PF8), however, this has been omitted. The panel for event control has been also skipped and on the last panel for backout reporting the parameter *Hardenbo* has been set to *Y* to maintain an accurate back out for this queue (Figure 37, page 115).

When pressing the enter key, the queue is created. If the queue is successfully created the first sub panel screen appears displaying following message in the lower area:

```
CSQ9022I !MQA1 CSQMMSGP ' DEFINE QLOCAL ' NORMAL COMPLETION
```

```

                                IBM MQSeries for OS/390 - Main Menu

Complete fields. Then press Enter.

Action . . . . . 2          1. Display   5. Perform
                             2. Define    6. Start
                             3. Alter     7. Stop
                             4. Delete

Object type . . . . . QLOCAL      +
Name . . . . . TBUSSE.NACT
Like . . . . . _____

Connect to queue
manager . . . . . : MQA1
Target queue manager : MQA1
Response wait time . : 30 seconds

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Command ==> _____
F1=Help      F2=Split    F3=Exit      F4=Prompt    F6=QueueMgr  F9=Swap
F10=Messages F12=Cancel

```

Figure 34: Defining the transmission queue TBUSSE.NACT – 01

```

                                Define a Local Queue

Complete fields, then press F8 for further fields, or Enter to define queue.

More:      +

Queue name . . . . . TBUSSE.NACT
Description . . . . . XMITQ THAT STORES RESPONSE_____
                             MESSAGES TO BE SEND_____

Put enabled . . . . . Y   Y=Yes,N=No
Get enabled . . . . . Y   Y=Yes,N=No
Usage . . . . . X   N=Normal,X=XmitQ
Storage class . . . . . DEFAULT

Command ==> _____
F1=Help      F2=Split    F3=Exit      F7=Bkwd      F8=Fwd       F9=Swap
F10=Messages F12=Cancel

```

Figure 35: Defining the transmission queue TBUSSE.NACT – 02

Define a Local Queue	
Press F7 or F8 to see other fields, or Enter to define queue.	
More: - +	
Default persistence	N Y=Yes,N=No
Default priority	0 0 - 9
Message delivery sequence . . .	F P=Priority,F=FIFO
Permit shared access	Y Y=Yes,N=No
Default share option	S E=Exclusive,S=Shared
Index type	N N=None,M=MsgId,C=CorrelId,T=MsgToken
Maximum queue depth	999999999 0 - 999999999
Maximum message length	4194304 0 - 4194304
Retention interval	999999999 0 - 999999999 hours
Cluster name	_____
Cluster namelist name	_____
Default bind	0 0=Open,N=Notfixed
Command ==> _____	
F1=Help	F2=Split
F10=Messages	F12=Cancel
F3=Exit	F7=Bkwd
F8=Fwd	F9=Swap

Figure 36: Defining the transmission queue TBUSSE.NACT – 03

Define a Local Queue	
Press F7 to see previous fields, or Enter to define queue.	
More: -	
Backout Reporting	
Backout threshold	0 0=No backout reporting
Harden backout counter . . .	Y Y=Yes,N=No
Backout requeue name	_____
Command ==> _____	
F1=Help	F2=Split
F10=Messages	F12=Cancel
F3=Exit	F7=Bkwd
F8=Fwd	F9=Swap

Figure 37: Defining the transmission queue TBUSSE.NACT – 04

5.4.3.2 The remote queue definition TBUSSE.NACT.REPLYQ

For the reply-to queue TBUSSE.NACT.REPLYQ created on the WINDOWS2000-client queue manager has to be defined a remote queue *definition* on the OS/390-server queue manager (Figure 38). It is chosen to give it the same name as the reply-to queue on the remote queue manager. In the field *object type* is entered the object type *QREMOTE*; if the selection panel is used (press PF4) the number *3* is to be chosen. A description for this object is also added. On the next panel “Define a Remote Queue” (Figure 39, next page) has to be specified the name of reply-to queue – *TBUSSE.NACT.REPLYQ* – on the field *Remote name*. The WINDOWS2000-client queue manager name *TBUSSE.NACT* has to be entered into the field *Remote queue manager*. As last definition, the name of the transmission queue for MQA1 – *TBUSSE.NACT* – has to be entered into the field *Transmission Queue*. Pressing PF8 leads to the next panel on which nothing needs to be altered. When hitting the enter key, the remote queue *definition* is created and if successfully, following message is displayed:

```
CSQ9022I !MQA1 CSQMMSGP ' DEFINE QREMOTE' NORMAL COMPLETION
```

IBM MQSeries for OS/390 - Main Menu

Complete fields. Then press Enter.

Action	2	1. Display	5. Perform
		2. Define	6. Start
		3. Alter	7. Stop
		4. Delete	

Object type QREMOTE +

Name TBUSSE.NACT.REPLYQ

Like _____

Connect to queue
manager : MQA1
Target queue manager : MQA1
Response wait time . : 30 seconds

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Command ==> _____

F1=Help F2=Split F3=Exit F4=Prompt F6=QueueMgr F9=Swap

F10=Messages F12=Cancel

Figure 38: Defining the remote queue definition TBUSSE.NACT.REPLYQ – 01

Define a Remote Queue	
Complete fields, then press F8 for further fields, or Enter to define queue.	
	More: +
Queue name	TBUSSE.NACT.REPLYQ
Description	REMOTE QUEUE DEFINITION FOR THE_ REPLY-TO QUEUE ON TBUSSE.NACT_____
Put enabled	Y Y=Yes,N=No
Default persistence	N Y=Yes,N=No
Default priority	0 0 - 9
Remote name	TBUSSE.NACT.REPLYQ_____
Remote queue manager	TBUSSE.NACT_____
Transmission queue	TBUSSE.NACT_____
Command ==> _____	
F1=Help	F2=Split
F10=Messages	F12=Cancel
F3=Exit	F7=Bkwd
F8=Fwd	F9=Swap

Figure 39: Defining the remote queue definition TBUSSE.NACT.REPLYQ – 02

5.4.3.3 The dead-letter queue MQA1.DEAD.QUEUE

The dead-letter queue has been defined on the OS/390-server queue manager MQA1 using the script *CSQ4INYG* provided within the MQSeries installation (cf. Listing 32, page 235). Therefore, a manually creation using the MQSeries panels is not required. The dead-letter queue is also a local queue as same as the MQSeries CICS Bridge queue. The MQSC *DEFINE QLOCAL* plus the name of the queue *MQA1.DEAD.QUEUE*, and setting the keyword *USAGE* to *NORMAL* create the queue (line 143, 164). Wrong-sent/failure messages are stored onto the queue (line 153) until they are picked up to check them (line 147). Activating *DEFPSIST* sets all dead-letter messages persistent on the queue (line 149). The shared access to the queue has also to be enabled because all programs should be able to store wrong-sent/failure messages onto the dead-letter queue (lines 154, 155). Messages to be stored onto the queue uses the FIFO method (line 156). A backout for the dead-letter messages is not required, therefore *NOHARDENBO* is specified (line 160). For the dead-letter queue a trigger is also not required; *NOTRIGGER* has been set (line 177):

```

143 DEFINE QLOCAL( 'MQA1.DEAD.QUEUE' ) REPLACE +
...
146     DESCR( 'MQA1 dead-letter queue' ) +
147     PUT( ENABLED ) +
148     DEFPRTY( 0 ) +
149     DEFPSIST( YES ) +
...
153     GET( ENABLED ) +
154     SHARE +
155     DEFSOPT( SHARED ) +
156     MSGDLVSQ( FIFO ) +
...

```

```

160                      NOHARDENBO +
...
164                      USAGE( NORMAL ) +
...
177                      NOTRIGGER +

```

Further, the same script also defines some needed MQSeries objects, an initiation queue required for the MQSeries CICS adapter and a default transmission unused by the MQSeries CICS application.

5.4.3.4 The channel sender TBUSSE.NACT.OS.WIN

A channel sender needs to be created to send the response messages from the transmission queue to the WINDOWS2000-client queue manager. On the MQSeries “Main Menu” panel is entered the string *CHLSENDER* into the field *Object Type* (Figure 40, next page). If the selection panel is used (press PF4), number *13* has to be chosen. The name of the channel sender is set to *TBUSSE.NACT.OS.WIN*. The character sequence *OS.WIN* indicates the direction from where the channel sender transmits the response messages to which target – from OS/390 to WINDOWS2000. Some more parameters has to be specified on the next panel “Define a Sender Channel” (Figure 41, next page). The response messages are sent to the remote queue manager using the TCP/IP protocol with the port number 1414 as default. Parameter *T* is specified in the field *Transport type* to use the TCP/IP protocol. In the field *Connection name*, the IP address of the remote WINDOWS2000 computer is filled in, in this case *80.135.230.111*. The host address is followed by the port number *1414* in parentheses. The closing parenthesis is optional. Into the field *Transmission queue* is entered the name of the local transmission queue. Fields on the next three panels need not to be set up. After confirming the creation of the channel sender, this message appears:

CSQ9022I !MQA1 CSQMMSGP ' DEFINE CHANNEL ' NORMAL COMPLETION

IBM MQSeries for OS/390 - Main Menu		
Complete fields. Then press Enter.		
Action	2	1. Display 5. Perform 2. Define 6. Start 3. Alter 7. Stop 4. Delete
Object type	CHLSENDER	+
Name	TBUSSE.NACT.OS.WIN	
Like	_____	
Connect to queue		
manager	MQA1	
Target queue manager	MQA1	
Response wait time . .	30	seconds
(C) Copyright IBM Corporation 1993,1999. All rights reserved.		
Command ==> _____		
F1=Help	F2=Split	F3=Exit F4=Prompt F6=QueueMgr F9=Swap
F10=Messages	F12=Cancel	

Figure 40: Defining the channel sender for the transmission queue – 01

Define a Sender Channel	
Complete fields, then press F8 for further fields, or Enter to define channel.	
	More: +
Channel name	TBUSSE.NACT.OS.WIN
Description	CHANNEL FOR THE XMITQ TO SEND____ THE RESPONSE MESSAGES_____
Transport type	T L=LU6.2,T=TCP/IP
Connection name	80.135.230.111(1414)_____
LU6.2 mode name	_____
LU6.2 TP name	_____
Transmission queue	TBUSSE.NACT_____
Command ==> _____	
F1=Help	F2=Split F3=Exit F7=Bkwd F8=Fwd F9=Swap
F10=Messages	F12=Cancel

Figure 41: Defining the channel sender for the transmission queue – 02

5.4.3.5 The channel receiver TBUSSE.NACT.WIN.OS

Request messages sent by the channel sender of the WINDOWS2000-client queue manager to the OS/390-server queue manager are received by the channel receiver TBUSSE.NACT.WIN.OS. The channel receiver must have the same name as the remote channel sender to create a message channel. After the message is received it is forwarded to the request queue – the MQSeries CICS Bridge queue.

Such a channel receiver is created when *CHLRECEIVER* is entered into the field *object type*, number 15 can also be chosen from the selection panel that is reached by pressing PF4 (Figure 42). The name of the channel receiver has to be entered in the associate field. On the next both panels is no modifying required, except adding a description if wanted (Figure 43, next page). Note: The field *Sequence number wrap* must have the same number as specified on the remote channel sender, usually it is set to 999999999. After confirming the creation of the channel receiver, the same message as for the channel sender is displayed:

```
CSQ9022I !MQA1 CSQMMSGP ' DEFINE CHANNEL' NORMAL COMPLETION
```

All required MQSeries objects for the OS/390-server queue manager MQA1 are now defined. As next, the MQSeries objects for the WINDOWS2000-client queue manager TBUSSE.NACT have to be created.

IBM MQSeries for OS/390 - Main Menu	
Complete fields. Then press Enter.	
Action 2	1. Display 5. Perform 2. Define 6. Start 3. Alter 7. Stop 4. Delete
Object type	CHLRECEIVER +
Name	TBUSSE.NACT.WIN.OS
Like	_____
Connect to queue	
manager	: MQA1
Target queue manager :	MQA1
Response wait time . :	30 seconds
(C) Copyright IBM Corporation 1993,1999. All rights reserved.	
Command ==> _____	
F1=Help	F2=Split F3=Exit F4=Prompt F6=QueueMgr F9=Swap
F10=Messages	F12=Cancel

Figure 42: Defining the channel receiver for the CICS Bridge queue – 01

Define a Receiver Channel					
Complete fields, then press F8 for further fields, or Enter to define channel.					
					More: +
Channel name	TBUSSE.NACT.WIN.OS				
Description	GETS RESPONSE MESSAGES, FORWARDS THEM TO THE MQ CICS BRIDGE QUEUE				
Put authority	D D=Default,C=Context,O=OnlyMCA,A=AltMCA				
Command ==>					
F1=Help	F2=Split	F3=Exit	F7=Bkwd	F8=Fwd	F9=Swap
F10=Messages	F12=Cancel				

Figure 43: Defining the channel receiver for the CICS Bridge queue – 02

5.5 Setting up MQSeries on the Windows2000 client

5.5.1 The WINDOWS2000-client queue manager TBUSSE.NACT

For the management of the MQSeries system on WINDOWS2000, two Snap-Ins for the Microsoft Management Console (MMC) have been installed – the **MQSeries Services** and the **MQSeries Explorer**. Using both programs help to create, start, stop and delete queue managers and its objects on the WINDOWS2000 client. MQSeries objects are managed by the MQSeries Explorer, as well as the status of the queue managers can be checked with this Snap-In. In contrast, the MQSeries Services do all that what a user understands in services. It starts and stops the MQSeries command server, the channel initiator program, and the channel listener program. For instance, these services can be configured to start them automatically, to use error checking, or to use transmission protocols. Furthermore, the alert monitor can be started in case of an abnormal error, and a trace facility can trace the whole processes.

After the MQSeries application is installed, the WINDOWS2000-client queue manager is to be created. It manages message queuing between the JAVA presentation logic and the CICS business logic. The WINDOWS2000-client queue manager is created using the MQSeries assistant. In the MQSeries Services window, a right mouse click on *Queue Managers* as shown in Figure 44 on the next page pops up a menu on which *New* and then *Queue Manager* is clicked to open the panel “Create Queue Manager (Step 1)”. On this first panel the name of the queue manager TBUSSE.NACT, the name of the default transmission queue TBUSSE.NACT.XMITQ, and the name of the dead letter queue TBUSSE.NACT.DEAD.LETTER.QUEUE are keyed in (Figure 45, a), next page). However, these queues exist not yet, they are defined and created later as described in chapter “The required queue manager objects” on page 125. When clicking on *Next*, the panel “Create Queue Manager (Step 2)” appears (Figure 45, b)). On this panel can be defined where to file the error log. The default parameters are chosen and a click on *Next* leads to the panel “Create Queue Manager (Step 3)” to mark the box *Start Queue Manager* (Figure 45, c)). On the last panel “Create Queue Manager (Step 4)” the box *Create listener configured for TCP/IP* is marked and the port number 1414 is entered in the box *Listen on port number* (Figure 45, d)). This creates a listener, automatically. When clicking on the *Finish* button the queue manager is created and already started with all services it needs. It is also not required to create manually a command server and a channel initiator. These services are always loaded automatically when the queue manager starts. The green upturned arrow in front of the queue manager's name confirms that the queue manager is started. If the arrow is red coloured and is oriented down the queue managers is stopped. All created and started services are shown in the right window of the MQSeries Services (Figure 46, page 124). After switching to the MQSeries Explorer window, all created default MQSeries system objects can be viewed, e.g. the created system queues (Figure 47, page 124). The option *Show/Hide System Objects* must be enabled to see the default objects. It is recommended to switch off this option to not loosing the overview, if own objects need to be defined.

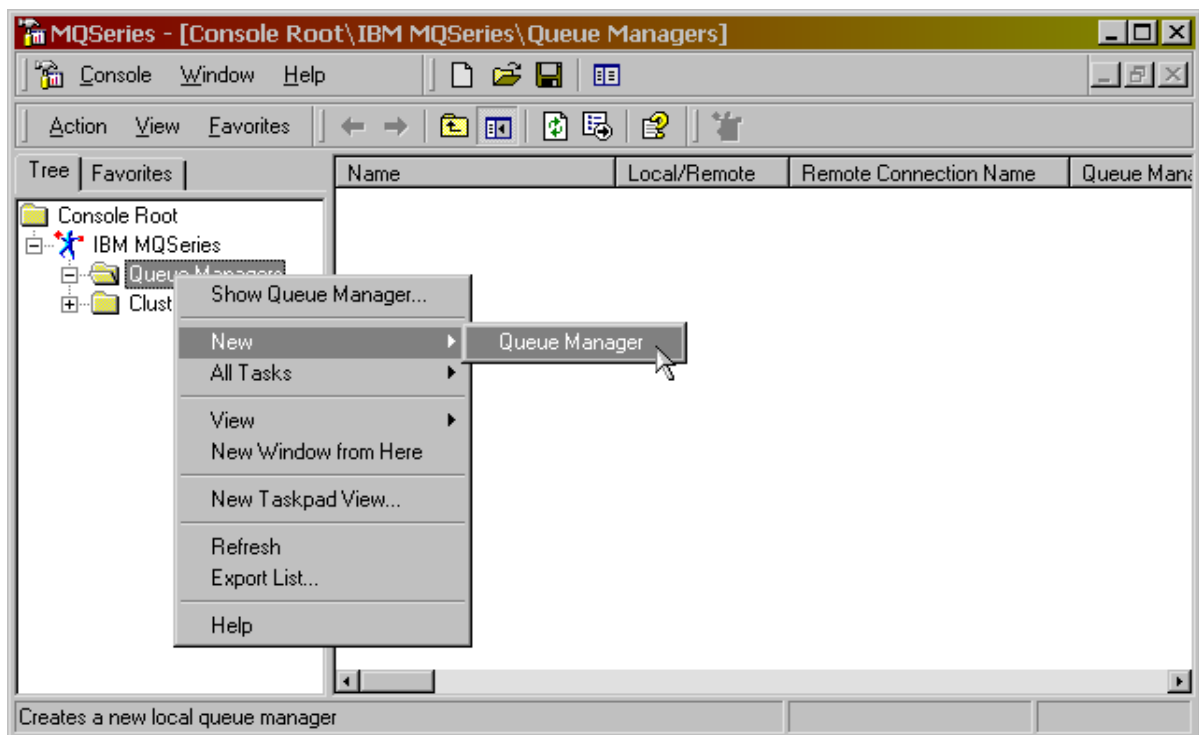


Figure 44: Defining the queue manager TBUSSE.NACT – 01

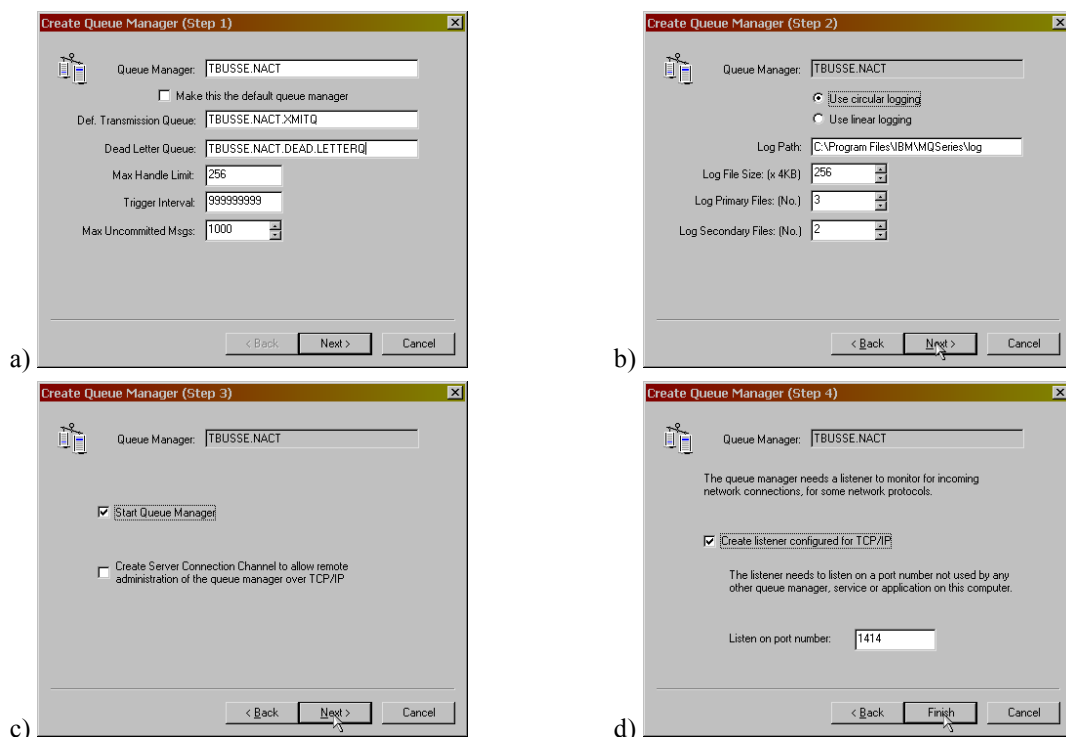


Figure 45: Defining the queue manager TBUSSE.NACT – 02

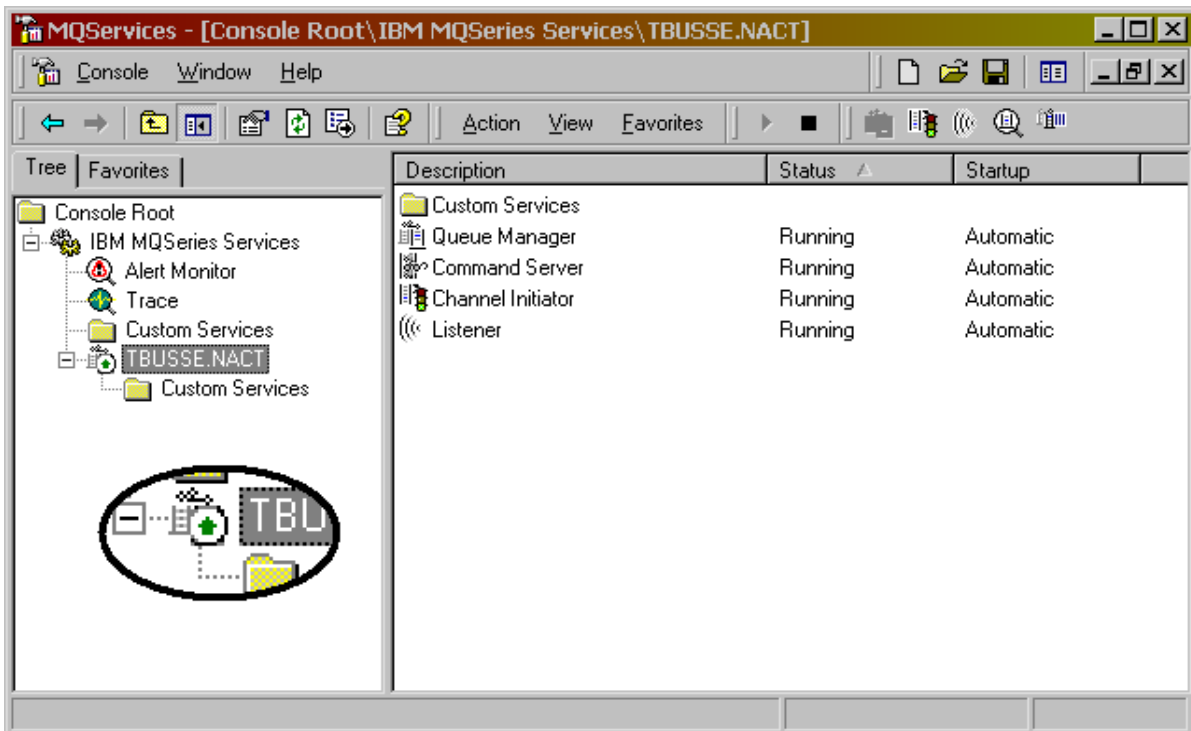


Figure 46: The MQSeries Services, the green arrow indicates that the queue manager is up

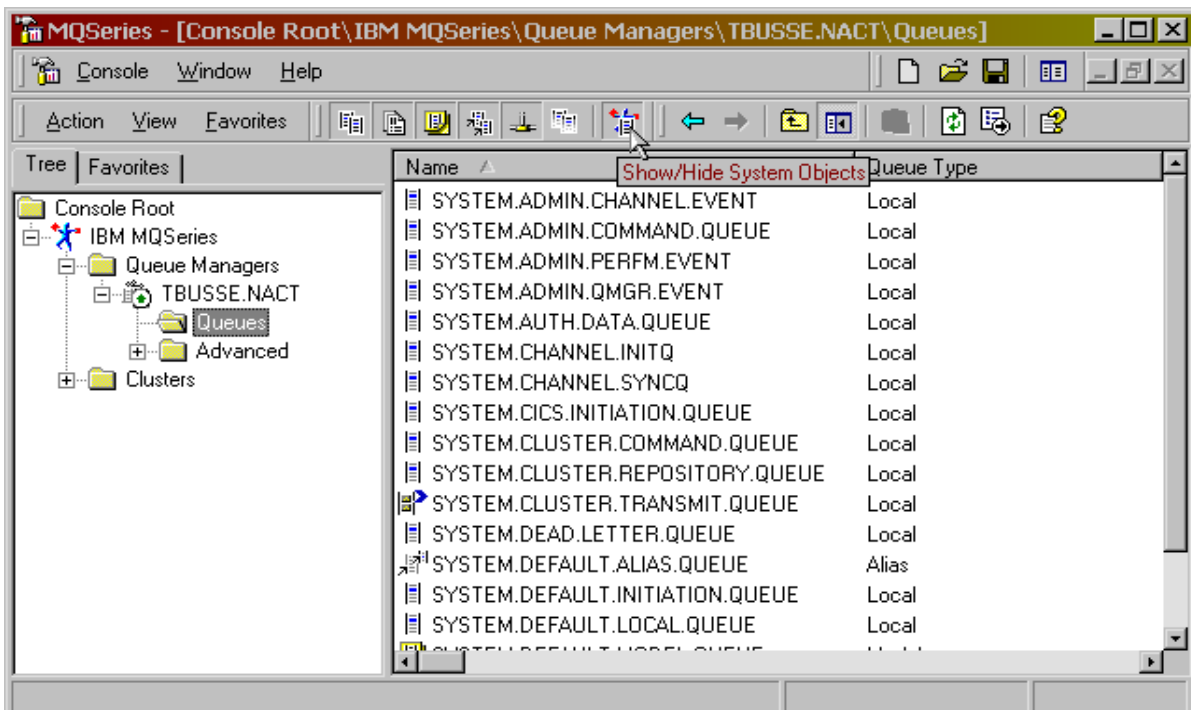


Figure 47: System objects for the queue manager TBUSSE.NACT

5.5.2 The required queue manager objects

5.5.2.1 A definition script for the queue manager objects

As on the OS/390-server queue manager adjacent queue manager objects has to be created on the WINDOWS2000-client queue manager. A transmission queue to send the request messages to OS/390-server queue manager, a reply-to queue that receives the response messages from the OS/390-server queue manager, a remote queue *definition* for the request queue on OS/390, and a dead-letter queue on which all messages are stored that are unable to send have been created. As channel objects, a channel sender and a channel receiver have been created to build the request channel. Additionally, an MQI channel has to be created to connect the WINDOWS2000-client queue manager with the JAVA application.

All these definitions can be defined using the MQSeries assistant in the MQSeries Explorer. For example, the reply-to queue can be defined as shown in Figure 48. Clicking on *Local queues* opens the panel “Create Local Queue” on which all specifications can be made. Instead using this manual method as used for the OS/390-server queue manager objects, a batch script and an MQSC script have been created. In an MQSC script all parameters can also be set for every queue manager object. Such a script can be either created for the OS/390-server queue manager (for example Listing 30, page 235; refer also to chapter 5.4.2.2 “Configuring CICS to use the MQSeries CICS Bridge”, page 101) or for the WINDOWS2000-client queue manager (cf. Listing 40, page 236).

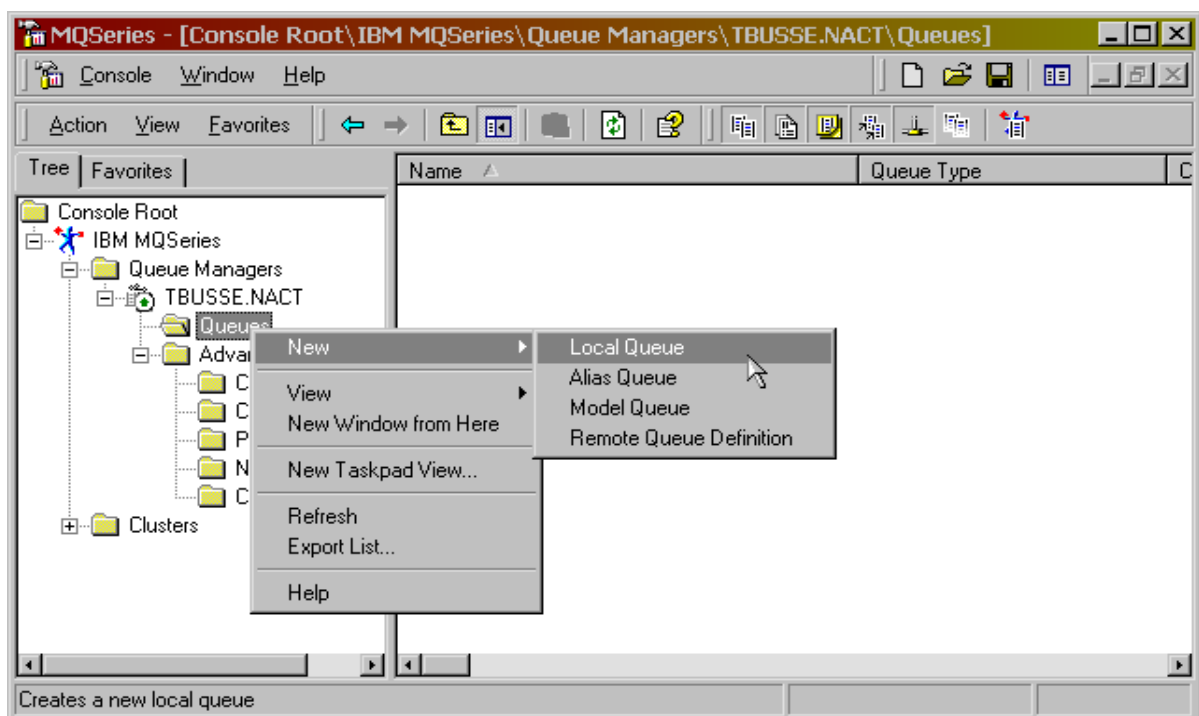


Figure 48: NACT objects for the queue manager TBUSSE.NACT

The MQSC script is executed within the batch file *def.cmd* (cf. Listing 41, page 236). The first batch command *strtmqm* checks whether the queue manager has been started previously (line 06). If not, the local queue manager TBUSSE.NACT is started. Usually, the second batch command *runmqsc*, executed from a MS-DOS-console, starts an MQSeries console on which MQSCs can be entered. However, the command *runmqsc* can also be used to read input data from an external MQSC script and to write a report to another file (line 11). Behind both batch commands it is required to write the name of the queue manager referring to:

```
06 strmqm TBUSSE.NACT
...
11 runmqsc TBUSSE.NACT < MQadmvs.tst > MQadmvs.out
```

All MQSCs are put together in the MQSC file *mqadmvs.tst* (Listing 40). The report is sent to the output file *mqadmvs.out*. If following message stands at the end of the report file, all MQSCs were successfully executed:

```
8 MQSC commands read.
No commands have a syntax error.
All valid MQSC commands were processed.
```

In the next sections are described the required MQSCs with their keywords and attributes for each MQSeries object that needs to be created. However, default parameters are adopted for the most objects. For a complete specification of all MQSCs, their keywords, and attributes please refer to [MCR00].

5.5.2.2 The transmission queue TBUSSE.NACT.XMITQ

The transmission queue TBUSSE.NACT.XMITQ is defined with the MQSC *DEFINE QLOCAL*. In parentheses the name of the queue is written (cf. Listing 40):

```
01 DEFINE QLOCAL('TBUSSE.NACT.XMITQ') REPLACE +
02     DESCR('XMITQ that stores request messages to be send') +
03     TRIGGER TRIGTYPE(FIRST) +
04     TRIGDATA(TBUSSE.NACT.WIN.OS) +
05     PROCESS('MQCLIENT') +
06     INITQ(SYSTEM.CHANNEL.INITQ) +
05     USAGE(XMITQ)
```

The keyword *REPLACE* defines the transmission queue always new when the command file is executed. Such an MQSC can often be spread over a few lines. The plus sign at the end of a line continues the command on the next line. Of course, on the last line of the MQSC this character has to be omitted. When specifying *DESCR*, a description of the queue can be added, as shown in line 2. An important note aside – the name of the queue and the description must be always surrounded by single quotes. In case trigger messages should be written to the initiation queue to trigger an application (named by the *PROCESS* keyword), *TRIGGER* has to be specified. Such a trigger is defined but not used for the MQSeries CICS business application (line 3). This is a reference for future use. A trigger message is send to the initiation queue when the first request message arrives on the transmission

queue. *TRIGDATA* names the data that is additionally inserted in the trigger message, in that case the name of the channel sender (line 4). When an error occurs, a message is displayed on the screen to check whether the channel sender has been started as the message was sent or not. On the keyword *PROCESS* is specified the triggered business application (line 5). The trigger messages are transmitted to the initiation queue *SYSTEM.CHANNEL.INITQ* specified on the keyword *INITQ* (line 6). When the keyword *USAGE* is set to *XMITQ*, the local queue becomes a transmission queue (line 7).

As referenced by the MQSC that creates the transmission queue, a process object needs to be defined to use the trigger. This object is created within the MQSeries command *DEFINE PROCESS* and the assigned name *MQCLIENT* (cf. Listing 40):

```

09 DEFINE PROCESS('MQCLIENT') REPLACE +
10     DESCR('MQSeries CICS Application') +
11     APPLICID('java MQClient') +
12     APPLTYPE(WINDOWSNT) +
13     USERDATA('80.135.230.111 TBUSSE.NACT.CLIENT TBUSSE.NACT +
14             TBUSSE.NACT.REMOTEQ TBUSSE.NACT.REPLYQ')

```

The keyword *APPLICID* specifies the application to be started and *APPL TYPE* specifies the application type. Because the application is running on a WINDOWS2000 operating system, the type has to be *WINDOWSNT*. On the parameter *USERDATA* is listed a string consisting of user-specific information for the application to be started. This specification can be used by a trigger monitor. The trigger monitor sends the user data as part of the parameter list to the started application. The trigger monitor has been previously created and started on the WINDOWS2000-client queue manager to use the trigger.

5.5.2.3 The reply-to queue TBUSSE.NACT.REPLYQ

All response messages are sent from the OS/390-server queue manager onto the reply-to queue. This queue is a local queue defined also with the MQSC *DEFINE QLOCAL* (line 16, Listing 40). When the keyword *USAGE* is omitted only a local queue is created. Setting the keyword *DEFPSIST* to *YES* make messages persistent to survive a queue manager restart (line 18). If *NO* is set, all messages are lost during a restart. As defined for the request queue on OS/390, the share option is also set using the keyword *SHARE* (line 19). Hence, shared access to the reply-to queue is permitted. For example, two independent screens of the application have been started; both can use the same reply-to queue to get the response messages:

```

16 DEFINE QLOCAL('TBUSSE.NACT.REPLYQ') REPLACE +
17     DESCR('Reply-to queue to store the response messages') +
18     DEFPSIST(YES) +
19     SHARE

```

5.5.2.4 The remote queue *definition* TBUSSE.NACT.REMOTEQ

On the WINDOWS2000-client queue manager a remote queue *definition* for the request queue/MQSeries CICS Bridge queue on OS/390 has to be created. The name of this remote queue *definition* is not the same as the name of the request queue on the OS/390-server queue manager (SYSTEM.CICS.BRIDGE.QUEUE). Because objects having the leading characters SYSTEM are system objects for MQSeries. When the option “Show/Hide System Objects” in the MQSeries Explorer is disabled, system objects are not displayed and hence, the remote queue *definition* would also not be displayed. Therefore, the remote queue *definition* is named as *TBUSSE.NACT.REMOTEQ* defined with the MQSC *DEFINE QREMOTE* (line 21, cf. Listing 40, page 236):

```

21 DEFINE QREMOTE('TBUSSE.NACT.REMOTEQ') REPLACE +
22   DESCR('Remote queue definition for the MQSeries CICS Bridge') +
23   RNAME('SYSTEM.CICS.BRIDGE.QUEUE') +
24   RQMNAME('MQA1') +
25   XMITQ('TBUSSE.NACT.XMITQ')

```

The request queue name is specified on the keyword *RNAME* and the remote queue manager is specified within *RQMNAME*. Onto which transmission queue the request message is transferred to, specifies the keyword *XMITQ*. This information is grabbed into a header data which is added to the request data. Both the header and the request data builds the request message.

5.5.2.5 The dead letter queue TBUSSE.NACT.DEAD.LETTER.QUEUE

As specified within the definition of the WINDOWS2000-client queue manager the default dead letter queue does not exist yet. Such a queue is also a local queue and is created using the same MQSC as for the definition for the reply-to queue as defined within the chapter 5.5.2.3 “The reply-to queue TBUSSE.NACT.REPLYQ” on page 127 (line 27, Listing 40). It is only required to set the *SHARE* option to permit shared access to the queue to store all wrong-sent messages on it (line 28). Other parameters need not to be defined; they are set automatically to default parameters:

```

27 DEFINE QLOCAL('TBUSSE.NACT.DEAD.LETTER.QUEUE') REPLACE +
28   DESCR('Dead letter queue on TBUSSE.NACT') +
29   SHARE

```

5.5.2.6 The server connection TBUSSE.NACT.CLIENT

For the communication between the WINDOWS2000-client queue manager TBUSSE.NACT and the JAVA application an MQI channel is used. It consists of the server connection TBUSSE.NACT.CLIENT and an automatically created client connection. The server connection is part of the channel objects, so it is created with the same MQSC *DEFINE CHANNEL*. Within the keyword *CHLTYPE* the type of the channel is set, in that case

SVRCONN, to specify the server connection. This parameter must be written immediately behind the MQSC and before all other keywords defining the other parameters. The MQI channel uses the TCP/IP transport type, which is set with the keyword *TRPTYPE*. *MCAUSER* sets up the user identifier for the MCA. However, a user identifier is not used because there is no need for it (cf. Listing 40):

```

31 DEFINE CHANNEL('TBUSSE.NACT.CLIENT') CHLTYPE(SVRCONN) REPLACE +
32     DESCR('MQI channel to connect the application with the QMGR') +
33     TRPTYPE(TCP) +
34     MCAUSER(' ')

```

5.5.2.7 The channel sender TBUSSE.NACT.WIN.OS

As another part of the channel family it is required to create the channel sender for the request channel on the WINDOWS2000-client (cf. Listing 40). Behind the MQSC *DEFINE CHANNEL* and the channel's name, it must be specified the channel type *SDR* within the keyword *CHLTYPE* to create the channel sender (line 36). Message to be transmitted to the OS/390-server queue manager use TCP/IP specified with the keyword *TRPTYPE* (line 38). The keyword *XMITQ* specifies the name of the transmission queue (line 39). This queue uses the channel sender to transfer the messages to the OS/390-server queue manager. The keyword *CONNAME* sets the IP address of the OS/390-server (line 40). *MCAUSER* leaves blank (line 41):

```

36 DEFINE CHANNEL('TBUSSE.NACT.WIN.OS') CHLTYPE(SDR) REPLACE +
37     DESCR('Channel for the XMITQ to send the request messages') +
38     TRPTYPE(TCP) +
39     XMITQ('TBUSSE.NACT.XMITQ') +
40     CONNAME('139.18.4.97(1414)') +
41     MCAUSER(' ')

```

5.5.2.8 The channel receiver TBUSSE.NACT.OS.WIN

The channel receiver of the response channel has been created using same MQSC as used for the channel sender. However, within the keyword *CHLTYPE* the attribute *RCVR* is specified. *RCVR* is a shortcut for the type channel receiver (line 43). Response message to be received use the TCP/IP protocol (line 45). The keyword *SEQWRAP* sets where the sequence numbers wrap of messages starts. The next number wrap always begins at 1. This number must match the same number as specified for the channel sender of the request channel. A user identifier for the channel receiver MCA is also not used; the default one is taken (cf. Listing 40):

```

43 DEFINE CHANNEL('TBUSSE.NACT.OS.WIN') CHLTYPE(RCVR) REPLACE +
44     DESCR('Gets response messages & forwards them to the local REPLYQ') +
45     TRPTYPE(TCP) +
46     SEQWRAP(999999999) +
47     MCAUSER(' ')

```

Figure 49 shows all defined queues as well as Figure 50 on the next page shows all created channels of the WINDOWS2000-client queue manager TBUSSE.NACT.

Hence, all definitions for the WINDOWS2000-client queue manager TBUSSE.NACT and the OS/390-server queue manager MQA1 have been made. However, before connecting both queue managers, the JAVA presentation and MQSeries communication logic have to be created.

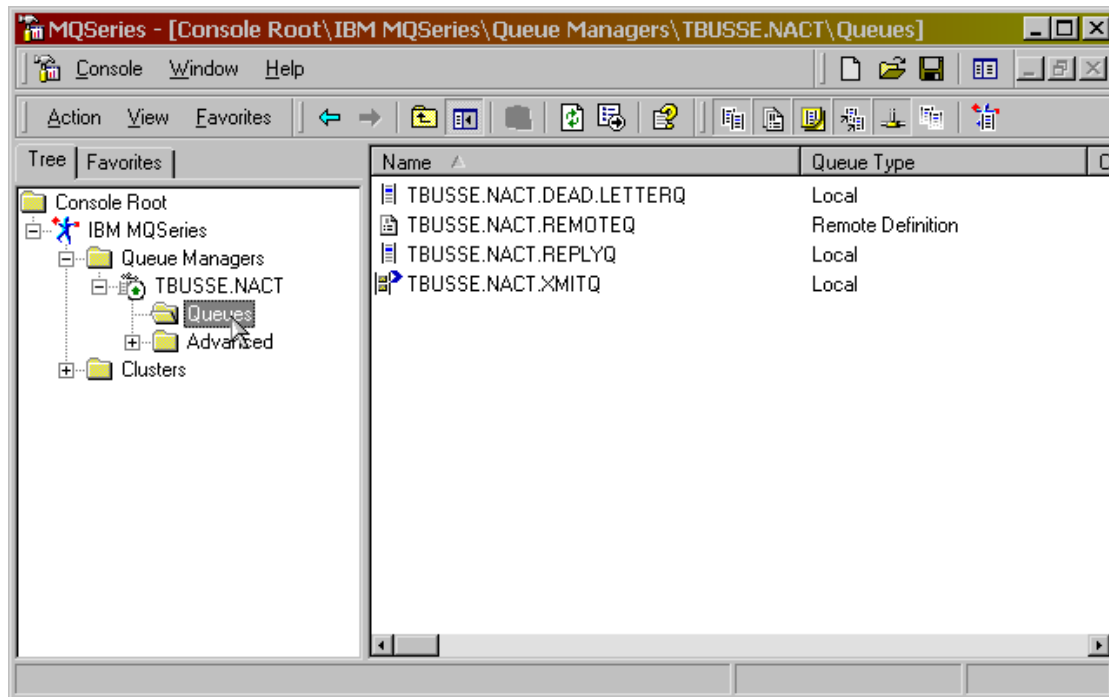


Figure 49: All defined queues for TBUSSE.NACT

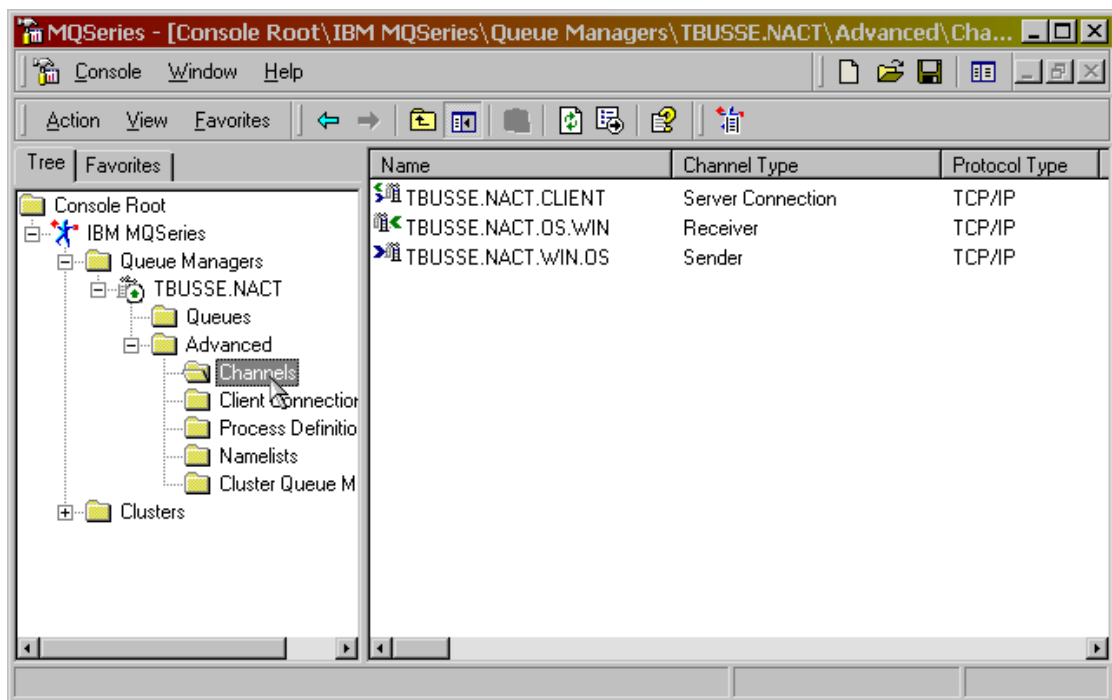


Figure 50: All created channels for TBUSSE.NACT

5.6 Building the JAVA application

5.6.1 Coding the MQSeries communication logic

5.6.1.1 Creating a connection to the WINDOWS2000-client queue manager

The JAVA-file *MQCommunicator.java* consists of the MQSeries communication logic, that uses the MQI to establish a connection to the MQSeries WINDOWS2000-client queue manager, to send the request messages to the OS/390 business logic, and to receive the response messages from the OS/390 business logic (Listing 42, page 237). With this JAVA-application an account record is read and displayed on the WINDOWS200-client. For using the MQI within JAVA-applications, IBM offers the product extension MA88¹¹. Within the JAVA-package *com.ibm.mq.jar* all required classes for the MQI-calls are provided.

For using the MQI to send and receive messages, an instance of *MQCommunicator* is constructed:

```
09 public class MQCommunicator
...
41 public MQCommunicator(String hostname, String channel, String qManager,      +
                        String aRequestQueue, String aReplyQueue)
```

The parameters used for the *MQCommunicator* constructor method read as follows:

<i>hostname</i>	IP-address of the WINDOWS2000 computer
<i>channel</i>	Name of the server connection of the MQI-channel
<i>qManager</i>	Name of WINDOWS2000-client queue manager
<i>aRequestQueue</i>	Name of the Remote Queue <i>Definition</i> (= Request Queue on OS/390)
<i>aReplyQueue</i>	Name of the Reply-To-Queue

Firstly, a connection to the WINDOWS2000-client queue manager has to be established using the constructor method *MQQueueManager* of the MQSeries supplied JAVA-class *MQQueueManager*. Before constructing an *MQQueueManager* instance for use in client mode, some static member variables must be set in the MQSeries supplied JAVA-class *MQEnvironment* because they take effect when the constructor is called – that are *hostname*, *channel*, and *port* (lines 44-46). The application start command passes the IP-address to *hostname* and the name of the MQI-channel to *channel*. The port on which the MQSeries Server listens for incoming connection requests is hard coded within the attribute *port* to 1414 in the JAVA source program. The method *enableTracing* is commented, when enabled, the MQSeries Client JAVA trace facility is started (line 47).

After setting these parameters, the connection to the WINDOWS2000-client queue manager *qManager* can be established, when an instance of *MQQueueManager* is created (line 51). The creation of such an object is in-

¹¹ For the MA88-extension downloading instructions refer to 5.2.1 on page 83.

tercepted by an exception, in case the queue manager cannot be connected. If the connection fails, CICS sends back a completion code to get to the bottom of the error (lines 95-104, please refer to Listing 42).

```

44 MQEnvironment.hostname = hostname;
45 MQEnvironment.channel = channel;
46 MQEnvironment.port = 1414;
47 // MQEnvironment.enableTracing(1, System.out);
...
51 qMgr = new MQQueueManager(qManager);

```

5.6.1.2 Opening the MQSeries queues for message transport

Before both queues are opened to perform PUTs and GETs on them (input=get, output=put), the name of reply-to queue is stored to the new variable *replyQueueName* to stores the response message on the right queue.

```

66 replyQueueName = aReplyQueue;

```

As next operation, the queues have to be opened. For placing messages on the request queue, the open option is set to *MQC.MQOO_OUTPUT* (line 73). This option is used for the method *accessQueue* of the MQSeries supplied class *MQQueueManager* (line 77). The first parameter *aRequestQueue* assigns the name of the request queue and the second parameter *openOptions* assigns the open options for the request queue. The last three parameters have been set to *null*, they are assigned to the default values: *null*, if it is the queue manager to which *MQQueueManager* is actually connected to; *null*, if a model queue is not used; and *null*, if the default user ID is used.

```

73 openOptions = MQC.MQOO_OUTPUT;
...
77 requestQueue = qMgr.accessQueue(aRequestQueue, openOptions, null, null, null);

```

For placing the response messages onto the reply-to queue, the open option for the queue is set to *MQC.MQOO_INPUT_AS_Q_DEF* (line 87). As same as for the request queue, the method *accessQueue* assigns the name of the reply-to queue, the open options, and the default values for the queue manager name, the model queue, and the user ID (line 88).

```

87 openOptions = MQC.MQOO_INPUT_AS_Q_DEF;
88 replyQueue = qMgr.accessQueue(aReplyQueue, openOptions, null, null, null);

```

In case, the reply-to queue and the request queue have the same name (that is possible), the open options have been set as follows.

```
70 openOptions = MQC.MQOO_INPUT_AS_Q_DEF | MQC.MQOO_OUTPUT;
```

5.6.1.3 Creating the request message and send it

The request message object is created within the *send*-method of the JAVA-class **MQCommunicator** (line 109). The request message object *sendMessage* is initialised (line 113) before it is created as an instance of the MQSeries supplied JAVA-class **MQMessage** (line 117). The format of the message (*sendMessage.format*) is set to the queue manager built-in format **MQC.MQFMT_STRING** to indicate the nature of the data in the message (line 126). In line 134 is specified the type of the message (*sendMessage.messageType*); the value **MQC.MQMT_REQUEST** sets the message to a request message. Both – the message format and the message type – build the message descriptor. The previously stored name of the reply-to queue *replyQueueName* specifies that queue on which the response messages are stored (line 137):

```
109 public MQMessage send(String customerNumber) {
...
113     MQMessage sendMessage = null;
...
117     sendMessage = new MQMessage();
...
126     sendMessage.format = MQC.MQFMT_STRING;
...
134     sendMessage.messageType = MQC.MQMT_REQUEST;
...
137     sendMessage.replyToQueueName = replyQueueName;
```

As next, a string is defined consisting of the contents of the request COMMAREA. It is specified by the strings *bufferFront*, the *customerNumber*, and the *bufferEnd* (line 140). This data string is always 408 characters long as same as the request COMMAREA measures. It consists of a 25 bytes *bufferFront*, a 5 digit *customerNumber*, and at least, a 378 bytes *bufferEnd*. The strings *bufferFront* and *bufferEnd* are defined in the MQSeries communication logic class **MQCommunicator**. The *customerNumber* is passed as a string from the external JAVA-class **MQClient** defined within the file *MQClient.java*.

Within the string *bufferFront* there are listed three fixed values and some blank characters – that is the header of the COMMAREA. The first 8 characters specifies the CICS program which is to be called, in that case NACT02 (line 24). Additionally, 2 blank characters have to be inserted behind the name to get an 8 bytes program name (“NACT02__”). The characters *VIA* refer to the version and is the “eyecatcher” to create the correct COMMAREA (line 25). Because the account is to be read, the request type *E* has also to be added to the *bufferFront* (line 26). The next 13 characters leave free to contain response and reason codes and an EIBFN code (lines 27-29). The string *customerNumber* (position 26-30 of the record) contains the account number to request the

customer account. Position 31 through 408 of the record is filled with empty strings to store the account record data on response (lines 30-37). With the method *writeString* of the *MQMessage*-instance *sendMessage*, the buffer/data is added to the message (line 141):

```

24 bufferFront = "NACT02 " +
25               "V1A" +
26               "E" +
27               " " +
28               " " +
29               " " +
30 bufferEnd    = " " +
31               " " +
32               " " +
33               " " +
34               " " +
35               " " +
36               " " +
37               " ";
...
140 String buffer = new String(bufferFront + customerNumber + bufferEnd);
141 sendMessage.writeString(buffer);

```

For a complete description on how the buffer is used to transmit data, please refer to the chapter 4.3.5.4 “COMMAREA – a scratchpad facility” on page 60.

After the message has been created, consisting of the message descriptor and the request data, it is put onto the request queue using the *put*-method of the MQSeries supplied JAVA-class *MQQueue* using default options set within an instance of the MQSeries object *MQPutMessageOptions* (line 144 & 148). When the message is placed onto the queue, a note is displayed (line 154). To retrieve the correct response message after requesting NACT02, a new MQSeries message object named *storedMessage* is created in which the message identifier is stored as a correlation identifier (line 159, 162 & 168). This object is used as a reference for the response message. If an error occurs on creating or sending the response message, some exception routines are specified (lines 170-182, please refer to Listing 42).

```

144 MQPutMessageOptions pmo = new MQPutMessageOptions();
...
148 requestQueue.put(sendMessage, pmo);
...
154 print("Message placed on queue");
...
159 storedMessage = new MQMessage();
...
162 storedMessage.correlationId = sendMessage.messageId;
...
168 return storedMessage;

```

5.6.1.4 Receiving the response message

When NACT02 has answered on the request and a message is sent back from the MQSeries server on OS/390 the JAVA application has to receive the response message. For this response message, the MQSeries message object is already supplied as the parameter *replyMessage* in the instance *storedMessage* (line 187):

```
187 public String receive(MQMessage replyMessage) {  
...  
190     MQGetMessageOptions gmo = new MQGetMessageOptions();  
...  
195     gmo.options = MQC.MQGMO_WAIT | MQC.MQGMO_CONVERT;  
...  
198     gmo.waitInterval = 60000;  
...  
211     replyQueue.get(replyMessage,gmo);  
...  
217     int msglen = replyMessage.getMessageLength();  
...  
220     String msgText = replyMessage.readString(msglen);  
...  
225     return msgText;  
}
```

The message is received with the *get*-method of the MQSeries supplied JAVA-class *MQQueue* using options set within an instance of the MQSeries object *MQGetMessageOptions* (line 190). The default options are not used. If the response message is not yet transmitted onto the reply-to queue, the application waits for it using the option *MQC.MQGMO_WAIT*. The received chars are converted to the right char set using the option *MQC.MQGMO_CONVERT* (line 195). The time period to wait for the response message is set to 60 seconds using the integer *waitInterval* (line 198). After the options are set, the *get*-method is used to receive the account record data (line 211). Defining the integer *msglen* provides the length of the transmitted message (line 217). This length is used to read the message data using the method *readString* (line 220 & 225). The data is stored within the string *msgText*. Receiving the response message is also intercepted by exceptions; however, for this code fragment refer to Listing 42.

5.6.1.5 Finalising the connection to the WINDOWS2000-client queue manager

The *finalise*-method closes the request and the reply-to queue after the response message is received. Closing the queues is done with the *close*-method of the MQSeries supplied JAVA-class *MQQueue* (line 246 & 249). At the end, the connection to the queue manager is terminated with the *disconnect*-method of the MQSeries supplied JAVA-class *MQQueueManager* (line 252):

```
243 public void finalise() {  
...  
246     requestQueue.close();  
...  
249     if (requestQueue != replyQueue) replyQueue.close();  
...  
252     qMgr.disconnect();  
}
```

5.6.2 Coding the presentation logic

The JAVA-file *MQClient.java* contains the presentation logic. It requests an customer account record by passing the typed-in account number to the MQSeries communication logic class. When the request is successful, the account record data is displayed within the JAVA-GUI on the WINDOWS2000 screen. The JAVA GUI uses the JAVA SWING classes.

The JAVA application is started when following command, including the required parameters, is executed on the command line of a MS-DOS console:

```
java MQClient <<WINDOWS-IP-ADDRESS>> <<server connection>>      +
<<queue manager>> <<remote queue definition>> <<reply-to queue>>
```

This opens an application screen as shown in Figure 51. With the command parameters and the constructor method of the JAVA class *MQClient*, an instance of the JAVA class *MQCommunicator* named *MQComms* is created (line 141). For a description of and using the parameters refer to chapter 5.6.1 “Coding the MQSeries communication logic”, page 132.

The input screen is build with the *JFrame* structure consisting of a menu bar created with the JAVA class *JMenuBar* using the *createClientMenuBar*-method (lines 149 & 366-403, Figure 51, No.1) and of two panels

The screenshot shows a Java Swing window titled "The Royal Bank of KanDoIT - Account Enquiry Client". The window has a menu bar with "Actions" and "Help" (labeled 1). Below the menu bar is a text input field for "Enter an Account Number:" (labeled 2a) and a button with a mobile phone icon (labeled 2b). The main area is divided into four sections: "PERSONAL INFORMATION" (labeled 3a) with fields for Title, Initial, First Name, Surname, Street, Postcode, City, and Telephone; "ACCOUNT HISTORY" (labeled 3c) with a table showing Balance, Billed, Amount, Paid, and Amount; "CREDIT CARD DETAILS" (labeled 3b) with fields for No. of Cards Issued, Date Card Issued, Reason for Card Issue, Card Code, Card Approved By, Special Codes, Account Status, and Credit Limit; and "Additional Authorised Card User:" (labeled 3d) with three empty text fields.

Balance	Billed	Amount	Paid	Amount

Figure 51: Input screen of the MQSeries JAVA-application

created as an instance of the JAVA-class **JPanel**. One panel, that holds the field to input the account number and a button to fetch it, is created using the method *createFetchPanel* (lines 154 & 440-469, Figure 51, No.2). The other panel is created as a scroll panel using the method *createRecordPanel* and displays the account record data (lines 150, 155 & 472-681, Figure 51, No.3). Both panels are adjusted using the standard layout manager **BorderLayout** (lines 153-155):

```

141    MQComms = new MQCommunicator(hostname, channel, qManager, requestQueue, +
      replyQueue);
...
149    setJMenuBar(createClientMenuBar());
150    JScrollPane scrollpane = new JScrollPane(createRecordPanel());
...
153    getContentPane().setLayout(new BorderLayout());
154    getContentPane().add("North", createFetchPanel());
155    getContentPane().add("Center", scrollpane);
...
366 protected JMenuBar createClientMenuBar()
...
440 protected JPanel createFetchPanel()
...
472 protected JPanel createRecordPanel()

```

The account number field is a combination box used for input and for choosing an account number from a list. It is built as an instance of **JComboBox** (lines 447-449, Figure 51, No.2a). The entry can be fetched by a clickable button created as an instance of **JButton** (lines 452-461, Figure 51, No.2b). It can also be fetched by a menu bar item created as an instance of **JMenuItem** within the method *createClientMenuBar* (lines 366 & 378-382). Both fetch methods have to be activated to get a response; this is handled by the method *createEventHandlers* (lines 175 & 339-363). With the method *enableDisableListItems* the fetch button and the fetch menu bar item are set enabled (lines 406, 408 & 410). Getting the response using the fetch button resp. the fetch menu bar item is done with the *get*-methods in line 415 resp. 420:

```

175    createEventHandlers();
...
339 protected void createEventHandlers()
...
366 protected JMenuBar createClientMenuBar()
...
378    menuFetch = new JMenuItem("Fetch Record");
...
406 public void enableDisableListItems(boolean option)
...
408    getMenuitemFetch().setEnabled(option);
...
410    getButtonFetch().setEnabled(option);
...
415 protected JButton getButtonFetch()
...
420 protected JMenuItem getMenuitemFetch()
...
447    accountNumberField = new JComboBox();
...
452    buttonFetch = new JButton(new ImageIcon("images/up.gif"));

```

Whether, if one of both fetch methods is used, the method *clickedFetch* is always activated to retrieve the account number from the account number field when clicked on the button or used the menu bar item (line 190-282). This method gets the account number as a string using the method *getAccountNumber* (lines 684-715). Using the method *getAccountNumberField* retrieves the number from the input field whereas *getSelectedItem* retrieves the number from the pull down list of the combination box (lines 435 & 687). The number is then passed to *MQComms* using its *send*-method (lines 207 referring to line 192). The *clickedFetch*-method also receives the requested data from *MQComms* using *receive*-method of *MQComms* (line 221) and validates whether the enquiry has been successful or not (lines 238-277). If the enquiry has been successful (lines 238-244), the methods *displayRecord* and *setAccountHistory* are executed to display the account record data (lines 718-742 & 745-780). Both methods calls the two external application classes *AccountRecord* and *AccountHistory* to extract the received account record data into the correct strings. If the response is returned with an error code, some information messages are displayed and the fields are cleared using the *clearDisplay*-method, that is called for example from line 202 (lines 783-811):

```

190 public void clickedFetch()
191     ...
192     String requested = getAccountNumber();
193     ...
202     clearDisplay();
203     ...
207     currentRequest = MQComms.send(requested);
208     ...
221     messageReturned = MQComms.receive(currentRequest);
222     ...
238     if(CICSresponseCode.equals("0000")){
239         ...
240         customerDetails = messageReturned.substring(25,408);
241         AccountRecord retrieved=new AccountRecord(customerDetails);
242         displayRecord(retrieved);
243         return;
244     }
245     ...
435 protected JComboBox getAccountNumberField()
436     ...
684 public String getAccountNumber()
685     ...
687     String accountNumber = (String)getAccountNumberField().getSelectedItem();
688     ...
718 public void displayRecord(AccountRecord record)
719     ...
741     setAccountHistory(record);
742     ...
745 private void setAccountHistory(AccountRecord record)
746     ...
783 public void clearDisplay()

```

The panel created within the *createRecordPanel*-method consists of 4 more panels arranged top left, top right, bottom left, and bottom right using the *GridLayout* with 2 rows and 2 columns (lines 478-494 & 669-677). The top left panel displays personal information about the customer (Figure 51, No.3a). The fields are arranged using the *GridLayout* again. There are used 9 rows and 2 columns (lines 587-610). In the first row is written the header for the panel using *JLabel* (line 551 & 552). The next 8 rows contains the output fields with an associated

label. In the first column are displayed the names using instances of **JLabel**, too (lines 553-560). The non-editable output fields besides the names are set in the second column using instances of the external application class **DisplayField** (497-504 & 93-100). All fields are added to the top left panel using the *add*-method (lines 593-610). The bottom left panel uses also the **GridLayout** consisting of 9 rows and 2 columns (Figure 51, No.3b). This panel is used to display the credit card details. The objects are defined as same as for the top left panel (lines 105-114, 507-516 & 562-571). The top right panel displays a scrollable table of the account history created as an instance of **JTable** and **JScrollPane** that calls another external application class **AccountHistoryTableModel** (lines 117-119, 534-548 & 651, Figure 51, No.3c). Furthermore, a title is also added with a **JLabel** instance (lines 573 & 650). The last panel, the bottom right panel displays user who are authorised to use the customer's credit cards, too (Figure 51, No.3d). This panel is once more arranged by a **GridLayout** consisting of 9 rows and only 1 column (lines 656-659). The labels and output fields are defined as same as the fields for the personal information (lines 101-104, 524-527, 575-576 & 661-666):

```

478     topLeft = new JPanel(), topRight = new JPanel(),      // Defining the Panels
479     bottomLeft = new JPanel(), bottomRight = new JPanel();
...
497     titleField = new DisplayField(50, background);
...
534     dataModel = new AccountHistoryTableModel();
536     JTable tableView = new JTable(dataModel);
...
547     JScrollPane scrollpane = new JScrollPane(tableView);
548     scrollpane.setPreferredSize(new Dimension(tableView.getWidth(), tableView.getHeight()));
...
551     JLabel personalLabel = new JLabel("PERSONAL ", JLabel.RIGHT),
552         personalLabel1 = new JLabel("INFORMATION"),
553         titleLabel = new JLabel("Title: ", JLabel.RIGHT),
...
562         creditCardLabel = new JLabel("CREDIT ", JLabel.RIGHT),
563         creditCardLabel1 = new JLabel("CARD DETAILS"),
...
573         acctHistoryLabel = new JLabel("ACCOUNT HISTORY"),
...
575         emptyLabel = new JLabel(""),
576         othersLabel = new JLabel("Additional Authorised Card User:",JLabel.LEFT);
...
587     GridLayout gridLeft = new GridLayout(9, 2);      // Layout topLeft Panel
...
593     topLeft.add(personalLabel);                        // Heading "Personal
594     topLeft.add(personalLabel1);                      // Information"
595     topLeft.add(titleLabel);                          // Label for Title
596     topLeft.add(titleField);                          // Title output
...
615     GridLayout gridBottomLeft = new GridLayout(9, 2); // Layout bottomLeft Panel
...
620     bottomLeft.add(creditCardLabel);                  // Heading "Credit Card
621     bottomLeft.add(creditCardLabel1);                 // Details"
...
650     topRight.add(acctHistoryLabel);                   // Heading Account History
651     topRight.add(scrollpane);                         // Table
...
656     GridLayout gridRight = new GridLayout(9, 1);     // Layout bottomRight Panel
...
661     bottomRight.add(emptyLabel);
662     bottomRight.add(othersLabel);                     // Heading
...
669     GridLayout gLay = new GridLayout(2, 2);         // Layout for Main Panel

```

In case, errors occur, they are intercepted by exceptions and the user are informed by popping up a message window. Some messages are displayed on the MS-DOS console such as MQSeries status messages or CICS response and reason codes.

At the end of the application class ***MQClient***, it is instantiated by the *main*-method (lines 814-828). The class ends in line 828.

```
814 public static void main (String[] args) throws Exception
...
822     new MQClient(args);
```

5.7 Connecting both queue managers

5.7.1 Checking the status of the queue managers and activate services

Before connecting both queue managers, a query has to be started to check whether all required services have been started successfully – the subsystem/command server, the queue manager, the channel initiator, and the TCP/IP listener. On the OS/390-server, an entry in the DA-panel shows if the MQSeries subsystem and the queue manager have been started. The jobid entry *MQAIMSTR* confirms that the MQSeries subsystem is up and the queue manager runs (Figure 52). Reaching the DA-panel is described in Appendix B.1 on page 231. When the jobid *MQA1CHIN* is displayed in the same panel, the channel initiator is activated, too (Figure 52). On the SDSF command line following command can be typed-in to show whether the channel initiator and the TCP/IP listener are started¹²:

```
/!MQA1 DISPLAY DQM
```

The output displays that both have been started (Figure 53, next page). This message can also be displayed using the MQSeries panels. On the main screen “MAIN MENU” choose *DISPLAY* (shortcut 2) and *SYSTEM* in the field *Object type*. Characters are not required to input in the field *Name*. On the next panel “Display a System Function” choose the option “1” for *Distributed queuing* and press the enter key. A similar output as on the DA-panel is displayed (Figure 54, next page).

Display Filter View Print Options Help											
SDSF	DA	SYS1	DAVI	PAG	0	SIO	0	CPU	41	LINE 35-51 (68)	
NP	JOBNAME	STEPNAME	PROCSTEP	JOBID	OWNER	C	POS	DP	REAL	PAGING	SIO
	JES2AUX	JES2AUX				NS	F5	45	0.00	0.00	
	JGATE01	JGATE01	*OMVSEX	STC03560	STCJGATE	WM	FF	55	0.00	0.00	
	JGATE013	*OMVSEX		STC02675	STCJGATE	IN	F9	2293	0.00	0.00	
	LLA	LLA	LLA			NS	FE	260	0.00	0.00	
	MQA1CHIN	MQA1CHIN	PROCSTEP	STC13524	STCMQA1	IN	F5	177	0.00	0.00	
	MQA1MSTR	MQA1MSTR	PROCSTEP	STC13523	STCMQA1	NS	FE	454	0.00	0.00	
	NFSC	NFSC	MVSCLNT	STC09109	NFSC	NS	FE	95	0.00	0.00	
	NFSS	NFSS	GFSAMAIN	STC09128	NFSS	NS	FD	359	0.00	0.00	
	OMVS	OMVS	OMVS			NS	FF	2380	0.00	0.00	
	PCAUTH	PCAUTH				NS	F5	50	0.00	0.00	
	PORTMAP	PORTMAP	PMAP	STC09119	PORTMAP	WM	FF	111	0.00	0.00	
	RACF	RACF	RACF	STC09108	RACF	NS	FE	78	0.00	0.00	
	RASP	RASP				NS	FF	128	0.00	0.00	
	RXSERVE	RXSERVE	RXSERVE	STC09121	RXSERVE	WM	FF	146	0.00	0.00	
	SDSF	SDSF	SDSF	STC09115	++++++	NS	F5	57	0.00	0.00	
	SMF	SMF	IEFPROC			NS	FF	47	0.00	0.00	
	SMS	SMS	IEFPROC			NS	FE	183	0.00	0.00	
COMMAND INPUT ==>										SCROLL ==> CSR	
F1=HELP			F2=SPLIT		F3=END		F4=RETURN		F5=IFIND		F6=BOOK
F7=UP			F8=DOWN		F9=SWAP		F10=LEFT		F11=RIGHT		F12=RETRIEVE

Figure 52: Displaying the active users on OS/390

¹² Suggestion: Use the command line of the syslog panel.

On the WINDOWS2000-client queue manager it is only required to start the MMC Snap-In “MQSeries Services” and all services will start automatically. When choosing the queue manager TBUSSE.NACT the services with their status will displayed (Figure 46, page 124).

Now, both queue managers can be connected.

```

Display Filter View Print Options Help
-----
SDSF SYSLOG 9096.106 SYS1 SYS1 01/10/2004 LINE 27,613 COLUMNS 51 130
COMMAND INPUT ==> /!MQA1 DISPLAY DQM SCROLL ==> CSR
0090 CSQ9022I !MQA1 CSQNCDSP ' DISPLAY CMDSERV' NORMAL COMPLETION
0290 !MQA1 DISPLAY DQM
0090 CSQM137I !MQA1 CSQMDDQM DISPLAY DQM COMMAND ACCEPTED
0090 CSQX830I !MQA1 CSQXRDQM Channel initiator active
0090 CSQX845I !MQA1 CSQXRDQM TCP/IP system name is TCPIP
0090 CSQX846I !MQA1 CSQXRDQM TCP/IP listener started, for port number 1414
0090 CSQX849I !MQA1 CSQXRDQM LU 6.2 listener not started
0090 CSQX831I !MQA1 CSQXRDQM 8 adapter subtasks started, 8 requested
0090 CSQX832I !MQA1 CSQXRDQM 5 dispatchers started, 5 requested
0090 CSQX840I !MQA1 CSQXRDQM 2 channel connections current, maximum 200
0090 CSQX841I !MQA1 CSQXRDQM 0 channel connections active, maximum 200
0090 CSQX842I !MQA1 CSQXRDQM 0 channel connections starting, 123
0090 2 stopped, 0 retrying
0090 CSQ9022I !MQA1 CSQXCRPS ' DISPLAY DQM' NORMAL COMPLETION
DUMP DATA SETS AVAILABLE FOR DUMPID=012 BY JOB (CICSC001). USE THE DUMPDS COMMAN
DUMP DATA SETS AVAILABLE FOR DUMPID=011 BY JOB (DBA1DIST). USE THE DUMPDS COMMAN
S READY* IMS1
***** BOTTOM OF DATA *****
F1=HELP F2=SPLIT F3=END F4=RETURN F5=IFIND F6=BOOK
F7=UP F8=DOWN F9=SWAP F10=LEFT F11=RIGHT F12=RETRIEVE

```

Figure 53: Displaying the started MQSeries Services – Channel initiator and TCP/IP listener – 01

```

Display a System Function
-----
S | Display messages | Row 1 of 11 |
F | CSQX830I !MQA1 CSQXRDQM Channel initiator active |
  | CSQX845I !MQA1 CSQXRDQM TCP/IP system name is TCPIP |
  | CSQX846I !MQA1 CSQXRDQM TCP/IP listener started, for port number 1414 |
  | CSQX849I !MQA1 CSQXRDQM LU 6.2 listener not started |
  | CSQX831I !MQA1 CSQXRDQM 8 adapter subtasks started, 8 requested |
  | CSQX832I !MQA1 CSQXRDQM 5 dispatchers started, 5 requested |
  | CSQX840I !MQA1 CSQXRDQM 2 channel connections current, maximum 200 |
  | CSQX841I !MQA1 CSQXRDQM 0 channel connections active, maximum 200 |
  | CSQX842I !MQA1 CSQXRDQM 0 channel connections starting, |
  | 2 stopped, 0 retrying |
  | CSQ9022I !MQA1 CSQXCRPS ' DISPLAY DQM' NORMAL COMPLETION |
  | Command ==> |
  | F1=Help F2=Split F3=Exit F7=Bkwd F8=Fwd F9=Swap |
  | F12=Cancel |
-----
Command ==>
F1=Help F2=Split F3=Exit F9=Swap F10=Messages F12=Cancel

```

Figure 54: Displaying the started MQSeries Services – Channel initiator and TCP/IP listener – 02

5.7.2 Connecting the WINDOWS2000-client queue manager with the OS/390-server queue manager

After the “MQSeries Services” MMC has been confirmed that all the required services for the WINDOWS2000-client queue manager TBUSSE.NACT are activated it is switched to the MQSeries Explorer. A right mouse click on the channel sender TBUSSE.NACT.WIN.OS pops up a menu where the option *Start* has been chosen to start the channel sender (Figure 55). Be sure, that the IP-address has been set correctly (JEDI's one is always 139.18.4.97). After the *Start*-button is clicked, a message appears and informs that The request to start the channel was accepted (see Figure 56, next page). That does not imply that the channel sender is successfully connected to the OS/390-server queue manager. Only the green turned up arrow in front of the channel sender name shows whether the start command has been successfully executed or not (Figure 57, next page). If not, a red turned down arrow appears and the error has to be found, for example looking at the log for the queue manager.

The channel receiver is set active automatically when the WINDOWS2000-client queue manager is connected to the OS/390-server.

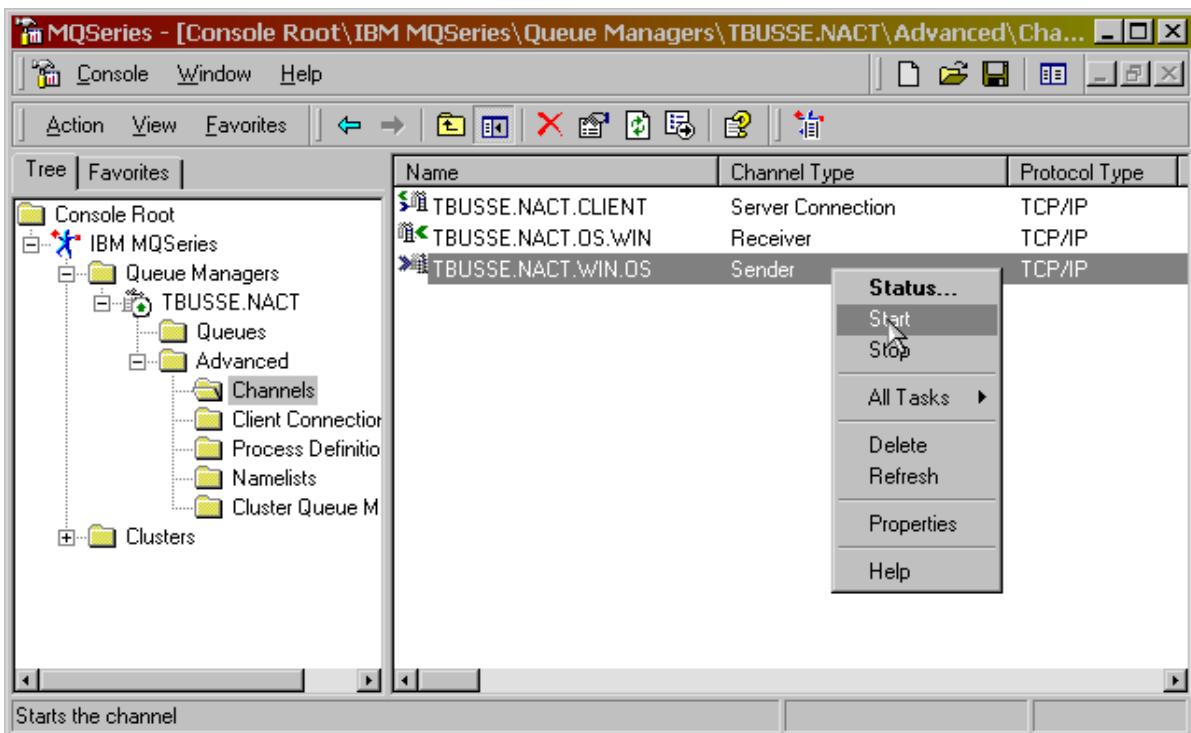


Figure 55: Starting the channel sender TBUSSE.NACT.WIN.OS

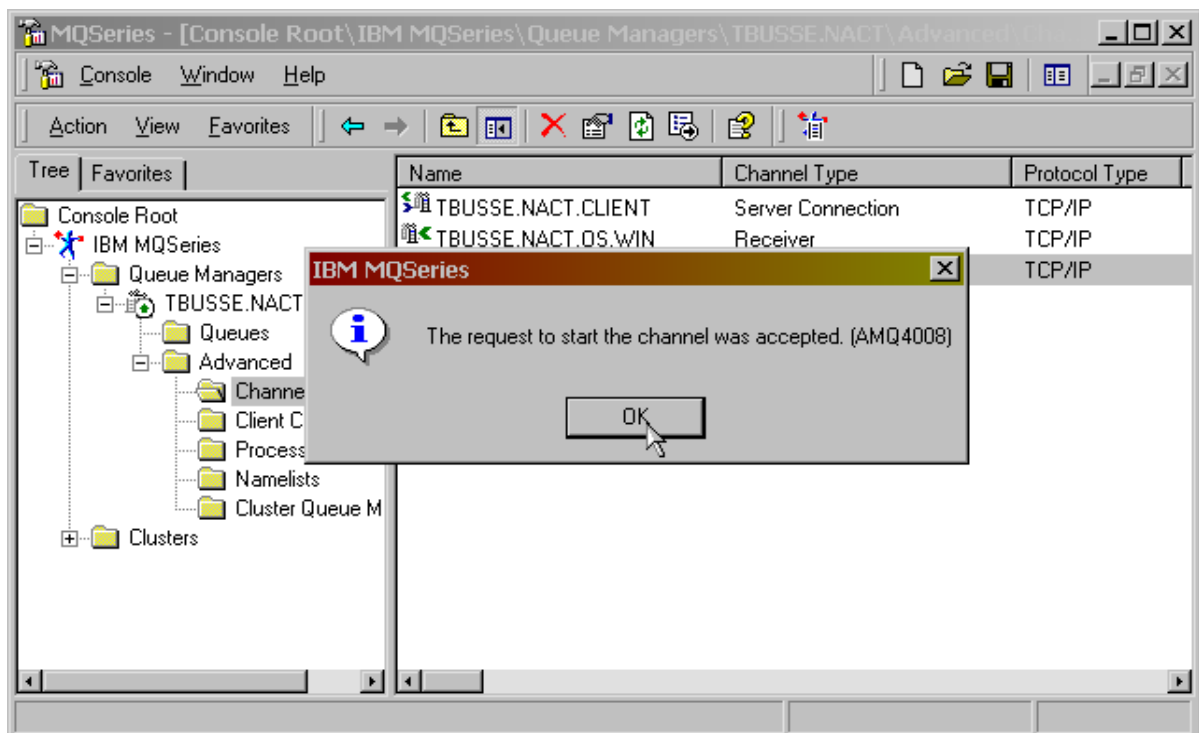


Figure 56: Message that the request to start the channel was accepted

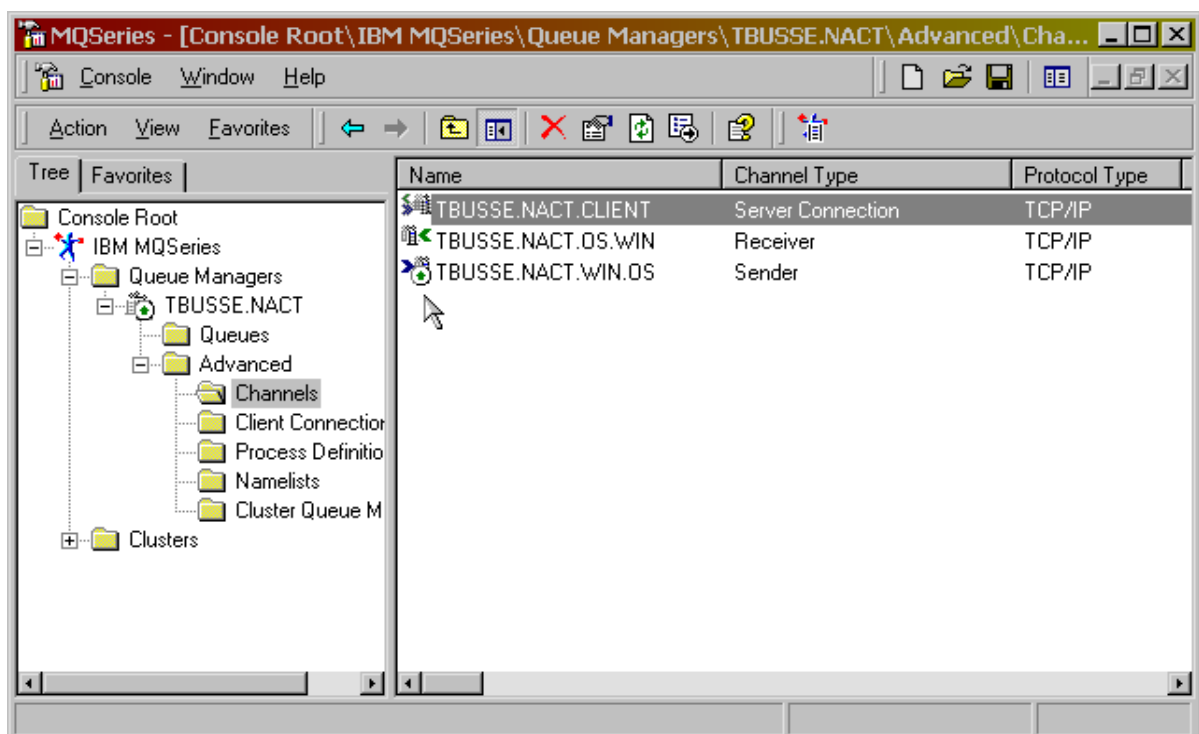


Figure 57: Channel was successfully connected to the server queue manager

5.7.3 Connecting the OS/390-server queue manager with the WINDOWS2000-client queue manager

After the channel sender of the WINDOWS2000 queue manager is started, the channel sender TBUSSE.NACT.OS.WIN of the OS/390-server queue manager has to be started and connected with WINDOWS2000. The channel sender is started from the MQSeries panel “List Channels”. This panel can be reached from the MQSeries MAIN MENU. On the field action *Display* (shortcut 2), on the field *Object type* the string *CHANNEL*, and on the field *Name* the string *T** have been entered. This panel is usually used to check the status of all channel objects of MQA1. As first, it can be seen, that the channel receiver TBUSSE.NACT.OS.WIN has been activated; in the column *Status* stands *RUN*. To start the channel sender the number 6 (shortcut for *Start*) is entered in front of the channel name (Figure 58, next page). If the IP-address of the WINDOWS2000-client has been changed during this set up, it has to be changed into the right one. If number 3 (shortcut for *Alter*) is keyed in, the channel can be altered. After modifying is done it is turned back to the panel “List Channels” (pressing PF12 instead of PF3) and the channel sender can be started. The next panel “Start a Channel” is only confirmed and immediately a message is shown that the channel sender is started:

```
CSQ9022I !MQA1 CSQXCRPS ' START CHANNEL ' NORMAL COMPLETION
```

Pressing PF12 leads back to the panel “List Channels” that displays the status of the channel objects. But, the status of the channel sender has not been changed into *RUN*. When pressing PF5, the screen is refreshed and the status of the channel changes into “RUN” (Figure 59, next page). The WINDOWS2000-client queue manager also displays that the response channel is activated. On WINDOWS2000 the Refresh Key (F5) has to be used to switch the status of the channel receiver. The green turned up arrow indicates that the receiver has been started (Figure 60, page 148).

After both queue managers are connected, the MQSeries CICS application MQNACT, as next and last step, are started.

List Channels				Row 1 of 2
Type action codes. Then press Enter.				
1=Display	2=Define like	3=Alter	4=Delete	5=Perform
6=Start	7=Stop			
6	Name	Type	Status	
	TBUSSE.NACT.OS.WIN	CHLSENDER	STOP	
-	TBUSSE.NACT.WIN.OS	CHLRECEIVER	RUN	
***** End of list *****				
Command ==> _____				
F1=Help	F2=Split	F3=Exit	F5=Refresh	F7=Bkwd
F9=Swap	F10=Messages	F11=Status	F12=Cancel	F8=Fwd

Figure 58: Connecting the channel sender with the client queue manager

List Channels				Row 1 of 2
Type action codes. Then press Enter.				
1=Display	2=Define like	3=Alter	4=Delete	5=Perform
6=Start	7=Stop			
	Name	Type	Status	
-	TBUSSE.NACT.OS.WIN	CHLSENDER	RUN	
-	TBUSSE.NACT.WIN.OS	CHLRECEIVER	RUN	
***** End of list *****				
Command ==> _____				
F1=Help	F2=Split	F3=Exit	F5=Refresh	F7=Bkwd
F9=Swap	F10=Messages	F11=Status	F12=Cancel	F8=Fwd

Figure 59: Channel status after pressed the refresh key

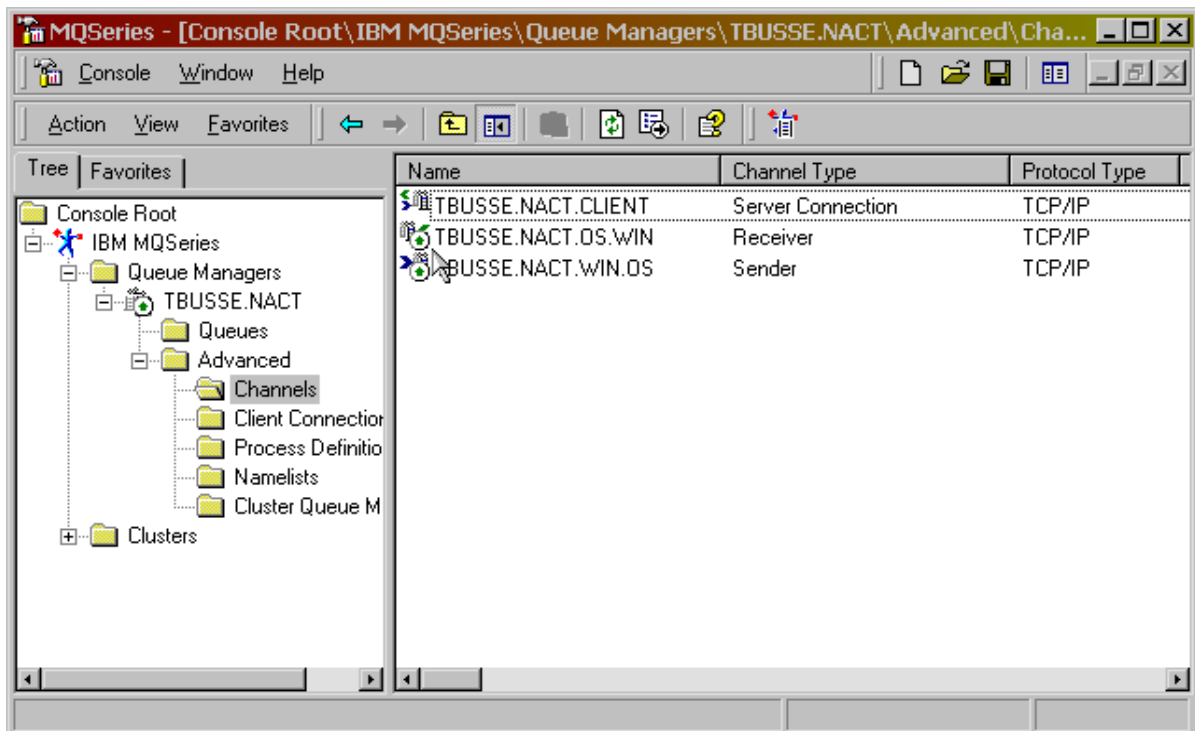


Figure 60: Channel receiver was activated after successful call from the server queue manager

5.8 Starting the JAVA application

After both – the request and response channels – have been created, which implies the connection of both queue managers, the MQSeries CICS application needs only to be started using this command on the DOS-console:

```
java MQClient <<WINDOWS-IP-ADDRESS>> <<server connection>>      +
<<queue manager>> <<remote queue definition>> <<reply-to queue>>
```

```
Example: java MQClient 80.135.228.155 TBUSSE.NACT.CLIENT          +
          TBUSSE.NACT TBUSSE.NACT.REMOTEQ TBUSSE.NACT.REPLYQ
```

This starts the JAVA interpreter to execute the code specified in the main-method of *MQClient.java*. When all parameters are transmitted, the connection to the WINDOWS2000-client queue manager is established and the screen “The Royal Bank of KanDoIT – Account Enquiry Client” appears. When a request on the account number 11100 is done, an application window like the Figure 61 appears. Synchronously, MQSeries status messages appear on the MS-DOS console (Figure 62, next page).

The screenshot shows a Java application window titled "The Royal Bank of KanDoIT - Account Enquiry Client". The window has a menu bar with "Actions" and "Help". Below the menu bar, there is a text input field for "Enter an Account Number:" with the value "11100" and a dropdown arrow. To the right of the input field is a small icon of a document with a magnifying glass. The main content area is divided into several sections:

- PERSONAL INFORMATION:** Fields for Title (Mr), Initial, First Name (TOBIAS), Surname (BUSSE), Street (MANSON STREET), Postcode (BN1 1BA), City (BRIGHTON), and Telephone (3419732211).
- ACCOUNT HISTORY:** A table with columns: Balance, Billed, Amount, Paid, and Amount. The table contains three rows of data, all showing 0.00 for Balance, Billed, and Paid, and 0.00 for Amount.
- CREDIT CARD DETAILS:** Fields for No. of Cards Issued (1), Date Card Issued (01-12-01), Reason for Card Issue (N), Card Code (G), Card Approved By (IBM), Special Codes (1, 2, 3), Account Status (N), and Credit Limit (1000.00).
- Additional Authorised Card User:** A list of names: FRAU ELSTER, RITTER RUNKEL, PITTIPLATSCH, and DIE DIGEDAGS.

Figure 61: The Royal Bank of KanDoIT – Account Enquiry Client

```

Java(TM) 2 Runtime Environment, Standard Edition (build 1.3.1_02-b02) - nact

E:\KanDoIT>java MQClient 80.135.244.189 TBUSSE.NACT.CLIENT TBUSSE.NACT TBUSSE.NA
CT.REMOTEQ TBUSSE.NACT.REPLYQ

Arguments:
IP-Address:      80.135.244.189
MQI-Cannel:     TBUSSE.NACT.CLIENT
Queue Manager:  TBUSSE.NACT
Remote Queue:   TBUSSE.NACT.REMOTEQ
Reply-To Queue: TBUSSE.NACT.REPLYQ

*** MQSeries Server for Windows2000 - Status Messages ***
>MQStatus: Connected to QManager TBUSSE.NACT
>MQStatus: MQMessage created
>MQStatus: Message placed on queue
>MQStatus: Message ID for sent message: [B04b52ae
>MQStatus: Correlation ID stored: [B04b52ae
>MQStatus: Waiting for a reply message...
>MQStatus: Current Msg ID used for receive: [B068c26c
>MQStatus: Correlation ID to use for receive: [B04b52ae
>MQStatus: Supported character set to use for receive: 0
>MQStatus: The receive message character set is: 819
>MQStatus: The message length is: 408
>MQStatus: Following message has been passed:

NACT02 U1AE0000000000153811100BUSSE          TOBIAS          Mr  3419732211MANSO
N STREET          BN1 1BA          BRIGHTON          FRAU ELSTER

      DIE DIGEDACS          1011201NGIBM123N  1000.00  0.00000000  0.
00000000  0.00  0.00000000  0.00000000  0.00  0.00000000  0.00000000
0.00

>CICS response code is: 0000
>CICS reason code is:  0000
>History balance:      0.00
  
```

Figure 62: The output messages on the DOS-console

5.9 Terminating the connection between the MQSeries servers

In case the connection between the both queue managers is terminated after the MQSeries CICS application MQNACT was closed, both channel senders need to be stopped. For stopping the channel sender of the OS/390-server queue manager switch, the MQSeries “*List Channels*” panel is to be opened on OS/390. Choosing option number 7 and filling it into the input field before the name of the channel sender (Figure 63) and pressing Enter opens the “Stop a Channel” panel. In this panel choose one of the two stop modes, press Enter and an information message confirms the termination. Returning to the “*List Channels*” panel and pressing PF5 refreshes the panel and the status of the channel sender switches to “STOP” (Figure 64, next page).

On the WINDOWS2000 client queue manager the channel sender is stopped when a right mouse click on this object is performed and the option “STOP” is chosen (Figure 65, next page). As next, a “*Stop a Channel*” panel opens and clicking on “Yes” stops the channel. In case, a force interrupt is wanted, choose the associated option and click on “Yes” (Figure 66, page 153). An information message appears and the green turned up arrow of the channel sender switches into a red one. The connection between both queue managers is now terminated.

If wanted, both queue managers can also be stopped, but consider, that both queue managers run on a MQSeries server. How to stop the queue manager on OS/390 is described in chapter 5.4.1 “The OS/390-server queue manager MQA1” on page 96. The WINDOWS2000-client queue manager is stopped with a right mouse click on the queue manager name and choosing “STOP” (Figure 67, page 153). The “End Queue Manager” panel opens to choose a controlled or immediate shutdown (Figure 68, page 154). Again, the green turned up arrow of the WINDOWS2000-client queue manager switches into a red one.

List Channels				Row 1 of 2	
Type action codes. Then press Enter.					
1=Display	2=Define like	3=Alter	4=Delete	5=Perform	
6=Start	7=Stop				
7	Name	Type	Status		
—	TBUSSE.NACT.OS.WIN	CHLSENDER	RUN		
—	TBUSSE.NACT.WIN.OS	CHLRECEIVER	RUN		
***** End of list *****					
Command ==>					
F1=Help	F2=Split	F3=Exit	F5=Refresh	F7=Bkwd	F8=Fwd
F9=Swap	F10=Messages	F11=Status	F12=Cancel		

Figure 63: List Channels panel – Stopping a channel sender of the OS/390-server queue manager

List Channels		Row 1 of 2
Type action codes. Then press Enter.		
1=Display	2=Define like	3=Alter
4=Delete	5=Perform	
6=Start	7=Stop	
Name	Type	Status
— TBUSSE.NACT.OS.WIN	CHLSENDER	STOP
— TBUSSE.NACT.WIN.OS	CHLRECEIVER	RUN
***** End of list *****		
Command ==> _____		
F1=Help	F2=Split	F3=Exit
F9=Swap	F10=Messages	F11=Status
	F5=Refresh	F12=Cancel
	F7=Bkwd	F8=Fwd

Figure 64: List Channels panel – Channel sender is stopped

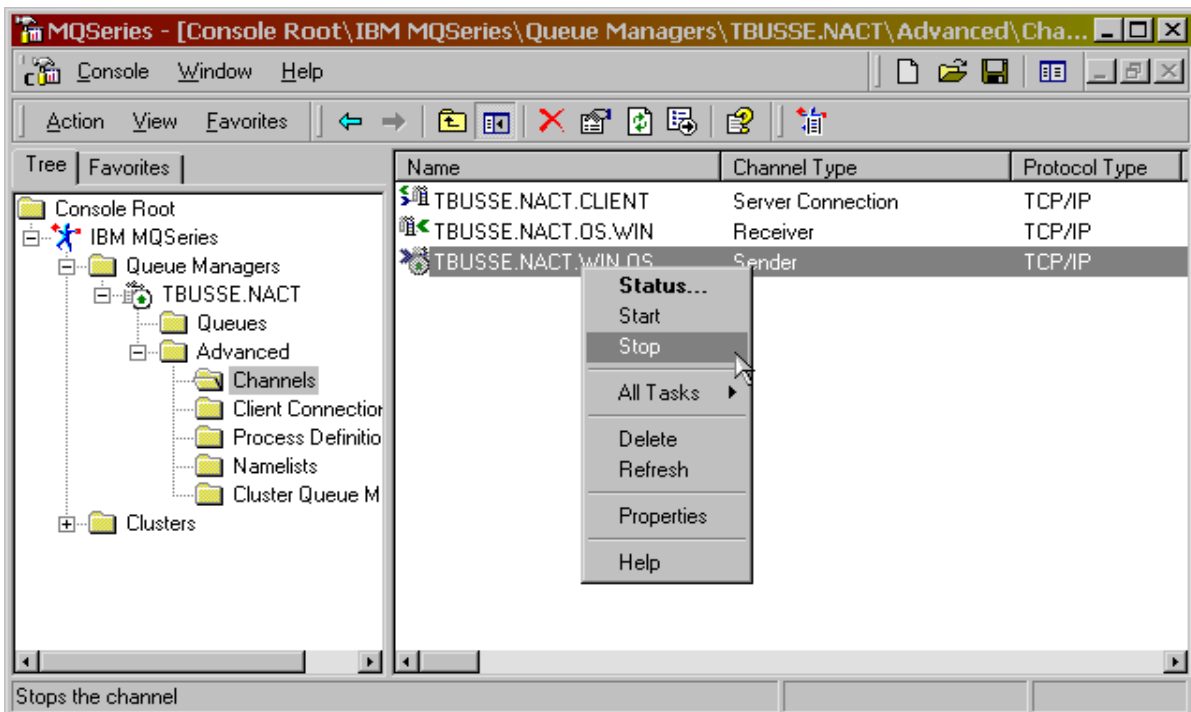


Figure 65: Stopping the channel sender on the WINDOWS2000 client queue manager

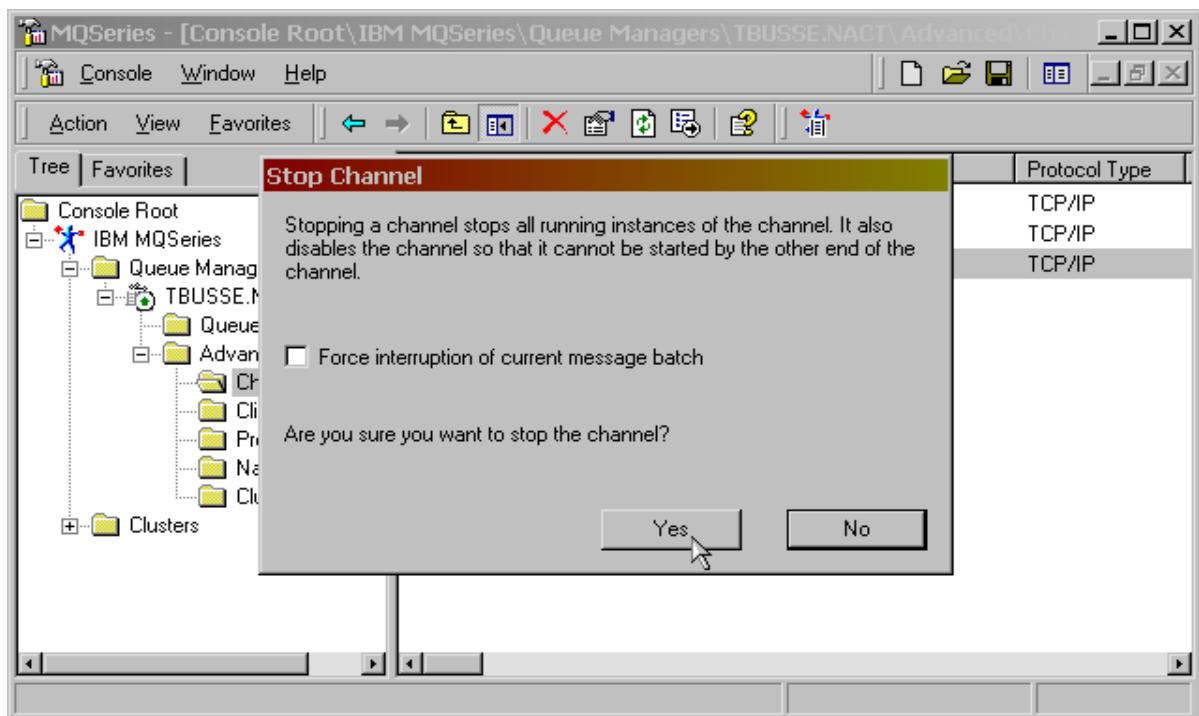


Figure 66: Stopping the channel sender on the WINDOWS2000 client queue manager

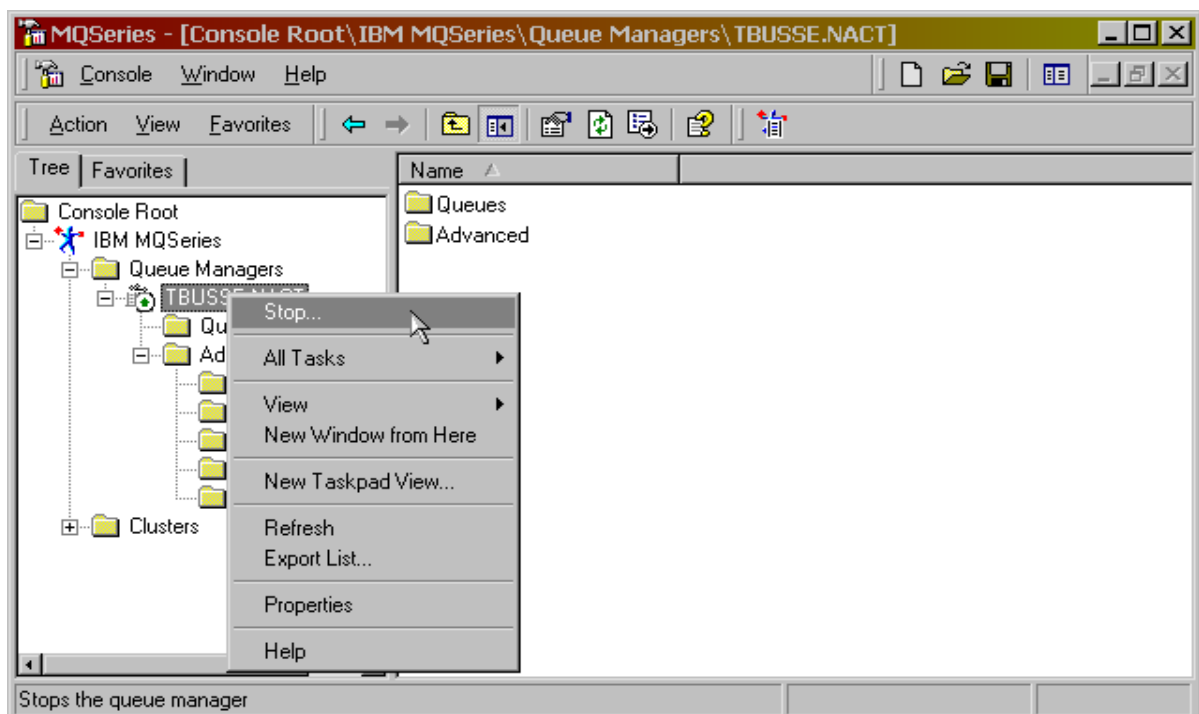


Figure 67: Stopping the channel sender on the WINDOWS2000 client queue manager

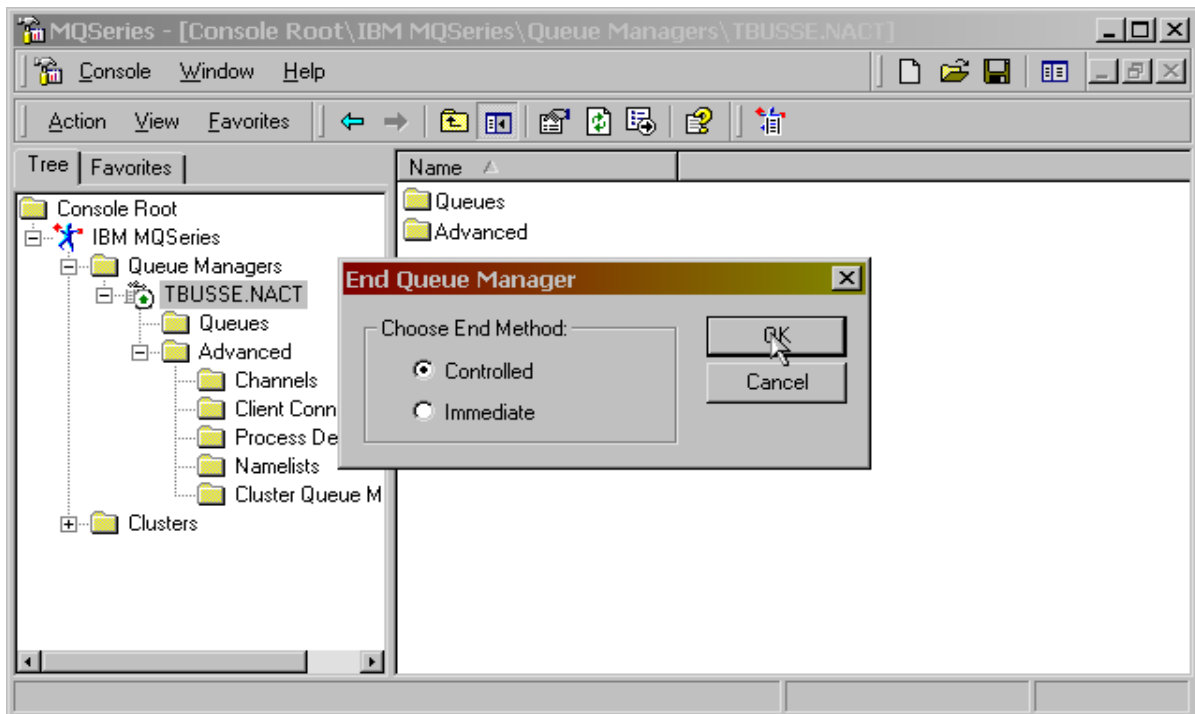


Figure 68: Stopping the channel sender on the WINDOWS2000 client queue manager

5.10 Common MQSeries problems indicated due to this thesis

5.10.1 Ghost channel connections on the OS/390-server queue manager

When a network outage occurs the channel receiver is often unaware of this and remains running even though the channel sender is retrying. When connected both queue managers again, the channel sender attempts to start a new receiver instance to OS/390 and sets its status, for example, to “2 RUN” because it does not detect the communication failure (Figure 69). That means, the more active connections are lost and reactivated the more channel receivers are activated when connected again. MQSeries believes that there has been an invalid attempt to start multiple instances of the same channel receiver, from the same channel sender and location, and accordingly treats this as an error, and fails the request. However, the communication behaves in a strange manner because sometimes the request is well done whereas in other situations the request fails.

List Channels

Row 1 of 2

Type action codes. Then press Enter.

1=Display

2=Define like

3=Alter

4=Delete

5=Perform

6=Start

7=Stop

Name

TBUSSE.NACT.OS.WIN

TBUSSE.NACT.WIN.OS

Type

CHLSENDER

CHLRECEIVER

Status

RUN

2 RUN

***** End of list *****

Command ==>

F1=Help

F2=Split

F3=Exit

F5=Refresh

F7=Bkwd

F8=Fwd

F9=Swap

F10=Messages

F11=Status

F12=Cancel

Figure 69: List Channels panel – Ghost connection

This misfeature is known by IBM and is remedied by a Program Temporary Fix (ptf). Every time a customer reports a problem, IBM creates a report called Authorized Program Analysis Report (APAR). The APAR PQ34355¹³ documents a requirement for the channel receivers of MQSeries in OS/390 to behave differently after a network outage. Within this document it is suggested to download the PTF UQ40939 to install two new functions to MQSeries – AdoptMCA and AdoptCH. Within AdoptMCA an orphaned instance of a channel connection can be automatically stopped. This PTF is also included in the IBM Corrective Service Package 39075476¹⁴,

¹³ Information about the APAR PQ34355 to download the PTF UQ40939 can be found at:
<http://www-306.ibm.com/software/integration/mqfamily/support/apars/mvs210cl.html>
 or browse the CD (includes the PTF): \additions\OS390\MQSeries_v2.1\apar\PQ34355

¹⁴ The IBM Corrective Service Package COER390754765 can be found on the CD at:

a full repository of all required updates until January 2003. However, this package is no more available at IBM, but included on the CD. Unfortunately, this update has not been installed on OS/390 because this must be done with the SMP/E product. However, this was not part of this master thesis. Managing SMP/E should be handled in future.

When such a failure occurs, simply terminate the channel initiator and restart it again using the MQSeries panels or the command line of the SD-panels as described in chapter 5.4.1 “The OS/390-server queue manager MQA1” on page 96.

5.10.2 Resetting channel in-doubt status – The message sequence error

Sometimes, the channel sender cannot communicate with the channel receiver due to a message sequence failure. In that case, MQSeries fails to deliver the message and sets the transmission queue to GET disabled. The OS/390 syslog and the MQSeries log on OS/390 notes following message due to this error:

```
+CSQX526E !MQA1 CSQXRCTL Message sequence error for TBUSSE.NACT.OS.WIN,  
sent=1 expected=904  
+CSQX506E !MQA1 CSQXRCTL Message receipt confirmation not received for  
TBUSSE.NACT.OS.WIN
```

On the WINDOWS2000-client such MQSeries messages are recorded in the log *AMQERR01.LOG* usually stored in the folder “*MQSeries_home\Qmgrs\TBUSSE\NACT\errors*”, where *MQSeries_home* is the high-level qualifier of the folder where MQSeries has been installed, and where *TBUSSE\NACT* is the name of the queue manager. The message written in the log due to the message sequence failure reads as:

```
03/18/2004 11:25:33  
AMQ9526: Message sequence number error for channel 'TBUSSE.NACT.OS.WIN'.
```

This misfeature can be remedied when the sequence number of the channels sender is reset. On OS/390 open the MQSeries “*List Channels*” panel and choose number 5 to execute the *Perform* operation (Figure 70, next page). After the Enter was pressed, the “*Perform a Channel Function*” appears. Number 1 has to be chosen to re-set the message sequence number (Figure 71, next page).

The channel sender on the WINDOWS2000-client queue manager is reset as it is shown in (Figure 72, page 158).

List Channels				Row 1 of 2	
Type action codes. Then press Enter.					
1=Display 2=Define like 3=Alter 4=Delete 5=Perform					
6=Start 7=Stop					
	Name		Type	Status	
5	TBUSSE.NACT.OS.WIN		CHLSENDER	RUN	
-	TBUSSE.NACT.WIN.OS		CHLRECEIVER	RUN	
***** End of list *****					
Command ==>					
F1=Help	F2=Split	F3=Exit	F5=Refresh	F7=Bkwd	F8=Fwd
F9=Swap	F10=Messages	F11=Status	F12=Cancel		

Figure 70: List Channels panel – List Channels panel – Perform a function

Perform a Channel Function	
select function type, complete fields, then press Enter.	
Function type 1	1. Reset sequence number 2. Ping 3. Resolve with commit 4. Resolve with backout
Channel name	TBUSSE.NACT.OS.WIN
Channel type	CHLSENDER
Description	CHANNEL FOR THE XMITQ TO SEND THE RESPONSE MESSAGES
Reset	
Sequence number 1	1 - 999999999
Ping	
Data length 16	16 - 32768
Command ==>	
F1=Help	F2=Split F3=Exit F9=Swap F10=Messages F12=Cancel

Figure 71: List Channels panel – Perform a Channel Function panel – Reset message sequence number

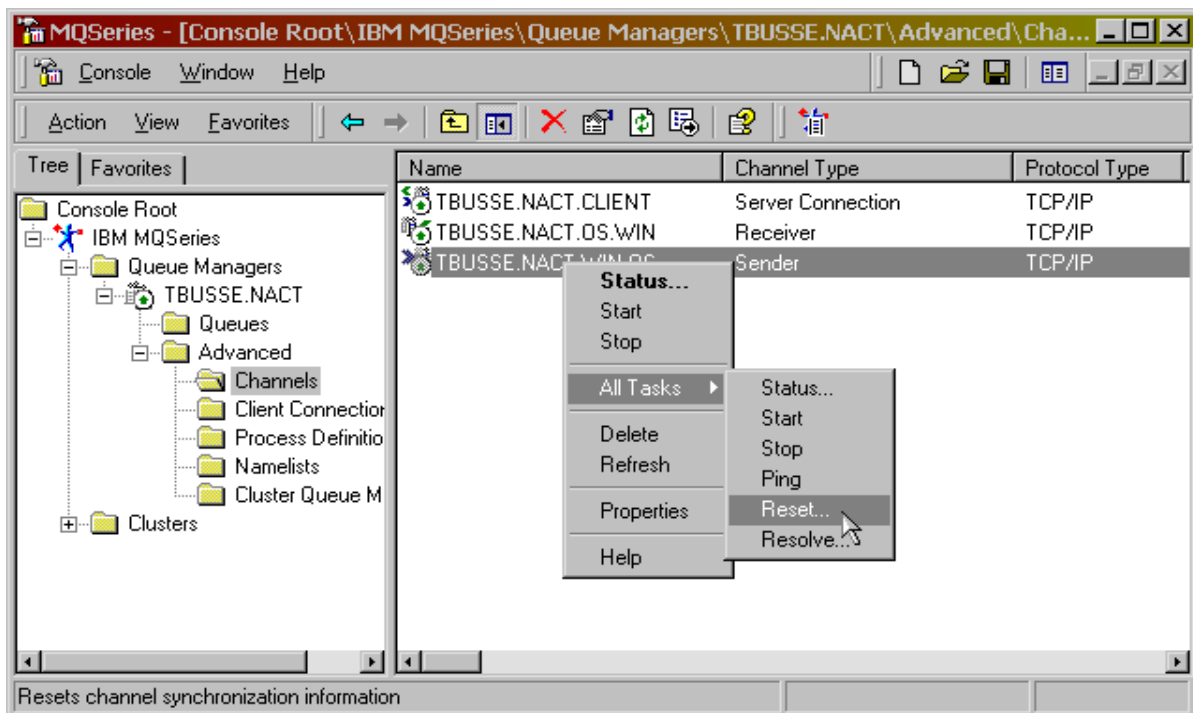


Figure 72: MQSeries for WINDOWS2000 – Reset the message sequence number

6 SECURING CICS WITH RACF

6.1 Introduction

During the installation of some CICS objects used for the two business applications NACT and MQNACT it is necessary to access the CICS region. Unfortunately, the CICS subsystem on the JEDI OS/390-server has not been protected by a security manager at this time. However, with the rise of more and more users who have to use this transaction monitor on the JEDI OS/390-server, securing the access to it is a really important feature. Without securing, each user could access CICS without logging on to the system, shut down the subsystem, change CICS-specific options, and change, discard, or delete all resources defined to the subsystem. All things considered, the user would have the full control of CICS. Since, this is intolerable access restriction to any CICS region is a must have. This part of the master thesis describes how to establish a standard CICS security management on the JEDI OS/390-server after CICS has been installed and configured. When the CICS security is installed, any user may log on to CICS and may only execute allowed CICS transactions and CICS commands on behalf of the associated security profile. Any access to unauthorised data is forbidden and recorded to a log journal, too.

CICS itself has no own security mechanism. Controlling, restricting, revoking, and resuming the access to any subsystem on an OS/390-server is done by the OS/390 security mechanism System Authorisation Facility (SAF). All incoming authorisation requests are sent from SAF to an External Security Manager (ESM), such as IBM's product RACF. This is the IBM security management product for OS/390 and VM. In 1976, the first release of RACF for MVS and VM has been shipped as a stand-alone version. Since march 1996, RACF is included as part of the OS/390 Security Server, later known as SecureWay Security Server for OS/390. This platform includes RACF, the DCE Security Server, OS/390 Firewall Technologies, and the LDAP Server. The JEDI OS/390-server runs RACF Version 2 Release 6¹⁵.

RACF is running like a CICS subsystem or an MQSeries queue manager in its own address space resp. region in the OS/390 kernel. Any security decision is routed from the resource manager (e.g. CICS) with the help of the system service SAF to the RACF router to invoke the correct RACF function calling the RACF database (Figure 73, next page). Hence, SAF acts primarily as a router facility (also called the OS/390 router). The resource manager gets a message back from RACF and due to this message it makes the decision. This security processing is controlled by the RACROUTE macro (Figure 73). The OS/390 router is present on all OS/390-systems even if RACF is not installed. In that case, an installation-supplied security-processing exit (equivalent to the OS/390

¹⁵ Hint: There is recorded the identifier “*HRF226*” in the OS/390-syslog during an IPL. This refers to the RACF Version 2 Release 6. For name conventions of these identifiers belonging to RACF versions refer to [HEN03].

router) can call another ESM (Figure 73). Such well known alternatives to RACF are Computer Associates CA-ACF2 for OS/390 (now: eTrust ACF2 Security for z/OS and OS/390), and CA-Top Secret for OS/390 (now: eTrust CA-Top Secret Security for z/OS and OS/390). In the latest operating system z/OS, IBM has excluded the RACROUTE macro to replace it by providing callable services written in the most common programming languages. Further descriptions of the security concept of the Operating System/390 can be found in [GUS01], [HK-S04], and [RSG03].

The next sections gives a short explanation of the RACF principles and how to invoke its services to show that securing CICS relies on a number of facilities provided by RACF. Securing a resource manager like a CICS region by RACF can be done in phases to have a up-to-date secured system at the required level. Firstly, the **CICS Region User ID (CRU)** is set up to allow the CICS subsystem an access to other subsystems on the OS/390-server. The **Default CICS User ID (DCU)** is defined to give, for example, all users a simple access to the CICS region as same as giving applications access to the CICS region. For programs that are executed during the CICS system initialisation an own user ID called the **PLTPI User ID (PLTPIU)** has been created. Further and as an important part, it is described how to define security profiles for the resources of the CICS region to give each CICS user an appropriate access to them. Last but not least, it is described how the CICS login terminal accepts not only the upper case characters.

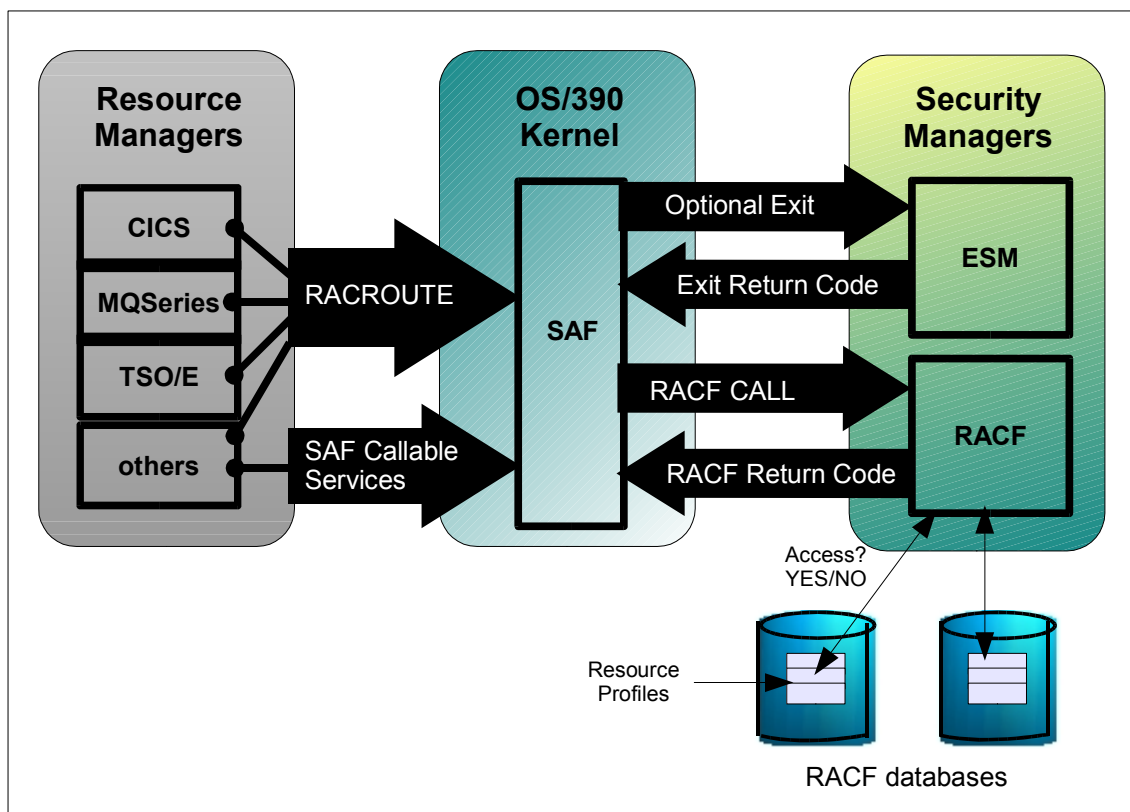


Figure 73: System Authorisation Facility (SAF)

6.2 RACF Topics

6.2.1 RACF mechanisms

The approach of RACF to data security is to provide an effective user verification, resource authorisation, and logging capabilities. Each component of the operating system and users like system administrators can invoke the services of RACF.

The concept of the **user accountability** is one of the prime security objectives RACF supports. IBM uses the word “user” in context to human users who work with the system through a terminal and in context to components which access RACF-protected resources in the same way as a user. Such a component could be a subsystem running on OS/390 like CICS or IMS, a machine like a printer which executes an output, or an application which reads, changes, or deletes data. Both the human user and the system component have an assigned user identification (user ID) and usually a password to access the called resources. Each user ID may be created to RACF only once. With it the user can access different subsystems, for example TSO/E or CICS, or a subsystem can access another subsystem. RACF stores the access information about the permission a user has to a demanded subsystem.

To simplify the maintenance of the system access, users are organised very flexible in groups. Each user must be connected to minimal one group and can be connected to any number of groups. The authority assigned to the group can be used to give one or more permissions for all users defined in the group and to supervise the user activity. Such a RACF group could be pointed for example to a department, project, number of applications, or to administrators, data controllers, trainees, or secretaries, and so on. There is one superior or owning group to every group – the system supplied SYS1 group. Each user or group defined to RACF is linked with the group SYS1 in any way. This relationship can be sketched very good in a tree diagram.

For each user and group RACF builds profiles and stores them in its own database. These profiles consist of one or more segments. The first or basic segment is always the RACF segment to both the user and group profile. It contains RACF specific user resp. group information. The RACF segment is subdivided into a few divisions. This could be in a user profile the user identification, the owner of the user profile, user attributes, the groups associated with the user, or additional installed security classifications. The RACF segment of the group profile stores information about the owner of the group profile, the superior group, subgroups if exist, and connected users.

User attributes are one of the importing RACF segment information in a user profile. It is differentiated with respect to user attributes and to group-related user attributes. A user attribute applies all of the time and is specified at the system level. In contrast to that, a group-related user attribute applies to a specified group or groups and is specified at the group level. User attributes can be used to administrate RACF centralised or decentralised. Centralised administration refers to the resources and functions controlled by users system-wide. Such a user has for example the user attribute SPECIAL. With it the user can modify all entries in the RACF database and may

perform all RACF functions, except auditing-related commands, on the scope of the system. That is why it is also called the system-SPECIAL user attribute. Contrary, the decentralised administration refers to all users who have a group-related user attribute. They can manage the authority in the scope of the groups to which they are connected. For instance, one user has the group-SPECIAL user attribute within her/his connected groups she/he is able to use the same RACF commands a user with the system-SPECIAL user attribute can use. User attributes that also can be assigned to the system or group level are the AUDITOR, OPERATIONS, ADSP and REVOKE attributes. In contrast to those user attributes the CLAUTH user attribute is not assigned to the group level, it is assigned only to users who defines and modifies profiles in general resource classes. The administrator who wants to enable CICS security to a CICS region must have the system-SPECIAL user attribute.

Beside the basic RACF segment there could be defined some more segments to a user/group profile. They can contain user resp. group information for another secured and activated subsystem on the OS/390-server. For a user and for a group there can be defined same segments, but the user profile can obtain a few more segments. A segment created to both is the OMVS segment. It specifies information about the OS/390 UNIX subsystem. The CICS segment, containing CICS terminal user data, is only defined to the user profile. It is not necessary to define an appendant segment in a profile to use a resource. RACF will take the default built-in system values. If required, in case of future demands, a non-activated segment can be added to a profile later.

Resource authorisation provides access control to the OS/390-components and their associated data. Access control is the process of determining who – the user – has access to what – the protected resource. At the end of a security request sent to the resource manager an access control decision is delivered back. Immediately, the manager allows or denies the access to the demanded resource. Each access control decision depends on transmitted factors to determine which access to the resource is demanded. Should have the user a read access to get information about the resource, or may he modify, execute, or delete resp. remove the resource? May the user access the resource on the date he wants the access?

Referring to a subsystem installed on OS/390, an access request to a resource is always sent first to a security manager, in this case RACF. The security manager identifies and authenticates the originator of the access request. It does not matter whether a system or a user-implemented resource is accessed. RACF protects such resources with resource security profiles, in which all the required information to access that resource is stored. For example, the access list of such a profile lists the users resp. groups with their authority to access the resource. Following authorisation levels are valid in an access list, specified from the highest security level to the lowest: ALTER, CONTROL, UPDATE, READ, EXECUTE, NONE (refer to Table 10 on page 166). In addition to own defined access rights the user gets the same rights the group has as long as he is connected to the group. If the user has no own access list he inherits the rights to access a resource from the connected group or groups.

Furthermore, RACF is able to **log** any security-related event and informs the associated user about the event. Consequently, RACF is used by security administrators, auditors, storage administrators, TSO, SDSF and CICS administrators, management and others, if the assigned access level permits the use. An administrator must have

the **SPECIAL** attribute, whereas the user attributes **AUDITOR** or **OPERATIONS** should only be assigned to those users who monitor RACF.

More information about the authorities required to control RACF and to work with CICS is given in the books [RAG98], [RUG98], and in the paper [GUS01].

6.2.2 RACF commands

Managing the RACF database means adding resource security profiles to and deleting these from the database, as same as modifying and listing them. These functions are started by RACF commands entered on the command line or started within special RACF panels. On the ISPF/PDF application panels the commands can be typed-in on the command panel. This panel can be reached when **P. 6** is entered in the **OPTION** line of the CMAM. RACF commands can also be executed from the TSO/E command line everywhere where this line turns up, for example in the SDSF application. However, it is noticed, that the system prefix **/** must be written in front of the commands (refer also to footnote 10 on page 96). A better and common way is to build command scripts called TSO/E CLISTS¹⁶, that include the RACF commands, in particular to summarise RACF commands.

Table 8 on the next page lists the special commands to list, add, change, or delete profiles to or from the RACF database. Within the table there are also listed commands to connect resp. remove users to or from groups. An access for a user/group to data sets resp. general resources is given with the RACF command **PERMIT**. The RACF command **PASSWORD** is used to change or reset the user's password, or to change the password interval. With the command **SEARCH** it is possible to search the RACF database for data set and general resource profiles. Setting RACF options is done by the command **SETROPTS**.

The command **HELP** displays information about the function, syntax, and operands of RACF commands. The RACF command **DISPLAY** is only available for users/groups having the **OPERATOR** attribute. It displays information held in the signed-on-from list. Entries in the signed-on-from list possess user IDs, groups, APPLs (the names of the local Logical Units (LU) from which the user is signed on), POEs (the names of the partner LUs from which the user is signed on), and SECLABEL (security labels to search for). There are a few more not so important RACF commands, for a complete list refer to [RCR98].

However, the most important command is **RVARY** which activates resp. deactivates RACF databases and hence, RACF, too. The command **RVARY LIST** displays all currently activated RACF databases on the OS/390-server. On the JEDI OS/390-server only one active RACF database is stored in the sequential data set **SYS1.RACF** on the volume **DAVS7A**. When the command **RVARY LIST** is executed on the JEDI OS/390-server following information is displayed:

ICH15013I	RACF	DATABASE	STATUS:	
ACTIVE	USE	NUMBER	VOLUME	DATASET
----	---	-----	-----	-----
YES	PRIM	1	DAVS7A	SYS1.RACF

¹⁶ Speak: "Cee lists".

	USERS	GROUPS	DATA SET	GENERAL RESOURCES
LIST	LISTUSER (LU)	LISTGRP (LG)	LISTDSD (LD)	RLIST (RL)
ADD	ADDUSER (AU)	ADDGROUP (AG)	ADDSD (AD)	RDEFINE (RDEF)
CHANGE	ALTUSER (ALU)	ALTGROUP (ALG)	ALTDSD (ALD)	RALTER (RALT)
DELETE	DELUSER (DU)	DELGROUP (DG)	DELDSD (DD)	RDELETE (RDEL)
	CONNECT (CO)			
	REMOVE (RE)			
			PERMIT (PE)	
	SEARCH (SR)			
	RVARY			
	SETROPTS (SETR)			
	HELP			
	DISPLAY			

Table 8: RACF commands

```
ICH15020I RVARY COMMAND HAS FINISHED PROCESSING.
```

6.2.3 Data set and general resource profiles

CICS resources are subdivided into general resources and data sets. Data sets can be installed and created on hard disk drives like a DASD or on tape volumes. Indeed, DASDs and tape volumes are general resources. For instance, the following resources are also general resources: load modules (programs), terminals (VTAM), application resources (such as resources for IMS, CICS, and DB2), and other installation-defined-resources. For each CICS resource there can be created a security profile protected by RACF. This resource profile is stored in a profile class which is listed in the class descriptor table (CDT). CICS resource profiles can be organised in groups to simplify the maintenance of the RACF database.

CICS resource profiles can be classified into generic and discrete profiles. Generic profiles protect several data sets resp. resources with one profile. RACF detects these profiles by substitute characters: the percent character (%) stands for exact one character, the asterisk character (*) stands for any character string in 1 qualifier, and the double asterisk character (**) is for any character string in n-qualifier. It is noticed, that Enhanced Generic Naming (EGN) has to be in effect to create generic data set profiles, for general resource profiles EGN is always in effect. *EGN* for data set profiles is activated when the RACF command *SETROPTS (SETR)* is executed:

```
SETROPTS EGN
```

Discrete profiles may not have any substitute token, they always identify the whole data set. However, such profiles should not be used because of their disadvantages in protecting each data set with an own profile. This results in reducing the number of profiles needed to protect data sets, and in reducing the size of the RACF database by using generic data set profiles.

Furthermore, RACF distinguishes also between two other types of CICS resource profiles – profiles for user data sets/single general resources, and profiles for group data sets/group of profiles. Each data set profile has to be associated with an own RACF user/group ID – the profiles for user data sets with a RACF user ID and the profiles for group data sets with a RACF group that has the same name as the data set's high-level qualifier name. All data set profiles have to be stored in the RACF profile class DATASET. There have to be created data set profiles for the CICS transaction server install data set and for each CICS region data set. Usually they are defined as generic data set profiles.

General resource profiles for CICS are managed in a set of IBM-supplied resource classes for CICS, in own defined resource classes, and in IBM-supplied RACF general resource classes affecting CICS. The default resource classes for CICS can protect several resources stored in a member resource class as same as a group of resources stored in a group resource class. Table 9 on the next page gives an overview of the IBM-supplied CICS resource class names.

There have been defined general resource profiles for CICS transactions and CICS commands for the CICS region A06C001 of the JEDI OS/390-server. For instance, several CICS transactions (e.g. the business transaction NACT) have been secured using the member resource class TCICSTRN whereas CICS transactions listed in groups (e.g. CICS system transactions) have been protected using the resource class GCICSTRN. How to enable the CICS transaction and the CICS command security and how to define profiles for their associated resource classes is described in chapter 6.4 “Securing the resources for the CICS region A06C001” on page 185.

Following IBM-supplied RACF resource classes affect CICS: APPCLU, **APPL**, CONSOLE, DIGTCERT, **FACILITY**, FIELD, LOGSTRM, OPERCMDS, PROPCNTL, PTKTDATA, RACFVARS, RACGLIST, **STARTED**, SUBSYSNM, SURROGAT, TERMINAL, and VTAMAPPL. How to use the class names that are formatted bold is explained in the next chapters. For example, within the resource class APPL there are defined security profiles to control the terminal user access to a CICS region (refer to chapter 6.5 “Authorising access to the CICS region” on page 205). Data set and general resource profiles consist of authority levels to decide which protected CICS resource the RACF-users resp. RACF-groups can access in which way (Table 10, next page).

Class name	Type	Protect these resources:
TCICSTRN GCICSTRN	Member Group	CICS transactions
GCICSCMD VCICSCMD	Member Group	CICS system commands & CICS FEPI system commands

ACICSPCT BCICSPCT	Member Group	CICS transactions started with the EXEC CICS START command (known as started transactions) & following CICS commands: COLLECT STATISTICS TRANSACTION DISCARD TRANSACTION INQUIRE TRANSACTION SET TRANSACTION INQUIRE REQID CANCEL
FCICSFCT HCICSFCT	Member Group	CICS files
MCICSPPT NCICSPPT	Member Group	CICS programs
PCICSPSB QCICSPSB	Member Group	CICS DL/I Program Specification Blocks (PSBs) for IMS
JCICSJCT KCICSJCT	Member Group	CICS journals and log streams
SCICSTST UCICSTST	Member Group	CICS temporary storage queues
DCICSDCT ECICSDCT	Member Group	CICS transient data queues

Table 9: RACF commands

Authorisation	Description
ALTER	Full access to data set/general resource (profile is also accessible) Allowing access for other users/groups to the data set/general resource Add and delete data sets/general resources
CONTROL	Used only for VSAM-data protecting mechanism (only data set) User/group can modify the VSAM file
UPDATE	User/group can modify the data set/general resource Data set: User/group can delete PDSs User/group cannot modify a VSAM file
READ	User/group can read the data set/general resource, and can print and copy the data set
EXECUTE	User/group can execute predefined programs (only data set)
NONE	User/group has no access to data set/general resource

Table 10: Authorisation Levels

A general resource class must be activated first before the general resource profiles can be used by RACF. The RACF-command *SETROPTS CLASSACT* activates such classes stored in the CDT. Usually, each RACF resource class needs to be activated separately. In case, a few general resource classes have the same position number (POSIT-number) in their CDT definitions only one resource class out of them needs to be activated. For example, all the CICS general resource classes have the same POSIT-number in their CDT definitions. It is noticed, that the group resource classes cannot be activated because they are managed by the member resource class:

```
SETROPTS CLASSACT(class_name)
```

Example: SETROPTS CLASSACT(TCICSTRN)

The command *SETROPTS NOCLASSACT* deactivates any protection for the profiles of the general resource class. However, when using this command the class is not deleted:

SETROPTS NOCLASSACT(*class_name*)

Example: SETROPTS NOCLASSACT(TCICSTRN)

Although, EGN is active for general resource resp. data set profile names, their associated profile classes need also to be set up to store such generic profiles with the command *SETROPTS GENERIC* (*Example 1*). Each class that stores generic profiles has to be refreshed after a new generic profile has been added to the class as *Example 2* shows:

SETROPTS GENERIC(*class_name*) [REFRESH]

Example 1: SETROPTS GENERIC(DATASET)

Example 2: SETROPTS GENERIC(DATASET) REFRESH

For performance reasons, consider activating the sharing of the general resource profiles using the RACF command *SETROPTS RACLIST* (*Example 1*). In that case, discrete and generic profiles are stored in main/virtual storage and RACF will not require accessing its database stored in a file when making an access decision. Each time such an in-storage profile is changed, it must be refreshed using the attribute *REFRESH* (*Example 2*). This storage method is recommended for all CICS general resource classes but not for the OS/390 DATASET class because data set profile may not stored to the main/virtual storage.

SETROPTS RACLIST(*class_name*) [REFRESH]

Example 1: SETROPTS RACLIST(TCICSTRN)

Example 2: SETROPTS RACLIST(TCICSTRN) REFRESH

For a small number of frequently referenced generic profiles stored in general resource profiles in the main/virtual storage can be also used the *SETROPTS GENLIST* command (*Example 1*). As same as for *RACLIST*, each time a generic profile is created, the main/virtual storage needs to be refreshed (*Example 2*, next page). Data set profiles also cannot use *GENLIST* processing.

SETROPTS GENLIST(*class_name*) [REFRESH]

Example 1: SETROPTS GENLIST(CCICSCMD)

Example 2: SETROPTS GENLIST(CCICSCMD) REFRESH

The *RACLIST* and *GENLIST* of all CICS general resource classes can also be refreshed with the CICS transaction CEMT. To refresh the main/virtual storage execute from a CICS terminal:

CEMT PERFORM SECURITY REBUILD

For the general resource classes eligible for the *RACLIST* and *GENLIST* processing see chapter Appendix C in [RMI98]. For more information on data set profiles and general resource profiles, that are not described in this thesis, and on how to create own resource class names refer to [RSG03].

6.3 Implementing RACF protection for the CICS region A06C001

6.3.1 The CICS region's SIT

In the SIT are stored CICS system initialisation parameters that specify system attributes. Some are required to secure the CICS region, some set attributes for the MQSeries CICS connection (refer to the chapters 5.4.2.2 “Configuring CICS to use the MQSeries CICS Bridge” and 5.4.2.5 “An automatic start job for the MQSeries CICS Bridge” on page 101 resp. 109), and some set other CICS system parameters (refer to chapter 4.5.2 “Setting up the CICS resources” on page 74). The SIT is assembled as a load table during the CICS region's start up. The information stored in it is used to suit the region environment to a well-suited level. Some CICS regions can share one SIT together, but if required, the CICS region can also have an own SIT. There should be used several scripts that built one SIT for a CICS region. Hence, the script for the SIT provided with the CICS installation leaves original. In another script there could be specified the modified parameters. If a failure happens due to modifying the SIT-parameters the original script can be used to remedy it. For instance, the SIT for the CICS region A06C001 is built by three scripts that are loaded within the SYSIN section of the CICS region start script *CICSC001* (Listing 8). This start script resides in the data set *SYS1.PROCLIB*.

```

01 //CICSC001 PROC SYSIDNT=C001,
...
50 //SYSIN      DD DISP=SHR,DSN=CICS.COMMON.SYSIN(COMMON)
51 //          DD DISP=SHR,DSN=CICS.COMMON.SYSIN(&SYSIDNT)
52 //          DD DISP=SHR,DSN=CICS.COMMON.SYSIN(END)

```

Listing 8: Extract from the data member SYS1.COMMON(CICSC001)

During startup of CICS the default SIT for the CICS region is assembled from the default script *COMMON* that is stored in the CICS region data set *CICS.COMMON.SYSIN* (Listing 49, page 245). The second SIT script *C001* (Listing 50 & Listing 51, both page 245), that is loaded after the *COMMON* script has been executed, changes some default SIT entries. It also specifies some new attributes for the CICS region, for example the region's application identifier *APPLID*. The script *C001* is located in the data set *CICS.COMMON.SYSIN*, too. As last script the third SIT script *END* is executed and the SIT is created. This script should be used for entries that specify some attributes for the CICS region shut down. However, this script is empty at this time.

Table 11 on the next page lists all SIT-parameters that have been modified during the process of securing the CICS region. The set options have been marked bold. Consider to activate the SIT-parameter ***SEC=YES*** rather at the end of the whole security procedure because it secures the CICS region completely. When no additional security mechanism has been previously set up and the SIT-parameter *SEC* is already activated, CICS resources cannot be accessed or executed.

The region's SIT can only be reassembled when the CICS region is restarted. For restarting the CICS region refer to APPENDIX C.1 “Restarting the CICS region” on page 239. Explanations about all CICS SIT parameters, if not described in this thesis, can be obtained from the book [SDG03] in part 3.

SIT-parameter	Description	Refer to chapter
SEC = YES NO	Activates the CICS security resp. initialises the external security interface	this chapter
DFLTUSER = <userid>	Specifies the name of the DCU	6.3.4, page 175
PLTPISEC = RESSEC CMDSEC NONE	Specifies whether to use resource or command security checking for PLT-programs executed during CICS initialisation	6.3.5, page 177
PLTPIUSR = <User ID>	Specifies the name of the user ID used for PLT-programs running during the CICS initialisation	6.3.5, page 177
GMTEXT = <text>	The “Good Morning” text to be displayed on the first screen after log/sign on	6.3.7, page 182
GMTRAN = <TRID>	The transaction that display the “Good Morning” text on the terminal	6.3.7, page 182
GNTRAN = <TRID>	Specifies the transaction that CICS invokes when a user's terminal-timeout period expires	6.3.8, page 183
PSBCHK= YES NO	PSB authorisation check for remote terminal users	6.3.8, page 183
SECPRFX = YES NO	Specifies whether to use the CRU as a prefix for all resource names, or not.	6.3.8, page 183
XUSER = YES NO <name>	Activates the surrogate user checking	6.4.3, page 187
XTRAN = YES NO <name>	Security checking for attached transactions	6.4.4, page 189
XCMD = YES NO <name>	Security checking for EXEC CICS system commands	6.4.5, page 197
CMDSEC = ASIS ALWAYS	<i>ASIS</i> means that CICS obeys the CMDSEC option in the resource definition. When <i>ALWAYS</i> is chosen, the CMDSEC option of the resource definition is ignored and a command check is always done.	6.4.5, page 197
RESSEC = ASIS ALWAYS	<i>ASIS</i> means that CICS obeys the RESSEC option in the resource definition. When <i>ALWAYS</i> is chosen, the RESSEC option of the resource definition is ignored and a resource check is always done.	see [RSG03], chapter 3
APPLID = <name>	Specifies the name of the CICS region	6.5, page 205

Table 11: SIT-parameters set resp. modified for the CICS region A06C001

6.3.2 User management of the CICS region

The consideration which RACF user may access the CICS region has to precede the authorisation management. This results in thinking about which user should access the subsystem in which relationship. On the JEDI OS/390-server all users accessing TSO/E may also access the CICS region A06C001. These TSO/E-users have been summarised in following RACF user groups (date 1.3.2004):

RACF User Group: RACF User IDs:

ADMIN:	BOSCH, BREITI, BUWD, BUWD1, DRECKER, HROMBA, JHORSWI, JOANNE, KDEGI, NILSM, NMICHA, VPET, PHERRM, RECKER, SPRUTH, MUELLER, EKOPP, WGS, WGREIS, TBOEHM, ELPUR, USTEMP, USETEM
DIPLOM:	MBEYER, RRONNE, SMUNZ, STEFANM, TBUSSE, YCUBAS, OAVIEN, ORAIB, AZIENT, MSCHLO
GAST:	GAST1, GAST2, GAST3, GAST99
PRAKT:	PRAKT1 ... PRAKT22, PRAKT24, PRAKT30 ... PRAKT53, PRAKT55 ... PRAKT69, PRAKT71 ... PRAKT100, PRAK100 ... PRAK183, PRAK190, PRAK500

All the listed users/groups should access CICS with different permissions to the resources of CICS. The users of the group *GAST* should only play with some resources of the CICS subsystem without modifying anything. Trainees who are organised in the group *PRAKT* should access CICS to solve their study exercises with rights to modify only those resources that are needed during their exercises. Users defined in the group *ADMIN* and *DIPLOM* require an access to CICS to control and update the resources of the CICS region.

Additionally, the two required CICS user IDs – the CRU *STCCICS* and the DCU *C001DEF* – need also an access to special CICS resources. The user ID *PLTCICS* needed for the PLT-programs, that are started during the initial start of the CICS region, requires also an access to some specified CICS resources:

RACF User Group: RACF Users:

CICSDEF	C001DEF
CICSREG	STCCICS
SURRGRP1	PLTCICS

6.3.3 The CRU

6.3.3.1 What is it?

From RACFs point of view each started CICS region on OS/390 has to be associated with an own unique RACF user ID, since a CICS region, as a subsystem of OS/390, is treated like a user and hence it identifies itself to RACF. The CRU is required to start the CICS region under RACF control. With its authority RACF decides

which protected resources on the JEDI OS/390-server the CICS region may access. Furthermore, a CRU becomes important, when more than one CICS region are installed on an OS/390-server. In this case, CICS uses the region user ID to prefix resource definitions before sending a request to RACF. For example, a CICS transaction should be secured by a RACF transaction security profile. In that case, this profile has to be stored with the CRU as prefix to use the transaction in the preferred region.

6.3.3.2 Defining the CRU to RACF

The CRU *STCCICS* is defined to RACF after the data for the CICS region have been installed. But firstly, its default user group *CICSREG* has to be added to the RACF database using the command *ADDGRP(AG)*:

Example: `ADDGROUP CICSREG OWNER(SYS1) SUPGRP(SYS1) OMVS(GID(1))`

The owner *SYS1* is also the default group and the superior group of the user group *CICSREG*. *SYS1* is a IBM-supplied group and resides always on the highest level of the user group hierarchy. Within the *OMVS* keyword there are added the default OS/390 UNIX group identifier (GID) to the OMVS segment of the group (OMVS = OpenMVS, the OS/390 UNIX substem). For more information on this segment please refer to [RSA98]. Into the group *CICSREG* there can also be added other CRUs to assign one authority level to that group resp. to all CRUs connected within the group.

The user ID for the CICS region A06C001 is defined using the RACF command *ADDUSER(AU)*:

```
ADDUSER user_id DFLTGRP(group_id) NAME(user_id_description)      +
OWNER(owner_id) PASSWORD(*****)                                  +
segment_1(attributes) ... segment_n(attributes)
```

Example: `ADDUSER STCCICS DFLTGRP(CICSREG) NAME(A06C001-REGION_ID) +
OWNER(CICSREG) PASSWORD(*****) +
OMVS(UID(1) HOME(/) PROGRAM(/bin/sh))`

Within the keyword *DFLTGRP* the CRU for A06C001 has been added to its default user group *CICSREG*. A name for the user ID has been specified with the *NAME* keyword whereas the *OWNER* of the user ID is *IBMUSER*. In case, that the CICS region wants to access some resources on the OS/390 UNIX subsystem, it has been added the *OMVS* segment with some default parameters to the user profile. As a security aspect, always define a password for the CRU, do not set it to the default one which is the name of the default group. The password is never checked by RACF to access resources.

After the CRU is created, it is used to run the CICS region. There are three ways to run the CICS region: as a *Started Task* using the RACF started procedure table ICHRIN03, as a *Started Job*, or simple as a *Job*. The CICS region A06C001 runs as a Started Job. For information on how to start CICS as a Started Task and as a Job refer to [RSG03].

6.3.3.3 Authorising the CRU to invoke CICS as a Started Job

Invoking the CICS region A06C001 as a Started Job requires that the CRU is specified on a *STARTED* general resource class profile. This profile refers to the CICS region start up script name *CICSC001* and to the script's job name, that is also *CICSC001*¹⁷. Therefore, the discrete *STARTED* general resource profile is named as *CICSC001.CICSC001*. In case, another CICS region should be started with the same script using another job name, for example *CICSC002*, the discrete *STARTED* general resource profile has to be named as *CICSC001.-CICSC002*. If one CRU should be used for different CICS regions started by the same start script but with different job names, the profile could be named as *CICSC001.CICSC***.

The profile *CICSC001.CICSC001* has been added to the *STARTED* general resource class with the RACF command *RDEFINE(RDEF)*:

```
RDEFINE STARTED script_name.job_name OWNER(owner_id)          +
STDATA(USER(CRU))
```

```
Example: RDEFINE STARTED CICSC001.CICSC001 OWNER(IBMUSER)      +
STDATA(USER(STCCICS))
```

The *OWNER* of the profile is *IBMUSER* and the CRU is added to the associated *STDATA* segment using the keyword *USER*. The profile can be displayed with the RACF command *RLIST(RL)*. The connected CRU is displayed if the segment name is entered as showed on Figure 74 on the next page.

After defining the *STARTED* general resource profile to the general resource class *STARTED*, the profiles in main/virtual storage need to be refreshed using the command *SETROPTS RACLIST*:

```
Example: SETROPTS RACLIST(STARTED) REFRESH
```

In case, the general resource class has not been activated and has not been stored in main/virtual storage previously, it must be firstly activated using the *SETROPTS CLASSACT* command together with the *RACLIST* command:

```
Example: SETROPTS CLASSACT(STARTED) RACLIST(STARTED)
```

¹⁷ The script is stored in the data set SYS1.PROCLIB on the JEDI OS/390-server.

```

Menu List Mode Functions Utilities Help
-----
ISP Command Shell
Enter TSO or workstation commands below:

==> RLIST STARTED CICS001.CICS001 NORACF STDATA

...

CLASS      NAME
-----
STARTED    CICS*.** (G)

STDATA INFORMATION
-----
USER= STCCICS
GROUP=
TRUSTED= NO
PRIVILEGED= NO
TRACE= NO

```

Figure 74: *RLIST STARTED CICS*.** NORACF STDATA*

6.3.3.4 Authorities required for the CRU

The CRU needs an access to all the resources CICS itself needs to use. There are two types of these resources – resources external to CICS, such as files on hard disks, or the spool system and resources internal to CICS, such as some CICS transactions. The authority to access external resources is obtained from the CRU, not from the CICS terminal user. Each CRU has to be associated with all the disk data sets that it uses. On JEDI OS/390-server the CRU has got an access to the whole CICS TS install data set having the high-level qualifier *CICST513*. Authorising the access for the CRU to that data set is described in chapter 6.3.6 “The CICS region data set protection” on page 178. More authorities required for CICS region user IDs to access external resources of CICS can be obtained from the book [RSG03] in chapter 3 “CICS data set and system security”.

Internal resources like CICS data sets and CICS system transactions need also to be authorised by the CRU. Authorising these so-called Category-1-transactions is explained in chapter 6.4.4 “The CICS Transaction Security” on page 189. When the SIT-parameter *XUSER* has been activated, the CRU has to be used as a surrogate user of some other user IDs. There are three types of using the CRU as a surrogate user ID – for the DCU, for the PLTPIU, and for the user ID used for transient data trigger transactions. How to use the Surrogate User Security is described in chapter 6.4.3 “The Surrogate User Security” on page 187. To define the PLTPIU refer to chapter 6.3.5 “The PLTPIU” on page 177.

6.3.4 The DCU

6.3.4.1 What is it?

When a CICS region is to be secured, it is needed to define the DCU. This user ID must match the value of the SIT-parameter *DFLTUSER*. If no value is specified on this parameter, CICS refers to the IBM-supplied user ID *CICSUSER*. In that case, a RACF user profile for *CICSUSER* must be defined to the RACF database. Each CICS region should have an own DCU as an aid to debugging. However, one DCU can be shared for all CICS regions.

CICS always signs on the DCU each time a CICS region starts up. If no DCU has been created to RACF resp. specified on the SIT-parameter *DFLTUSER*, CICS cannot sign on the DCU, and therefore, the CICS initialisation is terminated and a failure message is issued. When the sign on of the DCU is successful, its security attributes are assigned to all terminal users before they sign on. Therefore, a user connected to the CICS terminal is always logged on to CICS, but not signed on. If this user wants to sign on to CICS, the DCU must be able to execute a sign on transaction. This could be the IBM-supplied CICS transaction CESN, which opens the “Signon to CICS” panel (Figure 75). On this panel a valid RACF user ID with its associated password must be entered to access the CICS region and to execute some authorised resources. Furthermore, some other transactions, that need no protection, can also be authorised for the DCU. For example, each CICS user may additionally use the CMAC transaction to display on-line messages and codes without signing on to the CICS region. In that case, the DCU must also have a permission to initiate the CMAC transaction. To execute such “unsecured” transactions by the DCU a CICS general resource profile for those transactions has to be created. How to define such a profile is described in chapter 6.4.4 “The CICS Transaction Security” on page 189.

Signon to CICS		APPLID A06C001
----- WELCOME AT UNIVERSITY OF LEIPZIG -----		-JEDI-
BITTE TRANSAKTION <CESF LOGOFF> ZUM AUSLOGGEN BENUTZEN!		-CICS-
Type your userid and password, then press ENTER:		
Userid	Groupid . . .	
Password . . .		
Language . . .		
New Password . . .		
DFHCE3520 Please type your userid. F3=Exit		

Figure 75: The CICS SignOn panel

And last, but not least, the CICS segment of the DCU's terminal user data is established for user who have no own CICS segment data in their RACF user profile.

6.3.4.2 Defining the DCU to RACF

For the CICS region A06C001 the DCU has been already defined to the RACF database. But, this user ID matched the CRU of that CICS region. Such a combination is not a good choice, because both are two different kinds of user IDs. To rectify this problem, a new DCU has been created. Firstly, a group for the DCU has been added to RACF. Into this group there can also be added other DCUs to give them the same authority level as the group have. If required, there can also be created another group that holds DCUs having another authority level. The group for the DCU *C001DEF* has been named as *CICSDEF* having the superior group and the owner *SYS1*:

Example: `ADDGROUP CICSDEF SUPGROUP(SYS1) OWNER(SYS1) OMVS(GID(1))`

After that, the DCU *C001DEF* has been created using the RACF command *ADDUSER*:

Example: `ADDUSER C001DEF DFLTGRP(CICSDEF) NAME(A06C001-DEFAULT_ID) +
OWNER(CICSDEF) PASSWORD(*****) +
OMVS(UID(1) HOME(/) PROGRAM(/bin/sh)) CICS(OPCLASS(1))`

The default group of the DCU is *CICSDEF*, has the owner *SYS1*, and the well fitting name description *A06C001-DEFAULT_ID*. A password should always be defined for the DCU. If omitted, it is set to the default one – the group identifier, but this is not suggested. Within the *OMVS* segment there has been specified some parameters used for the OS/390 UNIX subsystem: the UNIX identifier, the home directory, and the program directory. For the DCU there has been also added a *CICS* segment with some default operator data, that should be differently for each DCU defined to RACF. The CICS segment for the DCU *C001DEF* contains the operator class *1* specified within the keyword *OPCLASS*. If no CICS segment is specified on the user's profile, CICS assigns built-in system default values for the DCU as same as for each user who has no own CICS segment and who signs on to the CICS region. On the CICS segment there can be specified some more terminal operator data – the operator identification *OPIDENT*, the operator priority *OPPRTY*, the *TIMEOUT*, and the *XRFSSOFF* parameters. These parameters are explained in the book [RSG03] in detail. After the DCU is defined to the RACF database, its information can be displayed with the RACF command *LISTUSER* as used in Figure 76 on the next page.

Furthermore, the DCU has to be defined on the access list of the CICS region's *APPL* general resource profile to access the CICS region itself. For information on how to grant this access browse to chapter 6.5 “Authorising access to the CICS region” on page 205. If the SIT-parameter *XUSER* is activated, the CRU should be authorised to be the surrogate user of the DCU. How to authorise the CRU to be a surrogate of the DCU is explained in chapter 6.4.3 “The Surrogate User Security” on page 187.

The DCU is assigned to the CICS region when it is defined to RACF and when it is set on the SIT-parameter *DFLTUSER*. However, it is not required to specify a DCU on this SIT-parameter. In this case, the IBM-supplied DCU *CICSUSER* is chosen. Therefore, a user profile for that user ID must be defined to RACF. The DCU of the CICS region A06C001 *C001DEF* has been specified in the default SIT script *C001* as same as the parameter *SEC*:

11	DFLTUSER=C001DEF,	DEFAULT CICS USER
...		
37	SEC=YES,	CICS SECURITY (STANDARD = YES)

```
Menu List Mode Functions Utilities Help
                                     ISPF Command Shell
Enter TSO or workstation commands below:
====> LISTUSER C001DEF NORACF CICS OMVS
...
USER=C001DEF
CICS INFORMATION
-----
OPCLASS= 001
OPIDENT=
OPPRTY= 00000
TIMEOUT= 00:00 (HH:MM)
XRFSOFF= NOFORCE
OMVS INFORMATION
-----
UID= 0000000001
HOME= /
PROGRAM= /bin/sh
```

Figure 76: LISTUSER C001DEF NORACF CICS

6.3.5 The PLTPIU

All CICS programs that are executed during the initialisation of the CICS region have to run under an own user ID that is called the PLTPIU. Those programs are compiled to the PLT that is loaded during the CICS system initialisation. For each CICS region this user ID is specified in the SIT on the parameter *PLTPIUSR*. If this parameter is omitted the CRU is used for all PLTPI programs. Therefore, the CRU must have an access to all the resources that these programs use including all the transactions started within the PLT-programs. On the CICS region A06C001 an own PLTPIU is used for programs started during such post-initialisation processing. The new user ID *PLTCICS* stored to the user group *SURRGRPI* has been created to the RACF database using the two commands *ADDGROUP* and *ADDUSER*:

Example 1: `ADDGROUP SURRGRP1 OWNER(SYS1) SUPGROUP(SYS1)`

Example 2: `ADDUSER PLTCICS NAME(PLT_USER-ID) OWNER(SURRGRP1) +
DFLTGRP(SURRGRP1)`

After that, the created PLTPIU has to be specified on the SIT-parameter *PLTPIUSR* (refer to Listing 51, page 245). For the PLTPIU exists an additional SIT-parameter called *PLTPISEC*. It specifies whether or not to use resource (*PLTPISEC=RESSEC*) or command security (*PLTPISEC=CMDSEC*) checking for PLT-programs executed during CICS initialisation. The resource security has been chosen for the PLT-programs (Listing 51).

CICS always performs a surrogate user security check to authorise the CRU acting as a surrogate user of the user ID specified within the SIT-parameter *PLTPIUSR*. A surrogate user security check is not required if no PLTPIU is specified resp. the CRU is the PLTPIU. For information on how to enable the surrogate user security checking for the PLTPIU refer to chapter 6.4.3 “The Surrogate User Security” on page 187.

6.3.6 The CICS region data set protection

6.3.6.1 Protecting the CICS region data sets

All data, that is required to start and run the CICS region A06C001, is installed to the data sets having the high-level qualifier “CICS” and “CICSTS13”. After the installation, both data sets have to be secured by the RACF data set protection. To secure the data sets generic group data set profiles have to be defined to the *DATA-SET* resource class. For the whole CICS TS install data, the RACF data set profile *CICSTS13.*** is created whereas the whole CICS region data set is protected by the data set profile *CICS.***. Following listing shows how to use the RACF command *ADDSD* (shortcut *AD*) to create the generic data set profile *CICS.***:

```
ADDSD 'data_set_name' OWNER(user_id) UACC(option)
```

Example: `ADDSD 'CICS.**' OWNER(ADMIN) UACC(NONE)`

Because of using the double asterisk, RACF knows to store the profile in its database as a generic one. It protects all data having the high-level qualifier “CICS” with this one profile. When executing this command, nobody has an access to the data stored within this data set. This is specified within the keyword *UACC* meaning universal access. The generic data set profiles for the CICS install data set having the high-level qualifier “CICSTS13” have been created using the same way.

Due to a failure occurred during the CICS region reinitialisation after an IPL of the JEDI OS/390-server, an additional data set profile is created to store the CICS system log having the qualifiers *CICS.A06C001.***. This data set profile secures the VSAM KSDSs used for the primary and secondary CICS system logs. Differently from the other two data set profiles the universal access has been set to UPDATE because CICS requires it to

write CICS log messages to the data set. If this access is not permitted, the primary CICS system log *DFHLOG* will not be reinitialised after the CICS region is restarted due to an IPL of an OS/390-server. Usually, it is not recommended to specify an UPDATE authority to the *UACC*-parameter because any user is in the position to delete the data set. Therefore, the a few CICS terminal users have been excluded from the access; see next chapter for the specification of an access list to this data set. How to patch such an access failure is described in chapter Appendix C.2 “Correction of a CICS system log failure after an OS/390-server IPL and a CICS restart” on page 240.

Furthermore, there have been defined four more data set profiles. Two of them protect the CICS load modules libraries named as *CICSTS13.CICS.SDFHLOAD* and *CICSTS13.CICS.PRAKLOAD* – both parts of the CICS TS install data set. The other two protect the transient data intrapartition data set stored in *CICS.C001.DFHINTRA* and the temporary storage data set *CICS.C001.DFHTEMP* – both parts of the CICS region data sets. They all have been specified using the *ADDSD* command as described above. The data set profile *CICSTS13.CICS.PRAKLOAD* is used as an example on how to define a generic data set profile having no substitute characters. The protected data set *CICSTS13.CICS.PRAKLOAD* is used to store CICS programs created by CICS users. It has been protected using following RACF command:

Example: `ADDSD 'CICSTS13.CICS.PRAKLOAD' GENERIC OWNER(SYS1) UACC(READ)`

To secure this profile even though as a generic data set profile, the keyword *GENERIC* (*GEN*) must be specified within the *ADDSD* command. In case of modifying or deleting this profile, *GENERIC* must always be written within the RACF command behind the data set profile name. If it has been omitted, this data set profile is not found by RACF but the discrete profile is displayed, if defined..

Summarised, the *UACC*-parameter for all the defined data set profiles has been set as follows:

CICS.**	UACC(NONE)
CICSTS13.**	UACC(NONE)
CICS.A06C001.**	UACC(UPDATE)
CICSTS13.CICS.PRAKLOAD	UACC(READ)
CICSTS13.CICS.SDFHLOAD	UACC(READ)
CICS.C001.DFHINTRA	UACC(NONE)
CICS.C001.DFHTEMP	UACC(NONE)

It is noticed, when a data set profile is to be created, the high-level qualifier of the associated data set must be firstly defined as a group ID to RACF. For the generic data set profiles the group IDs *CICS* (*Example 1*) resp. *CICSTS13* (*Example 2*, next page) have been defined using the RACF command *ADDGROUP* (*AG*):

Example 1: `ADDGROUP CICS OWNER(SYS1) SUPGRP(SYS1)`

Example 2: `ADDGROUP CICSTS13 OWNER(SYS1) SUPGRP(SYS1)`

Attention, do not forget updating the RACF database using the *SETROPTS* command to activate the data set protection:

Example: SETROPTS GENERIC(DATASET) REFRESH

6.3.6.2 Authorising access to the CICS data sets

For all the six defined data set profiles there have to be added RACF users/groups to the access list of the profiles. As an example on how to add such an access list to a data set profile, the profile *CICS.*** is chosen. Since the universal access has been set to *NONE*, no user has an access to the data set until the user is added with an appropriate authority level to the data set profile. For all users there is needed a well configured access list to the data set. It should be accessed by the *ADMIN* and *DIPLOM* group with an *ALTER* access permission because both need the full control of this data set (*Example 1*). The CRU *STCCICS* gets at least the *UPDATE* access because it changes some data in the data sets during the CICS region runs (*Example 2*). Other users get no access to the whole data set at this time. If required, those users, who need also an access, can be added to the access list with the appropriate permission. Using the RACF command *PERMIT* adds the user/group IDs with their assigned permission to the data set profile *CICS.***. This command must be executed for each security level:

```
PERMIT 'data_set_profile_name' ACCESS(option) ID(user_id1,          +
user_id1, ..., user_idn)
```

Example 1: PERMIT 'CICS.**' ID(ADMIN,DIPLOM) ACCESS(ALTER)

Example 2: PERMIT 'CICS.**' ID(STCCICS) ACCESS(UPDATE)

Defining an access list for a data set profile consisting of non-substitute characters is explained using the data set profile *CICSTS13.CICS.PRAKLOAD* as an example. Everybody has at least *READ* access to the protected data as specified within the *UACC* parameter. Additionally, the user groups *ADMIN* and *DIPLOM* get an *ALTER* access to have the full control of the data set (*Example 3*). Because this data set should be used by trainees to store, modify, and delete their load modules created during an educational course, the group *PRAKT* has to get an *UPDATE* access (*Example 4*, next page). The following definitions adds the user groups with their permissions to the access list of such a generic data set profile having no substitute characters. Each command must include the keyword *GENERIC*, hence, the access list will be added to the generic data set profile instead the discrete one, if it exists. Otherwise an error message is displayed:

```
Example 3: PERMIT 'CICSTS13.CICS.PRAKLOAD' GENERIC ID(ADMIN,DIPLOM)  +
ACCESS(ALTER)
```

```
Example 4: PERMIT 'CICSTS13.CICS.PRAKLOAD' GENERIC ID(PRAKT)        +
ACCESS(UPDATE)
```

Summarised, the following table lists all the specified access lists of the data set profiles:

Data set security profile	Users/Groups	Access permission
CICS.**	ADMIN, DIPLOM STCCICS	ALTER UPDATE
CICSTS13.**	ADMIN, DIPLOM STCCICS	ALTER READ
CCIS.A06C001.**	ADMIN, DIPLOM PRAKT, GAST	ALTER NONE
CICSTS13.CICS.PRAKLOAD	ADMIN, DIPLOM PRAKT	ALTER UPDATE
CICSTS13.CICS.SDFHLOAD	ADMIN, DIPLOM	ALTER
CICS.C001.DFHINTRA	STCCICS	CONTROL
CICS.C001.DFHTEMP	STCCICS	CONTROL

Table 12: Access permission to the CICS data sets

The access list of the generic data set profile *CICSTS13.*** is created using the command *PERMIT* as described within the data set profile *CICS.***. The other three generic data set profiles having no substitute characters have been defined as described within the data set profile *CICSTS13.CICS.PRAKLOAD*.

The CICS transaction NACT of the CICS application can only be executed if the CRU *STCCICS* has at least the *READ* authority to the data set with the high-level qualifier “TBUSSE.CICSADP”. But with this authority only the browse function can be used, if another function like modifying or deleting should be executed, the application replies with an error message. These functions can only be executed, when the CRU has an *UPDATE* access to the data set. The command to define the appropriate authority for the CRU reads as follows:

Example: `PERMIT 'TBUSSE.CICSADP.**' ID(STCCICS) ACCESS(UPDATE)`

But beware, this data set is allocated to the CICS start up libraries. Each changing of the access list of their associated data set profiles implies a restart of the CICS region. Only after restarting, the access list is updated. How to add such a data set to the CICS start up libraries is explained in chapter 4.5.2 “Setting up the CICS resources” on page 74.

After the RACF data set profiles have been added, they can be listed using the command *LISTDSD (LD)*. For displaying the generic data set profiles having no substitute characters the keyword *GENERIC* must also be used. When *AUTH* is specified only authority information is displayed, but when specifying *ALL* the whole profile information is listed – for example the creation date, the authority information, too, and some more. There can be specified some more keywords, for using them refer to [CSB98].

`LISTDSD DATASET('data_set_name') [AUTH] [GENERIC] [ALL]`

Example 1: `LISTDSD DATASET('CICS.**') ALL`

Example 2: LISTDSD DATASET('CICSTS13.CICS.PRAKLOAD') GEN AUTH

The command *LISTDSD* can also be used to display the profile information of all profiles beginning with the same characters. It is only needed to know a few prefix characters of the data sets, for example *CICS*:

LISTDSD PREFIX(*prefix_characters*) [AUTH] [GENERIC] ALL

Example 1: LISTDSD PREFIX(CICS) ALL

Example 2: LISTDSD PREFIX(CICS) GENERIC ALL

If no prefix is known, the RACF command *SEARCH (SR)* lists the names of all data set profiles stored in the RACF database when *NOMASK* is specified (*Example 1*). Some characters specified within the *MASK* parameter provides the same result as the *LISTDSD PREFIX* command (*Example 2*). *CLASS* needs not to be specified because it is the default value when no alternative item or operand is specified:

Example 1: SEARCH CLASS(DATASET) NOMASK

Example 2: SEARCH CLASS(DATASET) MASK(CICS)

As next, it is necessary to specify some entries in the SIT definition script of the CICS region to prepare the activation of the CICS region security.

6.3.7 Informing CICS terminal users about the forthcoming security change

Before activating the security for the CICS region, all CICS users have to be informed about the forthcoming update. This information should appear on the first screen each time a CICS user logs on to CICS until the security is activated. Such a message text can be specified on the SIT-parameter *GMTEXT*. To display it there can be used two IBM-supplied CICS transactions – CSGM known as the "Good Morning" transaction, or CESN known as the "Sign On" transaction. Before the CICS region has been RACF-protected, the CICS transaction CMSG has been always executed as first transaction after a user has been logged on to CICS terminal entry panel because it was specified on the SIT-parameter *GMTRAN* (cf. Listing 50, page 245). As the other possibility, the CICS transaction CESN can also be specified on this SIT-parameter (cf. Listing 51, page 245):

C001-temporary version:

15 GMTRAN=CSGM,	ENTRY PANEL	CSGM CESN
-----------------	-------------	-----------

C001 – final version:

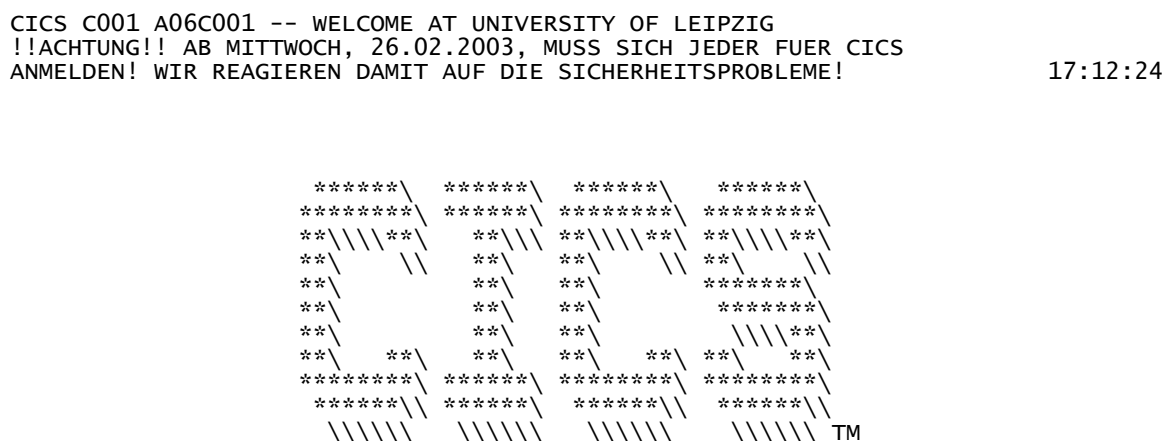
```
17 GMTRAN=CESN,                START PANEL - <CESN> SIGN ON PANEL
```

The message text specified within *GMTEXT* can contain up to 246 characters and can be three lines at all. The following text has been used to inform the users of the security update (cf. Listing 50, page 245):

c001-temporary version:

```
12 GMTEXT='CICS C001 A06C001 -- WELCOME AT UNIVERSITY OF LEIPZIG
13      !!ACHTUNG!! AB MITTWOCH, 26.02.2003, MUSS SICH JEDER FUER CICS
14      ANMELDEN! WIR REAGIEREN DAMIT AUF DIE SICHERHEITSPROBLEME! ',
```

After the CICS region has been restarted to generate the new SIT, the information about the security update appears on the entry screen as shown on Figure 77. Now each users knows that the CICS region will be secured until the date 26.02.2003.



```
CICS C001 A06C001 -- WELCOME AT UNIVERSITY OF LEIPZIG
!!ACHTUNG!! AB MITTWOCH, 26.02.2003, MUSS SICH JEDER FUER CICS
ANMELDEN! WIR REAGIEREN DAMIT AUF DIE SICHERHEITSPROBLEME! 17:12:24
```

The graphic consists of four columns of asterisks forming a stylized 'TM' logo. Each column is approximately 10 characters wide and 15 characters high. The first three columns are made of asterisks, and the fourth column is made of slashes followed by a 'TM' trademark symbol.

Figure 77: Terminal screen after log on to CICS (without security)

6.3.8 Other parameters necessary for CICS security

There have been set resp. modified two more important parameters in the SIT definition script *C001* to overwrite the parameters of the *COMMON* script – *SECPRFX*, *GNTRAN*, and *PSBCHK* (Listing 51, page 245). The parameter *SECPRFX* is activated in the default SIT definition script *COMMON*, but is only used if multiple CICS regions are running on the OS/390-server. With it, CICS prefixes the resource names of the different CICS regions to pass them to RACF for authorisation. *SECPRFX* has been set inactive in the script *C001* – *SECPRFX=NO*

(Listing 51, line 38). In contrast to the *GMTRAN* parameter, the *GNTRAN* (“Good Night” TRANsaction) specifies the CICS transaction invoked due to the expiration of the terminal time-out period. The default parameter in *COMMON* is set to *GNTRAN=CESN* to return to the Sign-On panel after the terminal time-out. However, in case of such a time-out CICS should log off the user from the terminal. Therefore, the transaction CESF with the option *LOGOFF* has been specified on the *GNTRAN* parameter (Listing 51, line 19). Furthermore, when the user signs off with transaction CESF plus option *GOODNIGHT*, CICS logs off the user, too.

The SIT-parameter *PSBCHK* can be activated, when a PSB authorisation check should be made for remote terminal users. Because this parameter has been set to *PSBCHK=NO* CICS checks only the remote link, but not the remote user.

6.4 Securing the resources for the CICS region A06C001

6.4.1 Decision about useful and necessary security mechanism

Before any user may access a secured CICS region it is important to find out what security levels RACF provides for the transaction monitor. The access to the region is controlled by the following different security mechanisms (according to [RSG03]):

- Terminal User Security
- Preset Terminal Security
- Surrogate User Security
- CICS Transaction Security, also called Transaction-Attach Security
- CICS Command Security
- CICS Resource Security, subdivided into security for:
 - Advanced Program-to-Program Communication through an LU6.2 session (APPC LU6.2)
 - DB2 Resource Classes
 - Transient Data
 - VSAM and BDAM Files
 - Journals and Log Streams
 - STARTED- and XPCT-checked Transactions
 - CICS Application Programs
 - PSBs
 - Temporary Storage
- QUERY SECURITY Command Security as part of the CICS Command security
- CICS Web Support Security
- MultiRegion Operation (MRO) Security
- Front End Programming Interface (FEPI) Security
- CICS Business Transaction Services (BTS) Security
- RACF PassTickets.

For the CICS region A06C001 on the JEDI OS/390-server there has been enabled the Terminal User Security, the Surrogate User Security, the CICS Transaction Security, and the CICS Command Security. The terminal user security is not more as defining user IDs to the RACF database. These user IDs have to be used to sign on the CICS region. When they enter their user IDs with their associated passwords using a Sign On transaction (for example CESN), CICS verifies the user IDs and the passwords. If both are valid the user may access the CICS region. Although the user is signed on to CICS, he/she cannot use any resource of the CICS region until the user gets the authorisation to use CICS transactions, for example. For using the Terminal User Security refer to chapter 6.4.2 “The CICS Terminal User Security” on page 187.

With the Surrogate User Security CICS is able to check whether a surrogate user is authorised to act for another user without knowing the user's password. CICS can enforce surrogate user security checking for the DCU, for preset terminals, and for the user ID of started transactions, of PLT post-initialisation programs, of BTS pro-

cesses, and of EXCI calls. Also, the user ID associated with transient data queues, and the user ID supplied on DB2-parameters can have a surrogate user ID. On the CICS region A06C001 there is performed a surrogate user checking against the CRU, if it is authorised to act as a surrogate user of the DCU and of the user ID of the PLT programs (cf. chapter 6.4.3 “The Surrogate User Security” on page 187).

Using the CICS Transaction Security secures one part of the CICS resources – the CICS transactions. The CICS users may only initiate those transactions in the CICS region, for which they have a permission. Such a transaction is for example the CICS-supplied transaction CEMT (CICS Execute-level Master Terminal). With this transaction there can be displayed or altered CICS environmental information. Another CICS-supplied transaction that is to be protected is the CEDA transaction. CEDA can be used to define and/or delete CICS resources. Implementing the transaction security is described in chapter 6.4.4 “The CICS Transaction Security” on page 189.

After activating these security mechanisms, a problem with the CICS Transaction Security has been occurred on the CICS region. Due to security reasons, the CEMT transaction has been only allowed to execute by designated users because this transaction assumes the control of CICS system parameters. These parameters can be displayed and changed with CICS commands called System Programming (SP)-type commands. Aside changing system parameters using the transaction CEMT, they can also be changed by the SP-type commands executed within CICS application programs. However, SP-type commands also provide information about user- and system-started resources. A simple example illustrates such a common situation. On the one hand, only authorised users may shut down the CICS region using the CICS SP-type command *PERFORM SHUTDOWN* executable within the transaction CEMT. It is simple to understand that a student or trainee should not have the right to perform this command. On the other hand, a trainee, who wants to monitor the execution of a started resource (e.g. a CICS program), gets this information when the CICS SP-type command *INQUIRE TASK* is executed within the transaction CEMT. Hence, users who may shut down a CICS region and users who only want information about a started resources need different access permissions for the SP-type commands such as *READ*, *UPDATE*, or *ALTER*. Such CICS SP-type commands are secured with the CICS Command Security mechanism. Please refer to chapter 6.4.5 “The CICS Command Security” on page 197 for using this security mechanism.

When all these security options are set, the JEDI OS/390-server will have a right secured CICS region at the demanded level. In case of future security demands, it could be possible that more security options have to be activated. For example, a secured preset terminal gives only a special local terminal and its associated user access to CICS transactions without sign on. Preset Terminal Security is usually used for terminals without keyboards. More security levels could be set when intercommunication between different CICS regions is used; either if connected by an SNA access method in various sysplexes like APPC, or using MRO in a single sysplex. If full resource control is required for CICS application programs, program specification blocks, files, journal logging, or for specific queues the associated security parts of the CICS Resource Security may be activated.

All security mechanisms for the CICS region are activated within the CICS region's SIT.

6.4.2 The CICS Terminal User Security

The terminal user security is the main CICS security mechanism. This mechanism controls whether a user is defined to RACF when the user wants to sign on to the CICS region. Such a user must have a predefined RACF user ID profile. However, all users may log on to the CICS region. A user who is not signed on can use only those resources, for example transactions, the DCU *C001DEF* may use or transaction that have a universal access. Which resources the user may use after a sign on to the CICS region depends on other CICS security mechanisms, for example the transaction and command security. These security mechanisms secure the CICS resources using associated resource security profiles. If a user or a user group is added to the access list of a resource security profile they may use all the resources specified within the member list of the security profile.

The consideration which user may sign on to the CICS region A06C001 has to precede the user management of CICS. This results in thinking about which user should access the subsystem in which relationship. On the JEDI OS/390-server users of the RACF groups *ADMIN*, *DIPLOM*, *GAST*, and *PRAKT* may access the CICS region. Refer to chapter 6.5 “Authorising access to the CICS region” on page 205 on how to give these four user groups an access to the CICS region.

When the SIT-parameter *SEC* is activated (*SEC=YES*), all users must sign on to the CICS region with their user ID and the associated password. But at this point no other security mechanism is set. Because of this, the signed on users cannot use any of the CICS resources in the CICS region A06C001. Therefore, some more security mechanisms have to be established, firstly it is described how to activate the CICS transaction security mechanism. After all required security mechanisms have been activated the SIT-parameter *SEC* may be set (cf. line 36, Listing 51, page 245).

6.4.3 The Surrogate User Security

On the CICS region A06C001 the CRU *STCCICS* is used as a surrogate user for the DCU *C001DEF* and for the user ID of PLT programs resp. started transactions *PLTCICS*. Surrogate user checking is enabled when *XUSER=YES* is specified as a parameter in the SIT (cf. line 45, Listing 51, page 245). On this parameter it can only be chosen between the values *YES* or *NO* because this SIT-parameter always refers to the IBM-supplied general resource class *SURROGAT*. An own defined resource class cannot be used. The surrogate user security comes only in effect, when the SIT-parameter *SEC* is also activated.

There are three forms of surrogate security profiles, which must conform the following naming conventions:

- **userid.DFHINSTL:** This form of a surrogate class profile is required for the PLTPUIU if specified on the SIT-parameter *PLTPUIUSR*, for the DCU specified on the SIT-parameter *DFLTUSER*, for user IDs associated with trigger-level transactions, for user IDs specified for preset terminal security, and for user IDs specified within the DB2 resource definition. On the CICS region A06C001 there have been created two

of such profiles, one for the PLTPI user ID, and one for the DCU. The CRU *STCCICS* has to be authorised to act on behalf of these both users.

- **userid.DFHSTART:** Such a surrogate security profile can be created for user IDs of started transactions or for user IDs of CICS BTS processes started by a *RUN* command. One profile has been created to start the MQSeries CICS Bridge under the authority of the surrogate user *PLTCICS* instead of the DCU.
- **userid.DFHEXCL:** This surrogate security profile is only needed for EXCI calls. Such a profile has not been defined the *SURROGAT* general resource class. For information on how to use this profile refer to chapter 7 “Surrogate user security” in [RSG03].

After the DCU *C001DEF* has been created to the RACF database and it has been specified within the SIT-parameter *DFLTUSER* its surrogate security profile has to be created using following command:

```
RDEFINE SURROGAT DCU.DFHINSTL UACC(option) OWNER(DCU)
```

Example: RDEFINE SURROGAT C001DEF.DFHINSTL UACC(NONE) OWNER(C001DEF)

The CRU *STCCICS* has been added to the access list of the surrogate profile *C001DEF.DFHINSTL* using the RACF command *PERMIT*. It is noticed, that each surrogate user must have at least *READ* access:

```
PERMIT DCU.DFHINSTL CLASS(SURROGAT) ID(CRU) ACCESS(option)
```

Example: PERMIT C001DEF.DFHINSTL CLASS(SURROGAT) ID(STCCICS) +
ACCESS(READ)

As next, the CRU *STCCICS* must also be authorised as a surrogate user to run the PLT-programs during the CICS region initialisation on behalf of the PLTPIU *PLTCICS*. Following commands has been executed:

Example 1: RDEFINE SURROGAT PLTCICS.DFHINSTL UACC(NONE) OWNER(PLTCICS)

Example 2: PERMIT PLTCICS.DFHINSTL CLASS(SURROGAT) ID(STCCICS) +
ACCESS(READ)

For example, during the CICS region initialisation” there is started the MQSeries CICS Bridge using the PLT-program *STRTCKBR* (refer to ch. 5.4.2.5 “An automatic start job for the MQSeries CICS Bridge”, page 109). All the resources started within PLT-programs must run under the authority of the PLTPIU. Therefore, this user ID must be authorised to all the resources referenced by *STRTCKBR*, for example the transaction CKBR which starts the MQSeries CICS Bridge Monitor Task. This transaction again starts another one – the MQSeries CICS DPL Bridge Task transaction CKBP. However, this transaction may always run under the authority of the DCU (see chapter 6.4.4.6 “Securing the MQSeries CICS transactions used for the NACT application”, page 195)!

CICS requires that each user ID who starts a transaction without using a terminal is a surrogate of the user ID that runs the transaction. Therefore, the PLTPIU which starts the CICS transaction CKBP must be a surrogate

user of the DCU under which CKBP is running. Following commands create such a surrogate class profile for the DCU and add the PLTPIU as the surrogate user to the access list of the profile:

Example 1: RDEFINE SURROGAT C001DEF.DFHSTART UACC(NONE) OWNER(C001DEF)

Example 2: PERMIT C001DEF.DFHSTART CLASS(SURROGAT) ID(PLTCICS) +
ACCESS(READ)

After all these profiles have been defined, the general resource class *SURROGAT* stored in main/virtual storage must be refreshed using the RACF command *SETROPTS RACLIST*. If this security class is not activated yet, the *SETROPTS CLASSACT* command has to be entered. For the general resource class *SURROGAT* it is also required to activate sharing of the in-storage profiles, therefore *RACLIST* should also be specified within the *SETROPTS* command:

Example 1: SETROPTS RACLIST(SURROGAT) REFRESH

Example 2: SETROPTS CLASSACT(SURROGAT) RACLIST(SURROGAT)

6.4.4 The CICS Transaction Security

6.4.4.1 The CICS Transaction Security Mechanism

As next, the CICS transactions as part of the CICS resources have to be secured. The permission to execute a CICS transaction is controlled by the CICS Transaction Security Mechanism whether the transaction is initiated by the user, by another transaction, or by programs external to CICS using the CICS terminal. This method is sometimes referred to as **Transaction-Attach Security**. A transaction that is executed without accessing the terminal directly, for instance during the CICS region start up, is also RACF checked. This method of the transaction security mechanism is also called as the **Non-Terminal Transaction Security**.

The Transaction Security Mechanism is activated by the associated SIT-parameter *XTRAN* set in the CICS SIT which becomes only active when the SIT-parameter *SEC* is also set to *YES*. If the SIT-parameter *XTRAN* is set to *YES*, RACF has to use the security profiles stored within the IBM-supplied RACF resource classes *TCICSTRN* and *GCICSTRN*, whereas specifying an own defined resource class name on the SIT-parameter *XTRAN* implies, that RACF has to use the security profiles stored in this resource class.

Transactions existing on CICS regions can be subdivided into CICS transactions supplied by IBM and transactions installed by CICS users. CICS-supplied transactions can be indicated as those IBM-supplied transactions that start with the letter *C*. They cannot be modified or deleted. In contrast, the transactions installed by CICS users are, for instance, the MQSeries CICS transactions, and, of course, the transaction NACT of the bank customer account application NACT.

IBM groups its supplied CICS transactions into three default categories. All transactions which CICS needs for internal use are called CAT1-transactions. No user except the CRU *STCCICS* requires an access to initiate these transactions. In contrast to these CICS-supplied internal transactions there exist two other transaction categories – CAT2- and CAT3-transactions. Transactions which CICS does not require for internal processing and which should not be executed by everybody are called CAT2-transactions. CAT2-transactions can be initiated by CICS users in dependence on their access permission, whereas CAT3-transactions are exempt from any security check. All CICS users must have an access to the CAT3-transactions, therefore, CICS permits all users to use these transactions. Protecting the CICS transactions is done by adding the user/group ID to the access list. Because it is only checked whether a user may initiate the transaction, it is only required a READ access to them.

6.4.4.2 Using security profiles to protect CICS transactions

CICS transactions can be secured by RACF transaction security profiles stored into IBM-supplied or own defined security classes. Single transactions should be secured by profiles stored within a member security class instead of creating a group consisting of this one and only transaction. When the IBM-supplied security classes are used the member security class is called *TCICSTRN*. Grouped transactions have to be secured by profiles stored within a group security class. IBM provides for them the *GCICSTRN* security class. Using transaction group profiles simplifies the security administration. The users need only an access to the transaction group to use its transactions.

Each profile and its access list can be added to the RACF classes when submitting appropriate RACF commands on the TSO/E command line. A better and common way is to build TSO/E CLISTs. They can contain special TSO/E commands or complex programming tasks written with the interpretive CLIST language. There are some important statement each CLIST contains. The *PROC* statement must be always the first command of a CLIST. It is followed by the *CONTROL* statement which defines the processing options for the CLIST. If the option *MAIN* is specified the main CLIST follows. *ASIS* means that the character strings have to be read as they were written, for example if written in lower case the letters will not be converted into upper case. The *SET* statement assigns values to a symbolic or control variable. The *WRITE* and *WRITENR* statements display a message on the screen. Using the *WRITE* statement causes the cursor to return to the beginning of the next line after the message. When using the *WRITENR* statement, the cursor remains at the end of the message text (NR is for “No Return”). Further information about TSO/E CLISTs is available from the book [TEC99].

In the case, the SIT-parameters *SEC=YES* and *XTRAN=YES* are set and the CICS region is restarted before any transaction security profile is defined, nobody has an access to initiate a CICS transaction. Hence, there has been firstly defined one generic profile called **** stored to the member security class *TCICSTRN*. This profile gives all CICS users an access to all transactions of the CICS region, the transactions defined on their own, too. Therefore, *UACC=READ* has to be set. However, before any generic profile can be defined to the RACF security class *TCICSTRN* following command must be issued to activate the storing of generic profiles to the member security class *TCICSTRN*:

Example: `SETROPTS GENERIC(TCICSTRN)`

Afterwards, the transaction security profile is created using the RACF command *RDEFINE*:

Example: `RDEFINE TCICSTRN ** UACC(READ)`

Because all transactions should not be accessible by all CICS users some transactions have been protected against an unauthorised access. Such transactions are for instance the IBM-supplied CICS transactions and the transactions for CICS transactions supplied by MQSeries. They are grouped in different group profiles to be stored to the *GCICSTRN* security class. Although, this class stores profiles for groups of transactions, each transaction itself is secured by the super class *TCICSTRN*. Only three transactions in the CICS region A06C001 are secured using member profiles stored to the *TCICSTRN* class directly. For defining the transaction security profiles to the *TCICSTRN* and *GCICSTRN* transaction security classes there can be used the two example scripts *DFH\$CAT1* and *DFH\$CAT2* stored in the CICS install library *CICSTS13.CICS.SDFHSAMP*. According to these CLISTs, there have been created five scripts *CAT1JEDI*, *CAT2JEDI*, *CAT3JEDI*, *MQSJEDI*, and *USERJEDI* stored in the data set *CICS.COMMON.RACF*.

The CAT1-transactions have been secured within one group profile specified in the script *CAT1JEDI*, whereas *CAT2JEDI* specifies groups containing CAT2-transactions. The *CAT3JEDI* also contains only one group that secures the CAT3-transactions though they are exempt from any security check per default. A security check for those transactions is only used for the QUERY SECURITY Command Security (see chapter 9 in [RSG03]). MQSJEDI defines one member and two group profiles to secure CICS transactions supplied by MQSeries. Within USERJEDI some user-relevant transactions have been still secured as member profiles. All the profiles are stored into the RACF database and in the main/virtual storage of JEDI OS/390-server.

6.4.4.3 Securing the IBM-supplied CAT1-transactions

Based on the CLIST *CAT1JEDI* it is described how to built such a script to add a security profile to the CICS RACF group class (Listing 9 on the next page resp. Listing 56 on page 246). Line 1 of *CAT1JEDI* starts with the CLIST command *PROC*. The number behind this command refers to the number of positional parameters to expect, 0 represents none. The *CONTROL* statement in line 29 introduces the main CLIST statements. Firstly, some variables have been set within the lines 34-37 using the SET statement. The CAT1-transactions to be secured

have been summarised in the group profile *CAT1* created with the RACF command *RDEFINE* (lines 41-50). Within the parameter *ADDMEM* the transaction identifiers are added to the profile *CAT1*. Authorised users have been added to the access list with the RACF command *PERMIT* in line 54. It is not needed to specify the *ACCESS* attribute together with an authority level, in case, a READ access is wanted as the level. Per default RACF assigns the READ access. The authorised user – the CRU *STCCICS* – has been set in line 37 using the variable *ACCESSLIST*. All messages to be displayed on the screen have been specified to the script using the CLIST commands *WRITE* resp. *WRITENR* (line 52, 56-58). Within the *ADDMEM* parameter there have been listed only the CAT1-transactions available on the CICS region A06C001. However, there are some more CAT1-transactions IBM usually provides within the CICS installation. For more information about these missing transactions and for a description of the function of the listed transactions refer to chapter 10 of [RSG03].

After the first time, this script has been successfully executed, the CICS resource class *TCICSTRN* needs to be activated using the RACF command *SETROPTS CLASSACT* to activate the CICS-supplied transaction security class *TCICSTRN*. Because the profiles should be stored in main/virtual storage the attribute *RACLIST* has been also specified:

Example: `SETROPTS CLASSACT(TCICSTRN) RACLIST(TCICSTRN)`

Using this command activates also all other CICS general resource and stores them to the main/virtual storage because they all have the same POSIT-number. Therefore, only one of the member classes needs to be refreshed with the *SETROPTS* command after a profile – group or member – has been modified or added to the RACF

```

01 PROC 0
...
29 CONTROL MAIN ASIS
...
34 SET NOTIFY      = NILSM
35 SET OWNER       = SYS1
36 SET CLASSNAME   = GCICSTRN
37 SET ACCESSLIST  = STCCICS
...
41 RDEFINE &CLASSNAME CAT1 UACC(NONE) +
42         NOTIFY(&NOTIFY) +
43         OWNER(&OWNER) +
44         ADDMEM(CATA, CATD, CDBD, CDBF, CDBO, +
45               CDBQ, CDTS, CESC, CEX2, CFTS, +
46               CIOD, CIOF, CIOR, CITS, CMTS, +
47               CRMD, CRMF, CRSQ, CRSY, CSFU, +
48               CSKP, CSNC, CSNE, CSPQ, CSQC, +
49               CSTE, CSZI, CWBG, CWXN, CXCU, +
50               CXRE)
51
52 WRITENR CICS CAT1-Transactions have been defined to RACF.
53
54 PERMIT CAT1 CLASS(&CLASSNAME) ID(&ACCESSLIST)
55
56 WRITENR The specified users have now access to the CAT1-Transactions.
57 WRITE
58 WRITENR End of CAT1JEDI CLIST.
```

Listing 9: Extract from the CLIST CAT1JEDI stored in the data set CICS.COMMON.RACF

database. For CICS general resource classes and POSIT-numbers refer to chapter 6.2.3 “Data set and general resource profiles” on page 164.

6.4.4.4 Securing the IBM-supplied CAT2-transactions

The sample *DFH\$CAT2* supplied in the library *CICSTS13.CICS.SDFHSAMP* can be used as a template to define all the other transaction security profiles. From that script the CLIST *CAT2JEDI* has been created to secure the CAT2-transactions containing ten group profiles stored to the *GCICSTRN* security class (cf. Listing 55, page 246): *ALLUSER*, *CICSGAST*, *DBCTL*, *DEVELOPER*, *INQUIRE*, *INTERCOM*, *OPERATOR*, *PRAKT*, *SYSADM*, and *WEBUSER*. Table 13 on the next page lists all the profile groups consisting of some transactions defined within the script *CAT2JEDI*. The profiles *DBCTL* and *WEBUSER* have been created to deny any access to transactions specified within. Therefore, no access list has been defined to both profiles. The owner of all the created profiles is the RACF super user group *SYSI* (line 47, Listing 55). The access to the CAT2-transactions have been given in necessity of the needs by the CICS users. The *UACC* parameter in all CAT2-transaction group profiles is set to *NONE* except the one in the profile *ALLUSER*, where the universal access has been set to *READ* (lines 63-66, Listing 55). The three transactions secured with this group profile are needed by all CICS terminal users. The other CAT2-transactions are closed against a universal access. Only users added to the access list of the security profiles with at least a *READ* authority are allowed to execute those transactions protected by the profiles.

The profile *CICSGAST* permits an access to transactions executable by the users of the GAST TSO/E-group (lines 69-73, Listing 55) The GAST-users should only test the CICS environment, hence, they have gotten an access to some special transactions which can demonstrate some capabilities of the system. The user group *PRAKT* has an access to the transactions of the profiles *DEVELOPER* and *PRAKT* (lines 84-88, and 113-117, Listing 55). Access to the transactions of the profile *DEVELOPER* also have the user groups *ADMIN*, and *DIPLOM*. Furthermore, they have an access to the transactions of the profiles *INQUIRE* (lines 91-95, Listing 55), *OPERATOR* (lines 105-109, Listing 55), and *SYSADM* (lines 120-124, Listing 55). The profile *INTERCOM* secures transactions to be used for intercommunication within CICS. For future usage, the user group *STCGRP* containing some of the important user IDs of applications running on OS/390 has been given the authority to initiate these transactions.

Furthermore, there have been defined on the script *CAT2JEDI* two more profiles which should protect transactions in the future. The members *CDBC* (interface menu transaction), *CDBI* (interface inquiry transaction), *CDBM* (interface operator transaction), *CDBT* (interface disconnection transaction) have been specified for the profile *DBCTL* (lines 85-89, Listing 55). These transactions should be protected, but no one needs them at this time, so no one has an access. The last listed profile *WEBUSER* protecting the single transaction *CWBA* is also protected by RACF but not accessible by any CICS user at this time (lines 137-141, Listing 55).

Profile Name	Transaction ID	Description
--------------	----------------	-------------

ALLUSER	CMAC	CICS Messages And Codes transaction
	CRTX	Routing transaction
	CSGM	Good Morning transaction
CICSGAST	CEMT	Master terminal transaction
	CEOT	Inquires on user's own terminal transaction
	CMSG	Message switching transaction
	CWTO	Write to operator transaction
PRAKT	CEMT, CEOT, CMSG, CWTO see profile CICSGAST	
	CEDA	Dynamic add resources transaction
	CEST	Supervisor terminal transaction
INQUIRE	CDBI	DB2 control interface (DBCTL) inquiry transaction
	CEDC	Transaction to view CICS resource definitions
OPERATOR	CEOT, CEST, CMSG, CWTO see profile PRAKT	
	CRTE	Start of transaction routing sessions
	CSFE	Test field engineering terminal transaction
	DSNC	DB2 attachment facility transaction
SYSADM	CEDA, CEMT see profile PRAKT	
	CDBC	DBCTL interface menu transaction
	CESD	Shutdown assist transaction
	CETR	Transaction for inquire and set trace options
	CIND	In-doubt test tool transaction
INTERCOM	CDFS	Dynamic starts with interval transaction
	CEHP	CICS OS/2 remote server mirror transaction
	CEHS	CICS/VM remote server mirror transaction
	CPMI	CICS OS/2 LU6.2 mirror transaction
	CSMI	ISC mirror transaction
	CSM1	ISC SYSMSG model transaction
	CSM2	ISC scheduler model transaction
	CSM3	ISC queue model transaction
	CSM5	ISC DL/1 model transaction
	CVMI	LU6.2 syncllevel 1 mirror transaction

Table 13: Profiles containing CAT2-transactions specified within the CLIST CAT2JEDI (according to [RSG03], ch. 10)

6.4.4.5 Securing the IBM-supplied CAT3-transactions

The script *CAT3JEDI* defines one transaction security profile called *CAT3* containing the CAT3-transactions (cf. Listing 54, page 246). Because all these transactions must be accessible by all the CICS terminal users the UACC parameter of the profile *CAT3* has been set to READ as same as for the profile *ALLUSER* defined within the script *CAT2JEDI*. Two important CICS transactions of the CAT3-transactions are the Sign-On and Sign-Off transactions with the identifier CESN resp. CESF. If the users do not have an access to these transactions they

cannot be sign on to the CICS terminal resp. sign off from it. Table 14 lists the transactions which have been added to the transaction security profile *CAT3*:

Transaction ID	Description
CSPP	3270 print support transaction
CSPG	BMS terminal paging transaction
CSPS	Scheduler for BMS terminal paging transaction
CLS1, CLS2, CLS3	ISC LU services model transactions
CLS4	Transaction to manage password expiry for ISC LU
CMPX	Transaction to ship ISC local queuing
CRSR	ISC remote scheduler transaction
CSSF	Transaction to cancel CRTE (see profile Operator)
CXRT	Transaction for the routing relay of transactions
CLQ2	Transaction for the outbound resynchronisation for APPC and MRO
CLR1	Transaction for the inbound resynchronisation for MRO
CLR2	Transaction for the inbound CNOS for APPC and MRO
CSRS	Transaction for the synchronisation of the 3614 message
CESN	Sign on transaction
CESF	Sign off transaction
CEGN	Goodnight transaction
CATR	Transaction to delete the auto-installed restart terminal
CQRY	Transaction to provide ATI query support
CSAC	Transaction to process the program abnormal condition
CSCY	Transaction to print the 3270 screen
CSPK	Transaction to provide the 3270 screen print
CSRK	Transaction to provide the 3270 screen print – release keyboard

Table 14: *CAT3-transactions secured by the CLIST CAT3JEDI*
(according to [RSG03], ch. 10)

6.4.4.6 Securing the MQSeries CICS transactions used for the NACT application

When the transaction security is enabled on the CICS region A06C001 the MQSeries CICS transactions should also be secured. Because at this time, all the CICS transactions are accessible on the CICS region except the IBM-supplied CICS transactions distinguished into CAT1-, CAT2, and CAT3-transactions. Within the script *MQSJEDI* there are defined two group profiles called *MQSeries* and *PLTMQS*, and one member profile for the MQSeries CICS DPL Bridge Task transaction CKBP (cf. Listing 55, page 246). The group profile *MQSeries* secures the transactions to administer the MQSeries CICS adapter. Table 15 lists all the transactions of the profile *MQSeries* with their descriptions. These transactions have been authorised for the user groups *ADMIN* and *DIPLOM* (lines 35-39, Listing 55).

Transaction ID	Description
Profile <i>MQSeries</i> :	

CKBM	Transaction to open the MQSeries CICS adapter control initial panel
CKQC	Same as CKBM
CKRT	Transaction to return to the MQSeries CICS adapter control initial panel
Transactions executed from the MQSeries CICS adapter control panels:	
CKCN	Connects the MQSeries queue manager and the MQSeries CICS adapter
CKDL	Starts the line mode display
CKDP	Transaction for the full screen display
CKRS	Displays some statistics
CKSD	Disconnects the MQSeries queue manager from the MQSeries CICS adapter
CKSQ	Start/stops the MQSeries CICS adapter resp. the transaction CKTI
<u>Profile <i>PLTMQS</i>:</u>	
CKAM	Handles unscheduled events (pending events) and generates messages to be sent to the terminal console
CKBR	Starts the MQSeries CICS BMT
CKTI	Starts the MQSeries CICS Task Initiator
<u>Profile <i>CKBP</i>:</u>	
CKBP	Starts the MQSeries CICS BDT

Table 15: MQSeries-supplied CICS transactions secured by the CLIST *MQSJEDI*

The transaction security profile *PLTMQS* consists of the three CICS transactions CKAM, CKBR, and CKTI (lines 42-45, Listing 55, and Table 15). These transactions are called when the MQSeries CICS adapter and bridge are started during the CICS region initialisation. CKBR starts the MQSeries CICS Bridge Monitor Task (BMT). In case a failure happens during the process, CKAM – the alert monitor of MQSeries – is called. For example, it reconnects MQSeries and CICS after an MQSeries restart, if the automatic connection is activated. CKTI monitors all the processes of the MQSeries CICS connection, for example it starts resp. monitors MQSeries-supplied CICS transactions, for example when a message is put onto a specific queue. Because all these transactions are referenced during the PLT-program *STRTCKBR* is loaded, the PLTPIU *PLTCICS* needs a READ access to them (line 46, Listing 55). For defining the PLTPIU refer to chapter 6.3.5 “The PLTPIU” on page 177. The PLT-program *STRTCKBR* is explained in chapter 5.4.2.5 “An automatic start job for the MQSeries CICS Bridge” on page 109.

After the MQSeries CICS BMT is started by the transaction CKBR and a message is put onto the MQSeries CICS Bridge queue the MQSeries CICS Bridge DPL Task (BDT) is initiated by the transaction CKBP (see Table 15). In case, no user ID has been specified in the message the MQSeries CICS BDT, the task always runs with the LOCAL level of authentication. Contrary, if a user ID is specified in a message there can be used three more levels – IDENTIFY, VERIFY_UOW, and VERIFY_ALL (refer to [RSG03], ch. 8.3.4.3, “Security considerations for the CICS bridge”). The MQSeries CICS Bridge has been started in the CICS region A06C001 with the LOCAL level of authentication. This means, that each CICS program run by the MQSeries CICS BDT is started with the DCU. Hence, the DCU needs an access to the MQSeries CICS BDT started by the transaction CKBP. This transaction has been secured by the transaction member profile *CKBP*. Consider, transaction member profiles must be stored in to the transaction security class *TCICSTRN*. The DCU *C001DEF* has been added to the

access list (lines 50-53, Listing 55). It has also to be verified that the PLTPIU *PLTCICS* is the surrogate user of the DCU, that is a must (refer to ch. 6.4.3 “The Surrogate User Security”, page 187).

6.4.4.7 Securing the transactions NACT and CSKL

Within the CLIST *USERJEDI* there have been defined two more member profiles – profile *NACT* secures the CICS transaction NACT and profile *CSKL* secures the transaction for the CICS Socket Listener for TCP/IP CSKL (cf. Listing 56, page 246). Both transaction profiles have been stored to the security class TCICSTRN. READ access to the CICS transaction NACT have got the user groups *ADMIN*, *DIPLOM*, *GAST*, and *PRAKT* (lines 36-39, Listing 56). Hence, they can initiate this transaction from the CICS terminal.

The CICS Socket Listener transaction CSKL that handles all inbound socket requests of the TCP/IP-protocol has to be authorised for the PLTPIU *PLTCICS* because it is also started by a PLT-program (lines 42-46, Listing 56).

6.4.5 The CICS Command Security

6.4.5.1 The CICS Command Security Mechanism

Due to the problems with the CICS Transaction Security, as described in chapter 6.4.1 “Decision about useful and necessary security mechanism” on page 185, there has been enabled the CICS Command Security. This mechanism secures the so-called SP-type commands. Using the SIT-parameter *XCMD=YES* enables the CICS Command Security Mechanism which is only activated when the SIT-parameter *SEC* is also enabled (cf. line 44, Listing 51, page 245). Per default RACF loads the standard command security classes *CCICSCMD* for the command member profiles and *VCICSCMD* for the command group profiles. If there should be used own defined command security classes they have to be named on this SIT-parameter.

All the SP-type commands are executable within the CEMT transaction or within a CICS application program that calls a specified CICS resource. SP-type commands used in a CICS application are also named as EXEC CICS commands. The subsets of the CEMT transaction CEBT, CEOT, and CEST use some but not all SP-type commands. The transaction CECI uses the same command-level interpreter as CEMT to enter an EXEC CICS command. All these transactions refer to the command security profiles stored within the CICS Command Security. With the SP-type commands only predefined CICS resources can be accessed. It is only needed to define the required authority level to these CICS resources to get an access to them, which can be one out of these three: READ, UPDATE, and ALTER. Table 16 lists the SP-type commands with the required access to execute them. For example, the *INQUIRE* command on a CICS resource can only be executed, when a *READ* access to the required CICS resource is permitted. For descriptions of CICS resources and how to secure them see next chapter.

Access permission	Command name
-------------------	--------------

READ	COLLECT	INQUIRE	
UPDATE	DISABLE	ENABLE	EXTRACT
	PERFORM	RESYNC	SET
ALTER	CREATE (CEDA INSTALL)	DISCARD	

Table 16: Access required for SP-type commands

(according to [RSG03], ch. 8)

CICS Command Security applies also to transactions which have an enabled CMDSEC option in their transaction resource definition. If it is enabled and the transaction initiates an appropriate SP-type command, a command security check is always made on the security profiles stored within the command security classes *CCIC-SCMD* resp. *VCICSCMD*. The *CMDSEC* parameter can also be set in the SIT globally. When specifying *CMDSEC=ALWAYS* in the SIT the transaction resource definition CMDSEC is set for all CICS transactions to *CMDSEC=YES*. However, this is not recommended because “invoking a command security check for every CICS command consumes extra overhead that reduces the performance of all your transactions.” ([RSG03], ch. 8) Setting *CMDSEC=ASIS* in the SIT implies that the security check has to obey the CMDSEC option in the transaction resource definition.

It is noticed, that a user who wants to execute an SP-type command within the CEMT, CEBT, CEOT, CEST, CECI transactions as same as within transactions having an enabled CMDSEC option on their transaction resource definition must have the permission to initiate the transaction given by the CICS Transaction Security (see chapter 6.4.4 “The CICS Transaction Security” on page 189).

6.4.5.2 Securing predefined CICS resources subject to CICS Command Security

The CLIST *COMIJEDI* stored in *CICS.COMMON.RACF* secures all the predefined CICS resources accessible by the SP-type commands listed in Table 16 (cf. Listing 10 on the next page; for a full listing see also Listing 57 on page 246). The script starts with the obligatory CLIST commands *PROC* and *CONTROL* (lines 1&70) as described in chapter 6.4.4.2 “Using security profiles to protect CICS transactions” on page 190. With the *SET* commands (line 74-78) there have been set variables for the:

- owner of the profiles: *OWNER=SYS1*
- group class to store the profiles in: *CLASSNAME=VCICSCMD*
- access authority the following user access lists require: *ALLUSER_ACCESS_LIST*, *CMDUPD_ACCESS_LIST*, and *CMDALT_ACCESS_LIST*.

The first security profile *ALLUSER* is created with the RACF command *RDEFINE* and is stored to the group class *VCICSCMD* using the variable *CLASSNAME* (line 87). The *ADDMEM* parameter lists the CICS resource identifiers accessible with the READ authority (lines 88-97). Such a READ authority have got the user groups *PRAKT*, *GAST*, *ADMIN*, and *DIPLOM* (line 100). Hence, all the CICS terminal users can at least execute the SP-

type commands to read a CICS resource. The section ACCESS(READ) in Table 17, which spreads from page 201 to 204, lists the CICS resources that can be accessed by all CICS users using the SP-type commands *COLLECT* and *INQUIRE*. Only the predefined CICS resource identifier *STATISTICS* can be used as an option with the command *COLLECT*. For all other specified resource identifiers the *INQUIRE* command is used.

The second security profile is called *CMDUPD* and makes resources accessible for an update process (line 106, Listing 10). Using the SP-type commands *SET*, *PERFORM*, *ENABLE*, *DISABLE*, *EXTRACT*, and *RE-SYNC* to access a CICS resource requires the UPDATE authority. On the *ADDMEM* parameter in line 107 are specified the resource identifiers subject to the UPDATE authority. Access to the specified resources have got only the user groups *ADMIN* and *DIPLOM* (line 114). Most of the resources accessible with *INQUIRE* command can also be accessed with the SET command (Table 17). The *PERFORM* command can be executed on seven predefined CICS resource identifiers, whereas the SP-type commands *DISABLE*, *ENABLE*, *EXTRACT*, and *RE-*

```

01 PROC 0
...
70 CONTROL MAIN ASIS /* LIST CONLIST SYMLIST
...
74 SET OWNER      = SYS1
75 SET CLASSNAME  = VCICSCMD
76 SET ALLUSER_ACCESS_LIST = PRAKT,GAST,ADMIN,DIPLOM
77 SET CMDUPD_ACCESS_LIST = ADMIN,DIPLOM
78 SET CMDALT_ACCESS_LIST = ADMIN,DIPLOM
...
87 RDEFINE &classname ALLUSER UACC(NONE) +
88     ADDMEM(AUTINSTMODEL,AUTOINSTALL,CFDTPPOOL,CONNECTION,DB2CONN,      +
89           DB2ENTRY,DB2TRAN,DELETSHIPED,DOCTEMPLATE,DSNAME,DUMPDS,      +
90           ENQMODEL,EXITPROGRAM,FILE,IRC,IRBATCH,JOURNALMODEL,        +
91           JOURNALNAME,JOURNALNUM,LINE,MODENAME,MONITOR,PARTNER,        +
92           PROCESSTYPE,PROFILE,PROGRAM,REQID,REQUESTMODEL,RRMS,        +
93           STATISTICS,STORAGE,STREAMNAME,SUBPOOL,SYSDUMPCODE,SYSTEM,    +
94           SYSTEM,TASK,TCLASS,TCPIP,TCPIPSERVICE,TDQUEUE,TERMINAL,      +
95           TRACEDEST,TRACEFLAG,TRACETYPE,TRANDUMPCODE,TRANSACTION,      +
96           TSMODEL,TSPOOL,TSQUEUE,TSQNAME,UOW,UOWDSNFAIL,UOWENQ,UOWLINK,+
97           VTAM,WEB) +
98     OWNER(&OWNER)
99
100 PERMIT ALLUSER CLASS(&classname) ID(&ALLUSER_ACCESS_LIST)
...
106 RDEFINE &classname CMDUPD UACC(NONE) +
107     ADDMEM(AUTOINSTALL,DELETSHIPED,DOCTEMPLATE,DSNAME,DUMP,DUMPDS,      +
108           EXITPROGRAM,IRC,LINE,MODENAME,MONITOR,REQUESTMODEL,RESETTIME,+
109           SECURITY,SHUTDOWN,STATISTICS,SYSDUMPCODE,SYSTEM,TASK,TCPIP,    +
110           TRACEDEST,TRACEFLAG,TRACETYPE,TRANDUMPCODE,TSQNAME,UOW,      +
111           UOWLINK,VTAM,WEB)+
112     OWNER(&OWNER)
113
114 PERMIT CMDUPD CLASS(&classname) ID(&CMDUPD_ACCESS_LIST) ACCESS(UPDATE)
...
120 RDEFINE &classname CMDALT UACC(NONE) +
121     ADDMEM(AUTINSTMODEL,CONNECTION,DB2CONN,DB2ENTRY,DB2TRAN,ENQMODEL,  +
122           FILE,JOURNALMODEL,LSRPOOL,MAPSET,PARTITIONSET,PARTNER,        +
123           PROCESSTYPE,PROFILE,PROGRAM,SESSIONS,TCLASS,TCPIPSERVICE,    +
124           TDQUEUE,TERMINAL,TRANSACTION,TSMODEL,TYPETERM) +
125     OWNER(&owner)
126
127 PERMIT CMDALT CLASS(&classname) ID(&CMDALT_ACCESS_LIST) ACCESS(ALTER)
...

```

Listing 10: Extract from the CLIST COMIJEDI stored in the data set CICS.COMMON.RACF

SYNC can only be executed within some CICS resources which are secured by the resource identifier *EXIT-PROGRAM*.

Not all the resource identifiers accessible with the UPDATE authority in the Table 17 has been added to the member list of the profile *CMDUPD* because they should also be accessible by the user groups *ADMIN* and *DIPLOM* issuing the two SP-type commands *CREATE* and *DISCARD*. For executing these both commands on a CICS resource they require an ALTER access. The profile which secures these resources is called *CMDALT* (line 120, Listing 10). The predefined CICS resources added to the security profile are listed within the *ADDMEM* parameter in lines 121-124. Issuing the RACF command *PERMIT* gives both user groups the ALTER authority (line 127).

Usually, the resource identifiers specified on the EXEC CICS commands matches the resource identifiers specified within the CEMT transaction. However, in some cases there are exceptions. These exceptions have been marked bold in Table 17.

Another exception is the SP-type command *CREATE* used with the CEMT transaction. This command does not exist for the transaction. It implies a *CEDA INSTALL* for which the user must have an ALTER access to the resource. Hence, all those users can install resources to the CICS region if they may execute the CEDA transaction. That are on the JEDI OS/390-server the user groups *PRAKT*, *DIPLOM*, and *ADMIN*. All these users may create any resource using the transaction CEDA until this resource has been protected by its associated resource security mechanism. When the several security mechanisms for the resources have been enabled, for example the Started Transaction Security, the CICS Program Security, or the Journal Log Security mechanisms, and no security profile for the started transactions or the CICS logs has been created, the user may not create any resource using CEDA. For the CICS programs it has to be enabled the parameter *XPPT* in the CICS region's SIT, for the CICS started transactions the parameter *XPCT*, and for CICS DB2-Entries the parameter *XDB2*. In case, that there exists a security profile for the resource and the user has an ALTER access to the resource profile, the user can create it. Therefore, the creation of a resource does not depend on the permission the user has to the SP-type commands, but it depends on the permission to the additional resource security profiles. However, they cannot delete resp. discard the resource from the CSD because this procedure can only be done within the CEMT transaction and its SP-type command *DISCARD*. For using this command the user needs an ALTER access to the resources subject to the SP-type command *DISCARD*, a lower access level blocks the creation.

Hence, the creation of a resource is always permitted until an explicit resource profile has been defined using the resource security classes as described in chapter 6.4.1 “Decision about useful and necessary security mechanism” on page 185. For further descriptions on how to activate the additional security mechanisms and create the security profiles refer to [RSG03]; begin at chapter 6 “Resource security”.

Resource to protect	EXEC CICS command	CEMT command	Remarks
ACCESS (READ)			
STATISTICS	COLLECT STATISTICS	----	
AUTINSTMODEL	INQUIRE AUTINSTMODEL	INQUIRE AUTINSTMODEL	
AUTOINSTALL	INQUIRE AUTOINSTALL	INQUIRE AUTOINSTALL	
CFDTPOOL	INQUIRE CFDTPOOL	INQUIRE CFDTPOOL	
CONNECTION	INQUIRE CONNECTION	INQUIRE CONNECTION	
DB2CONN	INQUIRE DB2CONN	INQUIRE DB2CONN	
DB2ENTRY	INQUIRE DB2ENTRY	INQUIRE DB2ENTRY	
DB2TRAN	INQUIRE DB2TRAN	INQUIRE DB2TRAN	
DELETSHIPPED	INQUIRE DELETSHIPPED	INQUIRE DELETSHIPPED	
DOCTEMPLATE	INQUIRE DOCTEMPLATE	INQUIRE DOCTEMPLATE	
DSNAME	INQUIRE DSNAME	INQUIRE DSNAME	
DUMPDS	INQUIRE DUMPDS	INQUIRE DUMPDS	
ENQMODEL	INQUIRE ENQMODEL	INQUIRE ENQMODEL	
EXITPROGRAM	INQUIRE EXITPROGRAM	----	
FILE	INQUIRE FILE	INQUIRE FILE	
IRBATCH	INQUIRE EXCI	INQUIRE EXCI	Both can be used
	INQUIRE IRBATCH	INQUIRE IRBATCH	
IRC	INQUIRE IRC	INQUIRE IRC	
JOURNALMODEL	INQUIRE JOURNALMODEL	INQUIRE JMODEL	Spelling!
JOURNALNUM	INQUIRE JOURNALNAME	INQUIRE JOURNALNAME	Resource name!
LINE	----	INQUIRE LINE	
MODENAME	INQUIRE MODENAME	INQUIRE MODENAME	
MONITOR	INQUIRE MONITOR	INQUIRE MONITOR	
PARTNER	INQUIRE PARTNER	INQUIRE PARTNER	
PROCESSTYPE	INQUIRE PROCESSTYPE	INQUIRE PROCESSTYPE	
PROFILE	INQUIRE PROFILE	INQUIRE PROFILE	
PROGRAM	INQUIRE PROGRAM	INQUIRE PROGRAM	
REQID	INQUIRE REQID	----	
REQUESTMODEL	INQUIRE REQUESTMODEL	INQUIRE REQUESTMODEL	
RRMS	INQUIRE RRMS	INQUIRE RRMS	
STATISTICS	INQUIRE STATISTICS	INQUIRE STATISTICS	
STORAGE	INQUIRE STORAGE	----	
STREAMNAME	INQUIRE STREAMNAME	INQUIRE STREAMNAME	
SUBPOOL	INQUIRE SUBPOOL	----	
SYSDUMPCODE	INQUIRE SYSDUMPCODE	INQUIRE SYDUMPCODE	Spelling!
SYSTEM	----	INQUIRE DSAS	These options require access to the same resource
	INQUIRE SYSTEM	INQUIRE SYSTEM	
TASK	INQUIRE TASK	INQUIRE TASK	Both can be used
	INQUIRE TASK LIST	----	
TCLASS	INQUIRE TCLASS	INQUIRE TCLASS	Both can be used
	INQUIRE TRANCLASS	----	
TCPIP	INQUIRE TCPIP	INQUIRE TCPIP	
TCPIPSERVICE	INQUIRE TCPIPSERVICE	INQUIRE TCPIPSERVICE	
TDQUEUE	INQUIRE QUEUE	INQUIRE QUEUE	Both can be used
	INQUIRE TDQUEUE	INQUIRE TDQUEUE	
TERMINAL	INQUIRE NETNAME	INQUIRE NETNAME	These options require access to the same resource
	INQUIRE TERMINAL	INQUIRE TERMINAL	

Table 17: The CICS resources accessible by the SP-type commands (continued on next page)

Resource to protect	EXEC CICS command	CEMT command	Remarks
TERMINAL	INQUIRE NETNAME	INQUIRE NETNAME	These options require access to the same resource
	INQUIRE TERMINAL	INQUIRE TERMINAL	
TRACEDEST	----	INQUIRE AUXTRACE	These options require access to the same resource
	----	INQUIRE GTFTRACE	
	----	INQUIRE INTTRACE	
	INQUIRE TRACEDEST	----	
TRACEFLAG	INQUIRE TRACEFLAG	----	
TRACETYPE	INQUIRE TRACETYPE	----	
TRANDUMPCODE	INQUIRE TRANDUMPCODE	INQUIRE TRDUMPCODE	Spelling!
TRANSACTION	INQUIRE TRANSACTION	INQUIRE TRANSACTION	
TSMODEL	INQUIRE TSMODEL	INQUIRE TSMODEL	
TSPOOL	INQUIRE TSPOOL	INQUIRE TSPOOL	
TSQUEUE	INQUIRE TSQNAME	INQUIRE TSQNAME	Both can be used
	INQUIRE TSQUEUE	INQUIRE TSQUEUE	
UOW	INQUIRE UOW	INQUIRE UOW	
UOWDSNFAIL	INQUIRE UOWDSNFAIL	INQUIRE UOWDSNFAIL	
UOWENQ	INQUIRE ENQ	INQUIRE ENQ	Both can be used
	INQUIRE UOWENQ	INQUIRE UOWENQ	
UOWLINK	INQUIRE UOWLINK	INQUIRE UOWLINK	
VOLUME	INQUIRE VOLUME	----	
VTAM	INQUIRE VTAM	INQUIRE VTAM	
WEB	INQUIRE WEB	INQUIRE WEB	
ACCESS (UPDATE)			
EXITPROGRAM	ENABLE PROGRAM	----	All options require access to the specified resource.
	DISABLE PROGRAM	----	
	EXTRACT EXIT	----	
	RESYNC ENTRYNAME	----	
CONNECTION	PERFORM ENDAFFINITY NETNAME	PERFORM ENDAFFINITY NETNAME	
DELETSHIPED	PERFORM DELETSHIPED	PERFORM DELETSHIPED	
DUMP	PERFORM DUMP	PERFORM DUMP	Both can be used
	----	PERFORM SNAP	
RESETTIME	PERFORM RESETTIME	PERFORM RESET	
SECURITY	PERFORM SECURITY REBUILD	PERFORM SECURITY (RE-BUILD)	REBUILD in the CEMT transaction is the default - it can be omitted!
SHUTDOWN	PERFORM SHUTDOWN	PERFORM SHUTDOWN	
STATISTICS	PERFORM STATISTICS RECORD	PERFORM STATISTICS (RECORD)	RECORD in the CEMT transaction is the default - it can be omitted!
AUTOINSTALL	SET AUTOINSTALL	SET AUTOINSTALL	
CONNECTION	SET CONNECTION	SET CONNECTION	
DB2CONN	SET DB2CONN	SET DB2CONN	
DB2ENTRY	SET DB2ENTRY	SET DB2ENTRY	
DB2TRAN	SET DB2TRAN	SET DB2TRAN	
DELETSHIPED	SET DELETSHIPED	SET DELETSHIPED	
DSNAME	SET DSNAME	SET DSNAME	
DUMPDS	SET DUMPDS	SET DUMPDS	

Table 17: The CICS resources accessible by the SP-type commands (continued on next page)

Resource to protect	EXEC CICS command	CEMT command	Remarks
ENQMODEL	SET ENQMODEL	SET ENQMODEL	
FILE	SET FILE	SET FILE	
IRC	SET IRC	SET IRC	
JOURNALNUM	SET JOURNALNAME	SET JOURNALNAME	Spelling!
LINE	----	SET LINE	
MODENAME	SET MODENAME	SET MODENAME	
MONITOR	SET MONITOR	SET MONITOR	
PROCESSTYPE	SET PROCESSTYPE	SET PROCESSTYPE	
PROGRAM	SET PROGRAM	SET PROGRAM	
STATISTICS	SET STATISTICS	SET STATISTICS	
SYSDUMPCODE	SET SYSDUMPCODE	SET SYDUMPCODE	Spelling!
SYSTEM	----	SET DSAS	These options require access to the same resource
	SET SYSTEM	SET SYSTEM	
TASK	SET TASK	SET TASK	
TCLASS	SET TCLASS	SET TCLASS	Both can be used
	SET TRANCLASS	----	
TCPIP	SET TCPIP	SET TCPIP	
TCPIPSERVICE	SET TCPIPSERVICE	SET TCPIPSERVICE	
TDQUEUE	SET QUEUE	SET QUEUE	Both can be used
	SET TDQUEUE	SET TDQUEUE	
TERMINAL	SET NETNAME	SET NETNAME	
	SET TERMINAL	SET TERMINAL	
TRACEDEST	----	SET AUXTRACE	These options require access to the same resource
	----	SET GTFTRACE	
	----	SET INTTRACE	
	SET TRACEDEST	----	
TRACEFLAG	SET TRACEFLAG	----	
TRACETYPE	SET TRACETYPE	----	
TRANUMPCODE	SET TRANUMPCODE	SET TRDUMPCODE	
TRANSACTION	SET TRANSACTION	SET TRANSACTION	
TSQUEUE	SET TSQUEUE	SET TSQUEUE	Both can be used
	SET TSQNAME	SET TSQNAME	
UOW	SET UOW	SET UOW	
UOWLINK	SET UOWLINK	SET UOWLINK	
VTAM	SET VTAM	SET VTAM	
WEB	SET WEB	SET WEB	
ACCESS (ALTER)			
CONNECTION	CREATE CONNECTION	CREATE CONNECTION	
DB2CONN	CREATE DB2CONN	CREATE DB2CONN	
DB2ENTRY	CREATE DB2ENTRY	CREATE DB2ENTRY	
DB2TRAN	CREATE DB2TRAN	CREATE DB2TRAN	
DOCTEMPLATE	CREATE DOCTEMPLATE	CREATE DOCTEMPLATE	
ENQMODEL	CREATE ENQMODEL	CREATE ENQMODEL	
FILE	CREATE FILE	CREATE FILE	
JOURNALMODEL	CREATE JOURNALMODEL	CREATE JOURNALMODEL	
LSRPOOL	CREATE LSRPOOL	CREATE LSRPOOL	
MAPSET	CREATE MAPSET	CREATE MAPSET	

Table 17: The CICS resources accessible by the SP-type commands (continued on next page)

Resource to protect	EXEC CICS command	CEMT command	Remarks
PARTITIONSET	CREATE PARTITIONSET	CREATE PARTITIONSET	
PARTNER	CREATE PARTNER	CREATE PARTNER	
PROCESSTYPE	CREATE PROCESSTYPE	CREATE PROCESSTYPE	
PROFILE	CREATE PROFILE	CREATE PROFILE	
PROGRAM	CREATE PROGRAM	CREATE PROGRAM	
REQUESTMODEL	CREATE REQUESTMODEL	CREATE REQUESTMODEL	
TCPIPSERVICE	CREATE TCPIPSERVICE	CREATE TCPIPSERVICE	
TDQUEUE	CREATE TDQUEUE	CREATE TDQUEUE	
TERMINAL	CREATE TERMINAL	CREATE TERMINAL	
TRANCLASS	CREATE TRANCLASS	CREATE TRANCLASS	
TRANSACTION	CREATE TRANSACTION	CREATE TRANSACTION	
TSMODEL	CREATE TSMODEL	CREATE TSMODEL	
TYPETERM	CREATE TYPETERM	CREATE TYPETERM	
AUTINSTMODEL	DISCARD AUTINSTMODEL	DISCARD AUTINSTMODEL	
CONNECTION	DISCARD CONNECTION	DISCARD CONNECTION	
DB2CONN	DISCARD DB2CONN	DISCARD DB2CONN	
DB2ENTRY	DISCARD DB2ENTRY	DISCARD DB2ENTRY	
DB2TRAN	DISCARD DB2TRAN	DISCARD DB2TRAN	
DOCTEMPLATE	DISCARD DOCTEMPLATE	DISCARD DOCTEMPLATE	
ENQMODEL	DISCARD ENQMODEL	DISCARD ENQMODEL	
FILE	DISCARD FILE	DISCARD FILE	
JOURNALMODEL	DISCARD JOURNALMODEL	DISCARD JMODEL	Spelling!
JOURNALNUM	DISCARD JOURNALNAME	DISCARD JOURNALNAME	Spelling!
PARTNER	DISCARD PARTNER	DISCARD PARTNER	
PROCESSTYPE	DISCARD PROCESSTYPE	DISCARD PROCESSTYPE	
PROFILE	DISCARD PROFILE	DISCARD PROFILE	
PROGRAM	DISCARD PROGRAM	DISCARD PROGRAM	
REQUESTMODEL	DISCARD REQUESTMODEL	DISCARD REQUESTMODEL	
TCPIPSERVICE	DISCARD TCPIPSERVICE	DISCARD TCPIPSERVICE	
TDQUEUE	DISCARD QUEUE	DISCARD QUEUE	Both can be used
	DISCARD TDQUEUE	DISCARD TDQUEUE	
TERMINAL	DISCARD TERMINAL	DISCARD TERMINAL	
TRANCLASS	DISCARD TRANCLASS	DISCARD TCLASS	Spelling!
TRANSACTION	DISCARD TRANSACTION	DISCARD TRANSACTION	
TSMODEL	DISCARD TSMODEL	DISCARD TSMODEL	

Table 17: The CICS resources accessible by the SP-type commands

(corrected version in contrast to [RSG03], ch. 8)

6.5 Authorising access to the CICS region

As an additional security option the CICS region must also be protected against its assigned application identifier. The access to the CICS region A06C001 is restricted by a security profile stored in the IBM-supplied RACF general resource class *APPL*. This profile must have the same name as the application identifier specified within the SIT-parameter *APPLID*. Each time the CICS region calls RACF to verify a sign-on, the CICS region's APPLID is passed to RACF. The security manager checks whether such a profile exists, and if yes, it is checked whether the user is permitted to access it. If the user may access the profile, RACF allows the sign-on to the CICS region.

However, the application identifier must be firstly defined in the CICS region's SIT definition script *C001* within the APPLID parameter (cf. Listing 51, page 245):

Script C001:

```
08 APPLID=A06C001,           APPLICATION NAME OF THE CICS REGION
```

As next, the *APPL* general resource profile A06C001 has to be defined to the resource class *APPL* using the RACF command *RDEFINE (RDEF)*:

```
RDEFINE APPL CICS_region_appl_id NOTIFY(user_id) OWNER(owner_id)    +
UACC(NONE)
```

```
Example: RDEFINE APPL A06C001 NOTIFY(TBUSSE) OWNER(IBMUSER)        +
UACC(NONE)
```

Following users/groups need an access to the *APPL* general resource profile *A06C001* – *ADMIN*, *DIPL*, *PRAKT*, and *GAST* as groups and the user IDs *STCCICS*, *C001DEF*, *PLTCICS*, and additionally *STCJGATE* as the user ID for the CICS Transaction Gateway. If the CRU and DCU have not been added to the access list of the profile *A06C001* it is impossible to start the CICS region. The RACF command *PERMIT* adds the users/groups to the access list of the *APPL* general resource profile. The users/groups need only a READ access to the profile:

```
Example: PERMIT A06C001 class(APPL) ID(ADMIN,DIPL,GAST,PRAKT,      +
C001DEF,STCCICS,PLTCICS,STCJGATE) ACCESS(READ)
```

After the general resource profile has been added and the access list for it is created, the information of the profile can be listed with the RACF command *RLIST(RL)*:

```
RLIST class_name profile_name all
```

```
Example: RLIST APPL A06C001 all
```

Before the profile can be used it has to be activated if it was not done previously:

SETROPTS CLASSACT(APPL) or

SETROPTS CLASSACT(APPL) RACLIST(APPL)

When the profile *A06C001* is saved to the main/virtual storage (already defined and activated), it is not necessary to activate the class again, it should only be refreshed:

SETROPTS RACLIST(APPL) REFRESH

6.6 Adjust the LOGIN terminal to pass capital letters to RACF

RACF recognises only upper case alphabetic characters. However, when a user wants to sign on to the CICS region, it could be possible that the data is passed to RACF as entered without converting the characters into upper case. The result is, that RACF denies the access. User IDs and passwords specified in the CESN transaction are only translated to upper case when the *UCTRAN(YES)* attribute is specified in the PROFILE resource definition of the transaction CESN.

For converting the characters into upper case a new profile called *AAACICST* has been created for the sign on transaction CESN. This profile has been copied from the original profile *DFHCICST* that CESN used by then. To get the information which profile the transaction CESN uses the transaction definition is searched for the profile name using following command:

```
CEDA DISP TRANS(CESN) GR(*)
```

Figure 78 on the next page lists the transaction definition CESN stored to the group *DFHSIGN* which is opened using the command VIEW (shortcut: v). This panel is searched for the profile the transaction uses – *DFHCICST* (Figure 79, next page). Both – CESN as a CICS supplied transaction stored in the group *DFHSIGN* and *DFHCICST* as a CICS supplied profile stored in the group *DFHSTAND* – cannot be modified until they have been copied into a new group. CICS does not allow any modifying of resources beginning with the string DFH or stored to groups beginning with that string. After the profile name is known, the transaction CESN as CESN and the profile definition *DFHCICST* as *AAACICST* have been copied into a new CICS resource group, for example *TYPENEU* (Figure 80 & Figure 81, both on page 209). If such a CICS resource group does not yet exist, CICS creates it new by taking the letters from the parameter *to(...)*.

When issuing *CEDA DISPLAY GR(TYPENEU)* the content of the new group *TYPENEU* is displayed (Figure 82, page 210). The profile *AAACICST* can be modified when the command ALTER (shortcut: a) is specified behind the resource name. This opens the alter panel to set the *UCTRAN* attribute to *YES* (Figure 83, page 210). Afterwards, this profile name has to be specified to the transaction definition of CESN on its parameter *PROFILE* (Figure 84, page 211). Before the *UCTRAN* parameter is activated, both resource definitions need to be installed to the CSD using the *CEDA INSTALL GROUP* command. CICS now converts all lower cases characters to upper case on the sign-on terminal.

```

DISP TRANS(CESN) GR(*)
ENTER COMMANDS
NAME      TYPE      GROUP      DATE      TIME
CESN      TRANSACTION DFHSIGN    V      99.232  12.12.27

RESULTS: 1 TO 1 OF 1
PF 1 HELP      3 END 4 TOP 5 BOT 6 CRSR 7 SBH 8 SFH 9 MSG 10 SB 11 SF 12 CNCL

                                SYSID=C001 APPLID=A06C001
                                TIME: 17.54.29 DATE: 03.265

```

Figure 78: Search for the transaction CESN – CEDA TRANS(CESN) DISP GR(*)

```

OBJECT CHARACTERISTICS                                CICS RELEASE = 0530
CEDA View TRANSAction( CESN )
TRANSACTION    : CESN
Group          : DFHSIGN
Description    :
PROGRAM        : DFH SNP
Twasize        : 00000                                0-32767
PROFILE        : DFHCICST
PARTITIONSET   :
STATUS         : Enabled                               Enabled | Disabled
PRIMESIZE      : 00000                                0-65520
TASKDATALOC    : Below                                Below | Any
TASKDATAKEY    : Cics                                 User | Cics
STORAGECLEAR   : No                                  No | Yes
RUNAWAY        : System                               System | 0 | 500-2700000
SHUTDOWN       : Disabled                             Disabled | Enabled
ISOLATE        : Yes                                  Yes | No
BREXIT         :
+ REMOTE ATTRIBUTES

                                SYSID=C001 APPLID=A06C001
PF 1 HELP 2 COM 3 END      6 CRSR 7 SBH 8 SFH 9 MSG 10 SB 11 SF 12 CNCL

```

Figure 79: Display the transaction CEDA using DISP TRANS(CESN) GR(DFHSIGN)


```

disp trans(CESN) gr(*)
ENTER COMMANDS
NAME      TYPE      GROUP      DATE      TIME
CESN      TRANSACTION DFHSIGN  c as(CESN) to(TYPENEU)  99.232  12.12.27

```

```

RESULTS: 1 TO 1 OF 1
PF 1 HELP      3 END 4 TOP 5 BOT 6 CRSR 7 SBH 8 SFH 9 MSG 10 SB 11 SF 12 CNCL

                                SYSID=C001 APPLID=A06C001
                                TIME: 17.58.41 DATE: 03.265

```

Figure 80: Copy the transaction definition to the new group TYPENEU

```

disp profile(DFHCICST) gr(*)
ENTER COMMANDS
NAME      TYPE      GROUP      DATE      TIME
DFHCICST PROFILE DFHSTAND c as(AAACICST) to(TYPENEU)  99.232  12.12.29

```

```

RESULTS: 1 TO 1 OF 1
PF 1 HELP      3 END 4 TOP 5 BOT 6 CRSR 7 SBH 8 SFH 9 MSG 10 SB 11 SF 12 CNCL

                                SYSID=C001 APPLID=A06C001
                                TIME: 18.01.14 DATE: 03.265

```

Figure 81: Copy the profile definition to the new group TYPENEU as AAACICST

```

disp gr(TYPENEU)
ENTER COMMANDS
NAME      TYPE      GROUP      DATE      TIME
AAACICST  PROFILE    TYPENEU  a        03.265  18.01.16
CESN      TRANSACTION TYPENEU  03.265  17.48.51

RESULTS: 1 TO 4 OF 4
PF 1 HELP      3 END 4 TOP 5 BOT 6 CRSR 7 SBH 8 SFH 9 MSG 10 SB 11 SF 12 CNCL

SYSID=C001 APPLID=A06C001
TIME: 18.00.45 DATE: 03.065

```

Figure 82: Display the contents of the group TYPENEU

```

OBJECT CHARACTERISTICS
CEDA Alter PROFile( AAACICST )
PROFILE      : AAACICST
Group       : TYPENEU
Description  : PROFILE FOR SIGN-ON SCREEN
Scrnsize    : Default      Default | Alternate
Uctran      : Yes          No | Yes
Modename    :
Facilitylike :
PRIntercomp : No          No | Yes
JOURNALLING
Journal     : No          No | 1-99
MSGJrn1    : No          No | INPut | OutPut | INOut
PROTECTION
MSGInteg    : No          No | Yes
Onewte      : No          No | Yes
PROtect     : No          No | Yes
Chaincontrol : No          No | Yes
+ PROTOCOLS

PF 1 HELP 2 COM 3 END      6 CRSR 7 SBH 8 SFH 9 MSG 10 SB 11 SF 12 CNCL

SYSID=C001 APPLID=A06C001

```

Figure 83: Modify UCTRAN from NO to YES

```

OVERTYPE TO MODIFY                                CICS RELEASE = 0530
CEDA Alter TRANSAction( CESN )
  TRANSAction      : CESN
  Group            : TYPENEU
  Description      ==> THE SIGN-ON TRANSACTION
  PROGRAM          ==> DFHSNP
  TWasize          ==> 00000                0-32767
  PROFile          ==> AAACICST
  PARTitionset     ==>
  STATUS           ==> Enabled              Enabled | Disabled
  PRIMedsize       : 00000                0-65520
  TASKDATAloc     ==> Below                Below | Any
  TASKDATAkey     ==> Cics                 User | Cics
  STORageclear     ==> No                  No | Yes
  RUNaway         ==> System               System | 0 | 500-2700000
  SHutdown        ==> Disabled             Disabled | Enabled
  ISolate         ==> Yes                  Yes | No
  Brexit          ==>
+ REMOTE ATTRIBUTES

                                SYSID=C001 APPLID=A06C001

PF 1 HELP 2 COM 3 END          6 CRSR 7 SBH 8 SFH 9 MSG 10 SB 11 SF 12 CNCL

```

Figure 84: Modify the profile name to the new one

7 SUMMARY AND FURTHER WORK

7.1 Summary

In this master thesis we have built two operational on-line business applications called **NACT** and **MQNACT**. Both represent a little clip of a customer account program how it could be used in a bank to create, read, update, and delete a customer account and its information (*MQNACT* only supports reading an account record). Additionally, the account records can be browsed by *NACT* for the names of the customers. All these customer accounts are saved to a database-like file on an S/390 architectural computer system. Like each application it consists of a business logic and a presentation logic part. Stored on the OS/390-server the programs of the business logic written in COBOL are accessed on-line using two different methods. This on-line accessing is handled by IBM's OLTP system CICS which runs on the OS/390-server. Therefore, the business logic programs consist of some special CICS COBOL commands. The first method uses the transaction monitor itself to display the customer information. The results are displayed by a CICS presentation logic program, also written in COBOL, on the CICS terminal screen using the 3270 interface. Within the second technique, presentation logic programs written in JAVA access the customer accounts on the OS/390-server using IBM's middleware product MQSeries. The results of this request can be displayed on each computer system that supports JAVA resp. has installed a JVM, here, the WINDOWS2000 environment has been used.

Because the programs for the CICS application *NACT* are provided by a CD – pure and compiled – they have been uploaded onto the OS/390-server using the FTP protocol. The text then describes both – the presentation and the business logic of the CICS application. The CICS presentation logic consists of the programs *NACT01* and *NACT03*. *NACT01* is used to display the results on the CICS terminal screen, whereas *NACT03* can be used to print the customer information. However, the presentation logic not only consists of these two CICS COBOL programs. An additional file, a map set called *NACTSET*, is needed to create the design of the CICS application for the CICS terminal screen. This map set is written with BMS. When the required data is entered in the input fields of *NACT* on a CICS terminal it is sent by *NACT01* to the business logic programs where the request is processed. As a result, an information appropriate to the request is sent back to *NACT01* and is listed on the terminal screen using the “map set mask”. *NACT03* also uses the map set to send the response data to a printer connected with the OS/390-server. The three programs of the business logic are distinguished into: *NACT02* – the so-called CRUD program, that creates, reads, updates, and deletes an account; *NACT05* – the browse program to search accounts by the customer's name. As part of the CICS business logic, the error handling program *NACT04* takes up an exceptional position. This program is always called in case of a sudden occurred problem whether it is initi-

ated by the presentation logic programs *NACT01* or *NACT03* or by the business logic programs *NACT02* and *NACT05*.

For exchanging the data between the CICS COBOL programs there are used different storage areas of OS/390. The most important and interesting storage area that is used by the CICS COBOL programs is called COMMAREA. This scratchpad facility transfers not only data between programs of one transaction but also between programs of many transactions.

Instead using a database, there has been chosen to save all the customer information to a special OS/390 file type. Such a VSAM KSDS is predefined and delivered within OS/390 and stores information using the key-sequenced method. The customer account number has been chosen as the key under which the information is to be stored. The file that contains these customer account information has been called as the account file. From this file there has been created a browse file which arrange the customer accounts by their names. Each time a customer record in the account file is updated, a lock file is created to prevent the account file from concurrent updates. The first time, the account file has been filled by predefined customer data, also published within the CD.

Before NACT can be used on the CICS terminal a few CICS resource definitions have to be set up. These definitions have been added to the CSD and create entries for the five CICS COBOL programs, for the one map set, for the three file objects, and, of course, for the two transactions; one starts the screen application, the other the print procedure.

After the CICS application *NACT* has been installed and runs properly on the CICS terminal, a new application called *MQNACT* has been created that runs outside a CICS terminal. It uses message and queuing to transfer data between OS/390 and WINDOWS2000 resp. CICS and JVM. *MQNACT* also accesses the customer accounts stored on the OS/390-server for a read process only. It consists of the CICS business logic originally created for the CICS application NACT and of a presentation logic component created for the JVM. This JAVA application, in turn, consists of a GUI logic that uses the SWING package and of the MQSeries communication logic that sends the request data to a specified WINDOWS2000-client queue manager and gets the response data back from it. The data is transferred to another QM residing on the MQSeries server on OS/390 called OS/390-server queue manager. For this transport procedure some QM objects, for instance, message queues and message channels, have to be created on the QMs. Each QM has got a transmission queue, a reply-to queue, a remote queue *definition*, and a dead letter queue. These queue stores the data until transmission by message channels. Since each QM needs a channel sender to send data and an appropriate channel receiver, both have been created. Additionally, there has been added a server connection for the communication between the JAVA application and MQSeries to the WINDOWS2000-client queue manager. The JAVA application requests the CICS business logic program *NACT02* which accesses the customer records. For transferring the data from the OS/390-server queue manager to the CICS COBOL program a specific connection, the MQSeries CICS Bridge, is needed and has been installed. For starting this bridge automatically each time CICS starts up, a script has been created, compiled, and added to the CICS start up jobs.

Within the last topic we have described how to secure the CICS region A06C001 using the ESM RACF. Each time CICS calls RACF for a security decision it compares the entries in its database to give only a secured access to the CICS region and its resources. CICS resources are subdivided into general resources and data sets. For each of both, there exist special RACF mechanisms to secure the resources. They are classified into Data Set Protection, CICS Transaction Security, and CICS Command Security. Other mechanisms as the Terminal User Security and Surrogate User Security are RACF-supplied mechanisms. Each of these mechanisms uses RACF security profiles stored into special resource classes. The Terminal User Security mechanism controls whether a user is defined to RACF resp. has an appropriate user profile stored to the RACF database. After the users, who require an access to CICS and its resources, were identified, some required user IDs for the CICS region have been created – the CRU, the DCU, and the PLTPIU. Because the CRU has to act as a surrogate user for the DCU and PLTPIU, the Surrogate User Security mechanism has been used to define appropriate surrogate user profiles. Before any user may access the CICS region an appropriate authority to the region's APPLID must be added to its general resource class.

The Data Set Protection mechanism secures the CICS region data sets using data set security profiles stored to the RACF database. As part of the CICS general resources the transactions and the SP-type commands are secured by security mechanisms only available for CICS. The CICS Transaction Security secures the transactions distinguished into three categories (CAT) – CAT1-, CAT2-, and CAT3-transactions. CAT1-transactions are called as CICS internal transactions to which only the CRU requires an access. Transactions that should not be executed by everybody are called CAT2-transactions, whereas CAT3-transaction are exempt from any security check. For each of these transactions, IBM-supplied or user-installed, there have been defined the security profiles within CLISTs. The CLISTs *CATxJEDI* (x=1,2,3) hold the member and group profiles for the CATx-transactions supplied by CICS. For defining the security profiles for the user-installed transactions there have been created own CLISTs called *MQSJEDI* and *USERJEDI*. A CICS transaction can be executed when the user has a minimum READ access, a higher access is not needed.

The CICS Command Security secures the SP-type commands that can only be executed within the special CICS-supplied transaction CEMT, CEMT-dependend transactions, or within CICS application programs that use these SP-type commands on the EXEC CICS statement. With the SP-type commands only predefined CICS resources can be accessed. It is only needed to define the required authority level to these CICS resources to get an access to them. These CICS resources and their access permission by the SP-type commands are secured within the CLIST *COMIJEDI*.

For managing the RACF database special commands are used. These RACF commands are distinguished into commands used for user profiles, user group profiles, data set profiles and general resource profiles. Some information required for RACF is stored within parameters in the CICS region SIT. Into this table some new security related entries for the region have been added, for example, the names of the DCU, and PLTPIU. The CICS RACF security mechanisms are also activated by SIT-parameters as same as own defined class names for the security profiles can be set on the associated parameters. Last but not least, the CICS login terminal has been suited

properly to convert the characters entered on the sign on screen into upper case characters because RACF only recognises them.

Furthermore, this master thesis is introduced by two chapters explaining some facts of the Operating System /390 and of the OLTP system CICS. There have been also given some facts about the MOM system MQSeries.

7.2 Further Work

An interesting point for further work is to write the business logic in other programming languages as for example in JAVA, or using object oriented languages as C++, C#, or Object COBOL. This could result in a comparison of the performance of these new created business logic programs with the existing ones. Instead using the COMMAREA as a storage area for exchange data, the TWA could be used for programs executed within one transaction. Only for the transmission between transactions the COMMAREA should then be used.

As another extension, the customer accounts could be stored onto a real database managed by a database system, for example DB/2, to increase the information contents. Using this database system requires no more an additional browse file, browsing can be done within this one file. Some more customer informations could also be added to the database as same as using the bank application as a real one with adding money to an account, and withdraw money from an account.

Since the IMS/DB system is also a common transaction system used in industries worldwide, the business application could be implemented to use its transaction monitor. This implies also a comparison with the CICS transaction monitor.

It could be also interesting to implement a real credit card banking as a new feature to the application. A credit card double could be used on an ATM-like machine to demonstrate the hardware facilities.

The presentation logic could also be written in other languages, but a bit more interesting is to use other transfer mechanisms to work with the customer accounts stored on the OS/390-server. For example, the CICS Transaction Gateway, or EJBs could be used. Afterwards, a comparison between these methods could be created.

As seen, the generic profile ** in class *TCICSTRN* should not be used. It is better to use for each transaction an own security profile or add it to an existing profile. Otherwise, all users have an access to all the transactions not secured by security profiles. Furthermore, transactions created by students should always begins with the letter *P* for a better security administration.

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APPENDICES

APPENDIX A

The CICS Business Application NACT

A.1 Defining an SDS template using ISPF/PDF

An SDS template can also be created on OS/390 using the ISPF/PDF. This template has also to be set to the “fixed block” format with 80 blocks per record. One after another, all source files can be uploaded from the CD into this template. After each upload step, the transferred data are received into their designated data sets as same as described in chapter 4.2 “Uploading the files”.

After log on to TSO by entering a user ID with its associated password the CMAM appears (Figure 85). The ISPF/PDF program is started by entering the shortcut *P* on the OPTION line. This opens the ISPF PRIMARY OPTION MENU. From there, the option *UTILITY* (shortcut *3*) opens the UTILITY SELECTION PANEL. The *DATA SET* option (shortcut *2*) opens the DATA SET UTILITY (DSU). The short form *P.3.2* entered on the option line of the CMAM leads directly to the DSU (Figure 85). After entering the DSU the SDS template is allocated by entering *TBUSSE.CICSADP.NEWSEQ* in the field **Data Set Name** and typing an *A* on the command line (Figure 86). The next screen ALLOCATE NEW DATA SET appears (Figure 87). An SDS is created, if the **Directory blocks**-field is set to *0*. The record size of the data set is set to 2 MB as **Primary quantity** with an additional 1 megabyte as **Secondary quantity**. In the **Record format**-field *FB* is entered to fix the record length and use the block format. The **Record length** is fixed as 80 and the **Data set name type** is left blank. After confirming these adjustments by pressing the enter key the message “Data set allocated” appears in the upper right corner of the DSU screen. After that, the created template is ready to get data from the CD using FTP.

After a successful log on at the FTP client the command *dir* is executed. This displays a list of OS/390 data sets containing the newly created SDS-template *TBUSSE.CICSADP.NEWSEQ*. The column LRECL reports that the SDS has a fixed record length of 80 blocks (Figure 88). As next step, the important command *bin* is executed. By using this command binary source files are sent as binary files to OS/390. The files are transferred on to OS/390 using the command *put*, for instance (Figure 89):

```
put cicsadp.loa cicsadp.newseq
```

The file is can be received into its associated data set.

CUSTOMPAC MASTER APPLICATION MENU	
OPTION ==> P.3.2	SCROLL ==> PAGE
IS ISMF	- Interactive Storage Management Facility
P PDF	- ISPF/Program Development Facility
ATC ATC	- Application Testing Collection
ART ARTT	- Automated Regression Testing Tool
DB2 DB2	- Perform DATABASE 2 interactive functions
QMF QMF	- QMF Query Management Facility
C CPSM	- CICSplex/SM
M MQ	- MQSeries
MA MQAPPS	- MQSeries Utilities
IP IPCS	- Interactive Problem Control Facility
OS SUPPORT	- OS/390 ISPF System Support Options
OU USER	- OS/390 ISPF User Options
SM SMP/E	- SMP/E Dialogs
SD SDSF	- System Display and Search Facility
R RACF	- Resource Access Control Facility
DI DITTO	- Data Interfile Transfer, Testing and Operations
HC HCD	- Hardware Configuration Definition
S SORT	- DF/SORT Dialogs
F1=HELP	F2=SPLIT
F7=UP	F8=DOWN
F3=END	F9=SWAP
F4=RETURN	F10=LEFT
F5=RFIND	F11=RIGHT
F6=RCHANGE	F12=RETRIEVE

Figure 85: CUSTOMPAC MASTER APPLICATION MENU on the JEDI OS/390-server

Menu RefList Utilities Help	
Data Set Utility	
A Allocate new data set	C Catalog data set
R Rename entire data set	U Uncatalog data set
D Delete entire data set	S Data set information (short)
blank Data set information	M Allocate new data set
	V VSAM Utilities
ISPF Library:	
Project . . . _____	
Group . . . _____	
Type _____	
Other Partitioned, Sequential or VSAM Data Set:	
Data Set Name . . . 'TBUSSE.CICSADP.NEWSEQ'	
Volume Serial . . . _____	(If not cataloged, required for option "C")
Data Set Password . . . _____	(If password protected)
Option ==> a _____	
F1=Help	F3=Exit F10=Actions F12=Cancel

Figure 86: Data Set Utility screen in ISPF/PDF

Menu RefList Utilities Help		
Allocate New Data Set		
Data Set Name	TBUSSE.CICSADP.NEWSEQ	More: +
Management class	DEFAULT_	(Blank for default management class)
Storage class	PRIM90_	(Blank for default storage class)
Volume serial	SMS001	(Blank for system default volume) **
Device type	_____	(Generic unit or device address) **
Data class	_____	(Blank for default data class)
Space units	MEGABYTE_	(BLKS, TRKS, CYLS, KB, MB, BYTES or RECORDS)
Average record unit	_____	(M, K, or U)
Primary quantity	2_____	(In above units)
Secondary quantity	1_____	(In above units)
Directory blocks	0_____	(Zero for sequential data set) *
Record format	FB_____	
Record length	80_____	
Block size	11440_	
Data set name type :	_____	(LIBRARY, HFS, PDS, or blank) *
Command ==> _____		
F1=Help	F3=Exit	F10=Actions F12=Cancel

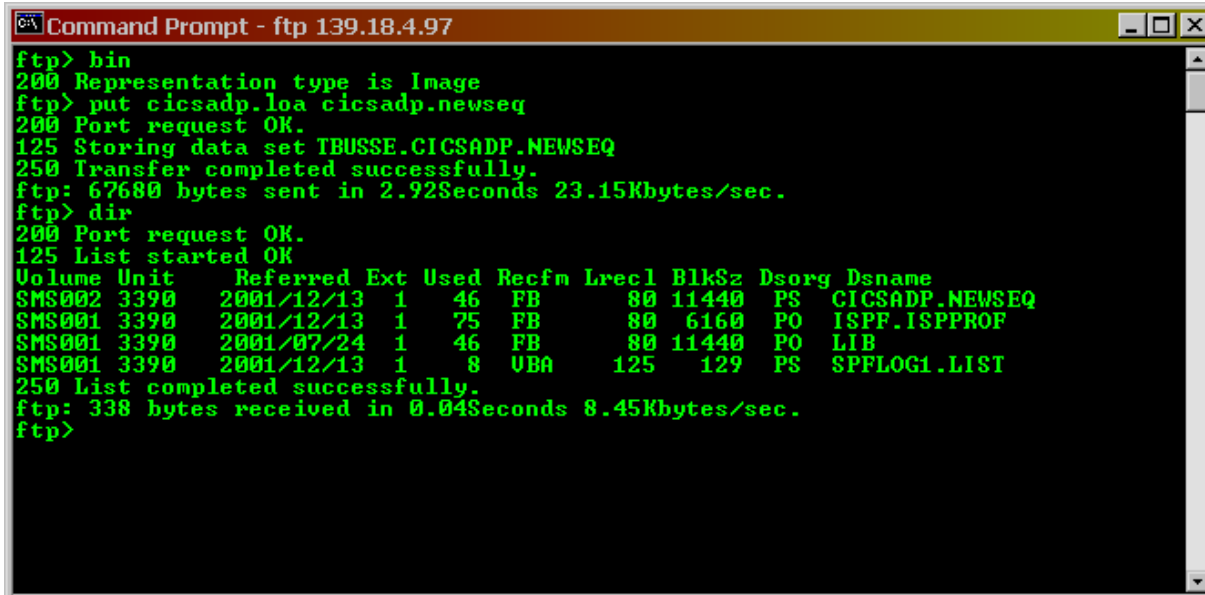
Figure 87: "Allocate New Data Set" screen in ISPF/PDF

```

C:\>ftp 139.18.4.97
Connected to 139.18.4.97.
220-FTPD1 IBM FIP CS V2R7 at TIWS007, 17:06:46 on 2002-12-13.
220 Connection will close if idle for more than 5 minutes.
User (139.18.4.97:(none)): TBUSSE
331 Send password please.
Password:
230 TBUSSE is logged on. Working directory is "TBUSSE."
ftp> dir
200 Port request OK.
125 List started OK
Volume Unit      Referred Ext Used Recfm Lrecl BlkSz Dsorg Dsname
SMS002 3390      **NONE**   1  46  FB    80 11440 PS  CICSADP.NEWSEQ
SMS001 3390      2001/12/13 1  75  FB    80  6160 PO  ISPF.ISPPROF
SMS001 3390      2001/07/24 1  46  FB    80 11440 PO  LIB
SMS001 3390      2001/12/13 1   8  VBA   125  129 PS  SPFLOG1.LIST
250 List completed successfully.
ftp: 338 bytes received in 0.10Seconds 3.38Kbytes/sec.
ftp>

```

Figure 88: FTP session – Listing the own files on OS/390



```
Command Prompt - ftp 139.18.4.97
ftp> bin
200 Representation type is Image
ftp> put cicsadp.loa cicsadp.newseq
200 Port request OK.
125 Storing data set TBUSSE.CICSADP.NEWSEQ
250 Transfer completed successfully.
ftp: 67680 bytes sent in 2.92Seconds 23.15Kbytes/sec.
ftp> dir
200 Port request OK.
125 List started OK
Volume Unit      Referred Ext Used Recfm Lrecl BlkSz Dsorg Dsname
SMS002 3390      2001/12/13 1  46  FB      80 11440 PS  CICSADP.NEWSEQ
SMS001 3390      2001/12/13 1  75  FB      80 6160  PO  ISPF.ISPPROF
SMS001 3390      2001/07/24 1  46  FB      80 11440 PO  LIB
SMS001 3390      2001/12/13 1   8  UBA     125 129  PS  SPFL0G1.LIST
250 List completed successfully.
ftp: 338 bytes received in 0.04Seconds 8.45Kbytes/sec.
ftp>
```

Figure 89: FTP-session – Copying one source file to OS/390

A.2 Listings referenced to in chapter 4

Listing 11: The physical map of the map set NACTSET

OS/390 – TBUSSE.CICSADP.COBSRCE(NACTSET)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobsrce/nactset

Listing 12: The symbolic description map of the map set NACTSET

OS/390 – TBUSSE.CICSADP.COBCOPY(NACTSET)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobcopy/nactset

Listing 13: The 3270 presentation logic of the NACT application – NACT01

OS/390 – TBUSSE.CICSADP.COBSRCE(NACT01)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobsrce/nact01

Listing 14: The CRUD business logic of the NACT application – NACT02

OS/390 – TBUSSE.CICSADP.COBSRCE(NACT02)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobsrce/nact02

Listing 15: The Browse business logic of the NACT application – NACT05

OS/390 – TBUSSE.CICSADP.COBSRCE(NACT05)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobsrce/nact05

Listing 16: The Error Handling business logic of the NACT application – NACT04

OS/390 – TBUSSE.CICSADP.COBSRCE(NACT04)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobsrce/nact04

Listing 17: The COBOL copybook NACWCRUD

OS/390 – TBUSSE.CICSADP.COBCOPY(NACWCRUD)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobcopy/nacwcrud

Listing 18: The COBOL copybook NACCTREC

OS/390 – TBUSSE.CICSADP.COBCOPY(NACCTREC)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobcopy/nacctrec

Listing 19: The COBOL copybook NACCCRUD

OS/390 – TBUSSE.CICSADP.COBCOPY(NACCCRUD)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobcopy/naccrud

Listing 20: Storing the data of the NACT application – Installing the account, locking, and name files on the OS/390-server

OS/390 – TBUSSE.CICSADP.JCLLIB(VSAM)

CD – listings/chapter4/os390/cobol/tbusse/cicsadp/cobsrc/jcllib/vsam

Listing 21: The CICS resource definitions for the NACT application

OS/390 – TBUSSE.CICSADP.CSDDEFS(CICSCSD)

CD – listings/chapter4/cobol/tbusse/cicsadp/cobsrc/csddefs/cicscsd

Listing 22: The additional CICS SIT definition script C001 (besides COMMON and END)

OS/390 – CICS.COMMON.SYSIN(C001)

CD – listings/chapter4/scripts/cics/common/sysin/c001

Listing 23: The CICS startup script CICSC001

OS/390 – SYS1.PROCLIB(CICSC001)

CD – listings/chapter4/scripts/sys1/proclib/cicsc001

APPENDIX B

The MQSeries CICS Business Application MQNACT

B.1 Reaching the log MSGUSR of the CICS region

Entering *sd.da* on the command line of the CMAM opens the DA-Panel (Figure 90). This panel displays active users in the sysplex. As next, the cursor has to be placed in the first column NP before the name of the started task procedure *CICSC001* and a question mark has to be entered (Figure 91). Pressing the enter key leads to the next panel – the logs of the CICS region A06C001. Into the log MSGUSR the MQSeries CICS Bridge writes its comments; to open the log, the character *S* has to be again entered into the column NP before the string *MSGUSR* (Figure 92). The log opens at the first message, but the interesting message is anywhere in the log. To search for messages about the MQSeries CICS Bridge queue the string *f bridge* or *find bridge* can be entered (Figure 93). Immediately, the result is presented (Figure 94).

CUSTOMPAC MASTER APPLICATION MENU			SCROLL ==> PAGE	
OPTION ==>	<i>sd.da</i>			
IS	ISMF	- Interactive Storage Management Facility		
P	PDF	- ISPF/Program Development Facility		
ATC	ATC	- Application Testing Collection		
ART	ARTT	- Automated Regression Testing Tool		
DB2	DB2	- Perform DATABASE 2 interactive functions		
QMF	QMF	- QMF Query Management Facility		
C	CPSM	- CICSplex/SM		
M	MQ	- MQSeries		
MA	MQAPPS	- MQSeries Utilities		
IP	IPCS	- Interactive Problem Control Facility		
OS	SUPPORT	- OS/390 ISPF System Support Options		
OU	USER	- OS/390 ISPF User Options		
SM	SMP/E	- SMP/E Dialogs		
<i>SD</i>	<i>SDSF</i>	- <i>System Display and Search Facility</i>		
R	RACF	- Resource Access Control Facility		
DI	DITTO	- Data Interfile Transfer, Testing and Operations		
HC	HCD	- Hardware Configuration Definition		
S	SORT	- DF/SORT Dialogs		
F1=HELP	F2=SPLIT	F3=END	F4=RETURN	F5=RFIND
F7=UP	F8=DOWN	F9=SWAP	F10=LEFT	F11=RIGHT
				F6=RCHANGE
				F12=RETRIEVE

Figure 90: Open the DA-Panel within SDSF

Display Filter View Print Options Help											

SDSF	DA SYS1	DAVI	PAG	0	SIO	0	CPU	13	LINE 1-17 (68)		
NP	JOBNAME	STEPNAME	PROCSTEP	JOBID	OWNER	C	POS	DP	REAL	PAGING	SIO
	MASTER			STC09096	+MASTER+	NS	FF	555	0.00	0.00	
	ALLOCAS	ALLOCAS				NS	FF	35	0.00	0.00	
	ANTAS000	ANTAS000	IEFPROC			NS	F1	83	0.00	0.00	
	ANTMAIN	ANTMAIN	IEFPROC			NS	FF	222	0.00	0.00	
	APPC	APPC	APPC			NS	FE	108	0.00	0.00	
	ASCH	ASCH	ASCH			NS	FE	69	0.00	0.00	
	BPXOINIT	BPXOINIT	BPXOINIT			LO	FF	73	0.00	0.00	
	CATALOG	CATALOG	IEFPROC			NS	FF	185	0.00	0.00	
?	CICSC001	CICSC001	CICS	STC17287	STCCICS	IN	F7	1485	0.00	0.00	
	CONSOLE	CONSOLE				NS	FF	60	0.00	0.00	
	DBA1DBM1	DBA1DBM1	IEFPROC	STC09124	DBA1DBM1	NS	FE	1262	0.00	0.00	
	DBA1DIST	DBA1DIST	IEFPROC	STC09131	DBA1DIST	NS	FE	129	0.00	0.00	
	DBA1IRLM	DBA1IRLM		STC09123	DBA1IRLM	NS	FE	71	0.00	0.00	
	DBA1MSTR	DBA1MSTR	IEFPROC	STC09122	DBA1MSTR	NS	FE	139	0.00	0.00	
	DBA1SPAS	DBA1SPAS	IEFPROC	STC09133	DBA1SPAS	NS	F1	84	0.00	0.00	
	DFS	DFS	GO	STC09135	DFS	NS	F1	67	0.00	0.00	
	DFSCM	DFSCM	GO	STC09103	+++++++	NS	FE	62	0.00	0.00	
COMMAND INPUT ===>										SCROLL ===> CSR	
F1=HELP			F2=SPLIT		F3=END		F4=RETURN		F5=IFIND		F6=BOOK
F7=UP			F8=DOWN		F9=SWAP		F10=LEFT		F11=RIGHT		F12=RETRIEVE

Figure 91: Placing a question mark in the column NP to display the logs

Display Filter View Print Options Help										

SDSF	JOB DATA	SET DISPLAY - JOB				CICSC001 (STC17287)		LINE 1-12 (12)		
NP	DDNAME	STEPNAME	PROCSTEP	DSID	OWNER	C	DEST		REC-CNT	PAGE
	JESMSG LG	JES2		2	STCCICS	K			364	
	JESJCL	JES2		3	STCCICS	K			125	
	JESYSMSG	JES2		4	STCCICS	K			462	
	PLIMSG	CICSC001		103	STCCICS	K			0	
	COUT	CICSC001		104	STCCICS	K			0	
	CEEMSG	CICSC001		105	STCCICS	K			0	
	CEEOUT	CICSC001		106	STCCICS	K			0	
	DFHCXRF	CICSC001		107	STCCICS	K			40	
S	MSGUSR	CICSC001		111	STCCICS	K			3,872	
	ATGPRINT	CICSC001		114	STCCICS	K			0	
	CAFF	CICSC001		115	STCCICS	K			0	
	CRPO	CICSC001		116	STCCICS	K			0	
COMMAND INPUT ==>										
F1=HELP		F2=SPLIT		F3=END		F4=RETURN		F5=IFIND		SCROLL ==> CSR
F7=UP		F8=DOWN		F9=SWAP		F10=LEFT		F11=RIGHT		F6=BOOK
										F12=RETRIEVE

Figure 92: Placing the character "S" in the column NP to display the MSGUSR log


```

Display Filter View Print Options Help
-----
SDSF OUTPUT DISPLAY CICSC001 STC17287 DSID 111 LINE 0 COLUMNS 02- 81
COMMAND INPUT ==> f bridge SCROLL ==> CSR
***** TOP OF DATA *****
DFHTD0402 04/03/04 17:25:42 A06C001 STCCICS CSSY TDQUEUE entry for CSSL has bee
DFHTD0402 04/03/04 17:25:42 A06C001 STCCICS CSSY TDQUEUE entry for CSTL has bee
DFHTD0402 04/03/04 17:25:42 A06C001 STCCICS CSSY TDQUEUE entry for CSZL has bee
DFHTD0402 04/03/04 17:25:42 A06C001 STCCICS CSSY TDQUEUE entry for CSZX has bee
DFHTD0402 04/03/04 17:25:42 A06C001 STCCICS CSSY TDQUEUE entry for CWBO has bee
DFHAM4893 I 04/03/04 17:25:42 A06C001 Install for group DFHDCTG has completed su
DFHPG0101 04/03/04 17:25:43 A06C001 STCCICS CSSY PPT entry for DFHTPQ has been
DFHPG0101 04/03/04 17:25:43 A06C001 STCCICS CSSY PPT entry for DFHTPR has been
DFHPG0101 04/03/04 17:25:43 A06C001 STCCICS CSSY PPT entry for DFHTPS has been
DFHXM0101 04/03/04 17:25:43 A06C001 STCCICS CSSY TRANSACTION definition entry f
DFHXM0101 04/03/04 17:25:43 A06C001 STCCICS CSSY TRANSACTION definition entry f
DFHXM0101 04/03/04 17:25:43 A06C001 STCCICS CSSY TRANSACTION definition entry f
DFHAM4893 I 04/03/04 17:25:43 A06C001 Install for group DFHBMS has completed suc
DFHPG0101 04/03/04 17:25:43 A06C001 STCCICS CSSY PPT entry for DFHCWT0 has been
DFHXM0101 04/03/04 17:25:43 A06C001 STCCICS CSSY TRANSACTION definition entry f
DFHAM4893 I 04/03/04 17:25:43 A06C001 Install for group DFHCONS has completed su
DFHFC0202 04/03/04 17:25:43 A06C001 STCCICS CSSY FCT entry for DFHDBFK has been
F1=HELP F2=SPLIT F3=END F4=RETURN F5=IFIND F6=BOOK
F7=UP F8=DOWN F9=SWAP F10=LEFT F11=RIGHT F12=RETRIEVE

```

Figure 93: Searching for the MQSeries CICS Bridge message

```

Display Filter View Print Options Help
-----
SDSF OUTPUT DISPLAY CICSC001 STC17287 DSID 111 LINE CHARS 'BRIDGE' FOUND
COMMAND INPUT ==> SCROLL ==> CSR
CSQC700I CKBR 0000027 IBM MQSeries for OS/390 v2.1 - CICS bridge. Copyright(c) 1
DFHFC0200 04/03/04 17:26:32 A06C001 Non-RLS file EZACONFG has been allocated to
DFHFCN.
CSQC702I CKBR 0000027 Monitor initialization complete
CSQC703I CKBR 0000027 Auth=LOCAL, waitInterval=-1, Q=SYSTEM.CICS.BRIDGE.QUEUE
DFHFC0201 04/03/04 17:26:32 A06C001 Non-RLS file EZACONFG has been deallocated.
DFHZC5966 I 04/03/04 17:27:15 A06C001 INSTALL started for TERMINAL ( CP03) (Mod
DFHZC6935 I 04/03/04 17:27:15 A06C001 Autoinstall for terminal CP03 with netname
AAALU2E2 successful.
DFHZC3461 I 04/03/04 17:27:16 A06C001 CP03 CSNE Node SC0TCP03 session started.
DFHPG0209 04/03/04 17:27:16 A06C001 CP03 C001DEF CESN PPT entry for DFHSNLEM has
DFHPGAMP.
DFHSN1105 04/03/04 17:27:20 A06C001 Signon at netname SC0TCP03 by user TBUSSE re
DFHSN1100 04/03/04 17:27:22 A06C001 Signon at netname SC0TCP03 by user TBUSSE in
DFHSN1200 04/03/04 17:34:40 A06C001 Signoff at netname SC0TCP03 by user TBUSSE i
0 errors.
DFHZC3462 I 04/03/04 17:34:40 A06C001 CP03 CSNE Node SC0TCP03 session terminated
DFHZC5966 I 04/03/04 17:34:40 A06C001 DELETE started for TERMINAL ( CP03) (Modu
F1=HELP F2=SPLIT F3=END F4=RETURN F5=IFIND F6=BOOK
F7=UP F8=DOWN F9=SWAP F10=LEFT F11=RIGHT F12=RETRIEVE

```

Figure 94: The MQSeries CICS Bridge has been successfully started

B.2 Listings referenced to in chapter 5

Listing 24: The script IEFSSN00 for the OS/390 subsystem name table

OS/390 – SYS1.PARMLIB(IEFSSN00)

CD – listings/chapter5/os390/scripts/sys1/parmlib/iefssn00

Listing 25: The start script MQA1MSTR for the queue manager MQA1

OS/390 – SYS1.PROCLIB(MQA1MSTR)

CD – listings/chapter5/os390/scripts/sys1/proclib/mqa1mstr

Listing 26: Non-recoverable objects for the queue manager MQA1 defined within the script CSQ4INP1

OS/390 – MQM.MQA1.SCSQPROC(CSQ4INP1)

CD – listings/chapter5/os390/scripts/mqm/mqa1/scsqproc/csq4inp1

Listing 27: Must have system objects for the queue manager MQA1 defined within the Script CSQ4INSG

OS/390 – MQM.MQA1.SCSQPROC(CSQ4INSG)

CD – listings/chapter5/os390/scripts/mqm/mqa1/scsqproc/csq4insg

Listing 28: System objects for distributed queuing and clustering (not CICS) for the queue manager MQA1 defined within the script CSQ4INSX

OS/390 – MQM.MQA1.SCSQPROC(CSQ4INSX)

CD – listings/chapter5/os390/scripts/mqm/mqa1/scsqproc/csq4insx

Listing 29: The script CSQ4STRT starts the Channel Initiator and the Channel Listener

OS/390 – MQM.MQA1.SCSQPROC(CSQ4STRT)

CD – listings/chapter5/os390/scripts/mqm/mqa1/scsqproc/csq4strt

Listing 30: CICS objects for the MQSeries CICS adapter defined within the script CSQ4B100

OS/390 – CICS.COMMON.CSDDEFS(CSQ4B100)

CD – listings/chapter5/os390/scripts/cics/common/csddefs/csq4b100

Listing 31: The script DFHCSD01 to update the CSD

OS/390 – CICS.COMMON.CSDDEFS(DHCSD01)

CD – listings/chapter5/os390/cics/common/csddefs/dfhcsd01

Listing 32: The script CSQ4INYG defines additional general objects for the queue manager MQA1

OS/390 – MQM.MQA1.SCSQPROC(CSQ4INYG)

CD – listings/chapter5/os390/scripts/mqm/mqa1/scsqproc/csq4inyg

Listing 33: The updated CICS SIT definition script C001 (besides COMMON and END)

OS/390 – CICS.COMMON.SYSIN(C001)

CD – listings/chapter5/os390/scripts/cics/common/sysin/c001

Listing 34: The script CSQ4CKBM defines the MQSeries CICS Bridge queue and its trigger process

OS/390 – MQM.MQA1.SCSQPROC(CSQ4CKBM)

CD – listings/chapter5/os390/scripts/mqm/mqa1/scsqproc/csq4ckbm

Listing 35: CICS objects for the MQSeries CICS Bridge defined within the script CSQ4CKBC

OS/390 – CICS.COMMON.CSDDEFS(CSQ4CKBC)

CD – listings/chapter5/os390/scripts/cics/common/csddefs/csq4ckbc

Listing 36: The MQSeries CICS Bridge – The script STRTCKBR to start the bridge automatically during CICS start up

OS/390 – CICS.COMMON.CICSSRC(STRTCKBR)

CD – listings/chapter5/os390/scripts/cics/common/cicssrc/strtkbr

Listing 37: The MQSeries CICS Bridge – The CICS COBOL compiling script DFHYITVL

OS/390 – CICSTS13.CICS.SDFHPROC(DFHYITVL)

CD – listings/chapter5/os390/scripts/cicsts13/cics/sdfhproc/dfhyitvl

Listing 38: The MQSeries CICS Bridge – The PLT for programs loaded during CICS startup

OS/390 – CICS.COMMON.TABSRC(PLTIT)

CD – listings/chapter5/os390/scripts/cics/common/tabsrc/pltit

Listing 39: The MQSeries CICS Bridge – The DFHAUPLE script that compiles PLT scripts

OS/390 – CICS.COMMON.TABSRC(DFHAUPLE)

CD – listings/chapter5/os390/scripts/cics/common/tabsrc/dfhauple

Listing 40: The MQSC file “mqadmvs.tst” defines the objects for the WINDOWS2000-client queue manager TBUSSE.NACT

CD – listings/chapter5/windows/mqseries/mqadmvs.tst

Listing 41: The batch file loads the MQSC script “mqadmvs.txt”

CD – listings/chapter5/windows/mqseries/def.cmd

Listing 42: The MQSeries communication logic of the JAVA application – MQCommunicator.java

CD – listings/chapter5/windows/java/MQCommunicator.java

Listing 43: The presentation logic of the JAVA application – MQClient.java

CD – listings/chapter5/windows/java/MQClient.java

APPENDIX C

Securing CICS with RACF

C.1 Restarting the CICS region

If a SIT should be rebuild the CICS region has to be restarted. There is no other way to create a new SIT for a CICS region. The CICS region needs also to be restarted in a few more situations. CICS can be shut downed by using the transaction CEMT within the command *PERFORM SHUTDOWN* that is typed on the CICS terminal:

```
CEMT PERForm SHUTdown
```

If an immediate shutdown is required the transaction command is:

```
CEMT PERForm SHUTdown Immediate
```

Before the CICS security was active these resp. every transaction could be executed by every user logged on to CICS. Performing a CICS shutdown after activation of the CICS security is only allowed to users which have permission to execute the transaction CEMT and the command *SHUTDOWN*. This message is displayed on the CICS terminal screen during a shutdown of CICS, if no security is activate:

```
A06C001  CICS is being quiesced by user ID STCCICS in transaction CEMT at netname SC0TCP02.
```

After activating CICS security this message shows "... user ID *TBUSSE* ..." instead of "... user ID *STCCICS* ...". Hence, CICS lists the user who initiated the shutdown.

The shutdown process of CICS can also be started from SDSF's LOG- or DAPanel by purging (*P*) the CICS jobname in case of a normal shutdown or by cancelling (*C*) the jobname from the command line. Sometimes, if the CICS terminal cannot be reached, the CICS region must be shut downed from SDSF. The appendant OS/390 commands are:

```
/P CICSC001
```

```
/C CICSC001
```

The restart of the CICS region can be performed by entering the OS/390 START command (*S*) together with the region start script CICSC001 on the command line in the SDSF LOG- or DAp panel:

```
/S CICSC001
```

It is essential to have the RACF system *SPECIAL* or *OPERATIONS* attribute to execute these commands.

C.2 Correction of a CICS system log failure after an OS/390-server IPL and a CICS restart

After the JEDI OS/390-server has been shut down and re-IPLed, a failure with the primary CICS system log DFHLOG occurred. As the CICS system log initialisation has been started during the CICS region restart due to the IPL, the primary CICS log stream called *A06C001.DFHLOG* stored to the VSAM KSDS *CICS.A06C001.D-FHLOG.DAVPLEX* should be accessed by the procedure *IEESYSAS*. This procedure is stored in the data set SYS1.PROCLIB. For the access the procedure needs an UPDATE authority but the job has not had the required authority. The data set profile *CICS.A06C001.*** existed not yet at this time (see chapter 6.3.6, “The CICS region data set protection”, page 178), only the generic data set profile *CICS.***.

Due to this behaviour an error message has been written to the OS/390 system log (Listing 44, next page). As listed in lines 03-06 of the Listing 44, the job *IEESYSAS* requires the UPDATE access to the generic data set profile *CICS.***. This could be specified with the RACF command *PERMIT* or *ALTDSD*:

Example 1: `PERMIT 'CICS.**' ID(IEESYSAS) ACCESS(UPDATE)`

Example 2: `ALTDSD 'CICS.**' UACC(UPDATE)`

Unfortunately, giving the job the required authority after the first impossible CICS region restart after an IPL is a pointless venture. CICS has intermediately deleted the VSAM KSDS due to the access failure during the region initialisation. When the region is then restarted again, CICS tries to create a new VSAM KSDS for the primary CICS system log using *IEESYSAS*, which is impossible, because *IEESYSAS* has only an UPDATE access. It now requires an ALTER access to create the data set. This error stops the CICS region initialisation again and shut down the CICS region. It is waited until the VSAM KSDS for the log stream is created. However, firstly it is checked, whether the log stream is still defined to the LOGR couple data set with the JCL-script *LISTLOG*, or not (Listing 45, next page). In the first line of Listing 45 is specified the job name *LILOG01* and some job parameters. The program *IXCMIAPU*, the administrative data utility to display and update the LOGR couple data set¹⁸, is defined in line 6. This program is stored in the data set *SYS1.MIGLIB* and therefore, it is set on the parameter *SYSLIB* in the next line. The *SYSIN* parameter introduces the commands to display the CICS system logs *A06C001.DFHLOG* and *A06C001.DFHSPUNT* (lines 9-11). *DATA TYPE(LOGR)* specifies that

¹⁸ For information about the LOGR couple data set and storing log streams to it refer to [MSS99].

the data which follows is for the LOGR couple data set. *REPORT(YES)* writes a complete report of the LOGR policies to the output.

```

01 +DFHLG0103I A06C001 System log (DFHLOG) initialization has started.
02 IEF196I ICH408I JOB(IEESYSAS) STEP(IXGLOGR )
03 IEF196I CICS.A06C001.DFHLOG.DAVPLEX CL(DATASET ) VOL(DAVS7A)
04 IEF196I INSUFFICIENT ACCESS AUTHORITY
05 IEF196I FROM CICS.** (G)
06 IEF196I ACCESS INTENT(UPDATE ) ACCESS ALLOWED(NONE )
07 ICH408I JOB(IEESYSAS) STEP(IXGLOGR ) 028
08 CICS.A06C001.DFHLOG.DAVPLEX CL(DATASET ) VOL(DAVS7A)
09 INSUFFICIENT ACCESS AUTHORITY
10 FROM CICS.** (G)
11 ACCESS INTENT(UPDATE ) ACCESS ALLOWED(NONE )
12 IEF196I IEC161I 040(056,006,IGG0CLFT)-002,IEESYSAS,IXGLOGR,SYS00002,,,
13 IEC161I 040(056,006,IGG0CLFT)-002,IEESYSAS,IXGLOGR,SYS00002,,,
14 IEF196I IEC161I CICS.A06C001.DFHLOG.DAVPLEX
15 IEC161I CICS.A06C001.DFHLOG.DAVPLEX
16 IEA794I SVC DUMP HAS CAPTURED: 038
17 DUMPID=001 REQUESTED BY JOB (IXGLOGR )
18 DUMP TITLE=COMPON=LOGGER,COMPID=5752SCLOG,ISSUER=IXGR1REC,MODUL
19 E=IXGA1MM ,ABEND=S00C9,REASON=00000009
20 IXG210E RECOVERY FOR LOGSTREAM A06C001.DFHLOG 039
21 IN STRUCTURE *NOT APPLICABLE* WAS NOT SUCCESSFUL.
22 DATA MAY BE LOST FOR THE CONNECTION ON SYSTEM DAVI DUE TO:
23 ERRORS ENCOUNTERED DURING STAGING DATASET PROCESSING.
24 DIAGNOSTIC INFORMATION: 00000008 00000008 0F010001 98286000
25 IXG231I IXGCONN REQUEST=CONNECT TO LOG STREAM A06C001.DFHLOG DID NOT 041
26 SUCCEED FOR JOB CICS001. RETURN CODE: 00000008 REASON CODE:
27 00000812 DIAG1: 00000000 DIAG2: 00000000 DIAG3: 03070023 DIAG4:
28 00000000
29 +DFHLG0772 A06C001 042
30 An error has occurred during MVS logger operation IXGCONN CONNECT for
31 log stream A06C001.DFHLOG. MVS logger codes: X'00000008',
32 X'00000812'. Log stream attributes: SYSTEMLOG(YES), DASDONLY(NO),
33 STRUCTNAME('*****'), RETPD(X'00000000'), AUTODELETE(NO).
34 +DFHME0116 A06C001 043
35 (Module:DFHMEME) CICS symptom string for message DFHLG0772 is
36 PIDS/565501800 LVLS/530 MS/DFHLG0772 RIDS/DFHL2HS2 PTFS/ESA530
37 VALU/H00000812
38 +DFHDU0205 A06C001 A SYSTEM DUMP FOR DUMPCODE: LG0772 , WAS
39 SUPPRESSED BY THE GLOBAL SYSTEM DUMP SUPPRESSION OPTION
40 +DFHLG0731 A06C001 A failure has occurred while opening the system log
41 (DFHLOG). CICS will be terminated.
...
53 IST804I CLOSE IN PROGRESS FOR A06C001 OPENED BY CICS001
54 IST400I TERMINATION IN PROGRESS FOR APPLID A06C001

```

Listing 44: Error messages explain that the primary CICS system log cannot be accessed

```

01 //LILOG01 JOB , 'TBUSSE',MSGCLASS=H,MSGLEVEL=(1,1),CLASS=A,
02 // NOTIFY=&SYSUID,REGION=6M
03 //*****
04 //* DISPLAY THE LOGSTREAMS *
05 //*****
06 //STEP1 EXEC PGM=IXCMIAPU
07 //SYSLIB DD DSN=SYS1.MIGLIB,DISP=SHR
08 //SYSPRINT DD SYSOUT=*
09 //SYSIN DD *
10 DATA TYPE(LOGR) REPORT(YES)
11 LIST LOGSTREAM NAME(A06C001.DFH*) DETAIL(YES)
12 /*

```

Listing 45: The script LISTLOG displays information about the log stream and its definition

```

IXG005I LOGR POLICY PROCESSING LINE# 2
LOGSTREAM NAME(A06C001.DFHLOG) STRUCTNAME() LS_DATACLAS()
LS_MGMTCLAS() LS_STORCLAS() HLQ(CICS) MODEL(NO) LS_SIZE(0)
STG_MGMTCLAS() STG_STORCLAS() STG_DATACLAS() STG_SIZE(3000)
LOWOFFLOAD(60) HIGHOFFLOAD(95) STG_DUPLEX(YES) DUPLEXMODE(UNCOND)
RMNAME() DESCRIPTION() RETPD(0) AUTODELETE(NO)
DASDONLY(YES) DIAG(NO)
MAXBUFSIZE(64000)

LOG STREAM ATTRIBUTES:
User Data:
0000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000

LOG STREAM CONNECTION INFO:
SYSTEMS CONNECTED: 1

      SYSTEM        STRUCTURE          CON CONNECTION   CONNECTION
      NAME          VERSION            ID  VERSION     STATE
-----
DAVI             0000000000000000    00  00000000    N/A

LOG STREAM DATA SET INFO:

DATA SET NAMES IN USE: CICS.A06C001.DFHLOG.<SEQ#>

Ext.  <SEQ#>      Lowest Blockid       Highest GMT         Highest Local      Status
-----
*00001 A0000000  0000000000000000                                CURRENT

NUMBER OF DATA SETS IN LOG STREAM: 1

POSSIBLE ORPHANED LOG STREAM DATA SETS:

NUMBER OF POSSIBLE ORPHANED LOG STREAM DATA SETS: 0

```

Listing 46: The output of the LIST LOGSTREAM request

LIST LOGSTREAM is the request to display LOGR policies specified within the *NAME* parameter. Detailed information about the named log stream(s) data and definition provides *DETAIL (YES)*. After the JCL script *LISTLOG* has been submitted the output is written to the job's log (Listing 46).

After it has been confirmed that the log stream *A06C001.DFHLOG* is still existing in the LOGR couple data set, it has been deleted to initialise it new to the LOGR couple data set. For the deletion a similar JCL-script as for the log stream listing has been used. The job name has been changed to *DELLOG1* and the LOGR request parameter changes to *DELETE LOGSTREAM*. The required name is specified on the *NAME* parameter (Listing 47, next page).

```

01 //DELLOG1 JOB , 'TBUSSE',MSGCLASS=H,MSGLEVEL=(1,1),CLASS=A,
02 //      NOTIFY=&SYSUID,REGION=6M
03 //*****
04 //* DISPLAY THE LOGSTREAMS *
05 //*****
06 //STEP1 EXEC PGM=IXCMIAPU
07 //SYSLIB DD DSN=SYS1.MIGLIB,DISP=SHR
08 //SYSPRINT DD SYSOUT=*
09 //SYSIN DD *
10 DATA TYPE(LOGR) REPORT(YES)
11 DELETE LOGSTREAM NAME(A06C001.DFHLOG)
12 /*

```

Listing 47: The script *DELLOG* deletes the log stream entry from the *LOGR* policy

```

01 //DEFCLOG JOB , 'TBUSSE',MSGCLASS=H,MSGLEVEL=(1,1),CLASS=A,
02 //      NOTIFY=&SYSUID,REGION=6M
03 //*****
04 //* DEFINE THE CICS LOGSTREAMS *
05 //* -----*
    ...
31 //STEP1 EXEC PGM=IXCMIAPU
32 //SYSLIB DD DSN=SYS1.MIGLIB,DISP=SHR
33 //SYSPRINT DD SYSOUT=*
33 //SYSIN DD *
34 DATA TYPE(LOGR) REPORT(YES)
35 DEFINE LOGSTREAM NAME(A06C001.DFHLOG)
36 DASDONLY(YES)
37 STG_SIZE(3000)
38 HLQ(CICS) MODEL(NO)
39 LOWOFFLOAD(60) HIGHOFFLOAD(95)
40 AUTODELETE(NO) RETPD(0)
41 MAXBUFSIZE(64000)
    ...
50 /*

```

Listing 48: The script *DEFCLOG* defines the log stream entry from the *LOGR* policy

When the log stream is deleted it can be new created to the *LOGR* couple facility. For this procedure the JCL-script *DEFCLOG* is used (Listing 48). The log stream is created with the command *DEFINE LOGSTREAM* and gets the name *A06C001.DFHLOG* using the parameter *NAME*. *DASDONLY(YES)* specifies that the log stream is for DASD-only and not for a coupling facility¹⁹. *STG_SIZE(3000)* is the size, as a number of 4 K blocks, of the staging data set for the log stream. *HLQ(CICS)* defines the high level qualifier which prefixes the name of the log stream data set. If the HLQ attribute is omitted “the log stream will have a high level qualifier of *IXGLOGR*.” ([MSS99], chapter Appendix B) The both attributes *LOWOFFLOAD* and *HIGHOFFLOAD* specifies the range in percentage where the MVS system logger starts and stops offloading data to the DASD log stream data sets. *MAXBUFSIZE* sets the size of the largest block that can be written to the log stream. The MVS system logger can automatically delete log data from the log stream using the attribute *AUTODELETE* after a retention period has been specified within *RETPD*. Both parameters must not be used for CICS system logs. Before the script *DEFCLOG* is to be executed an *ALTER* permission is required to create the VSAM KSDS. It is recommended to

¹⁹ Coupling facility or DASD-only? Please refer to chapter 1.20.2.1 in [CIG00].

specify *UACC(ALTER)* for a generic data set profile called *CICS.A06C001.*** that secures the VSAM KSDSs for the primary and secondary CICS system logs *DFHLOG* and *DFHSHUNT* on the CICS region A06C001. The data set profile is created with the RACF command *ADDSD* (*Example 1*) and stored in the *DATASET* resource class, which has then to be refreshed using the *SETROPTS* command (*Example 1*)

Example 1: `ADDSD 'CICS.A06C001.**' UACC(UPDATE)`

Example 2: `SETROPTS GENERIC(DATASET) REFRESH`

After the class *DATASET* has been refreshed the log stream can be created to the *LOGR* policy. Afterwards, the universal access to the data set profile *CICS.A06C001.*** can/should be set to *UPDATE*.

If you specify *REPORT(YES)* (or accept the default for the report keyword) with a *DATA TYPE* of *LOGR*, the requestor must have SAF read access to the *MVSADMIN.LOGR* resource to successfully obtain a report.

To define and delete log structures using *IXCMIAPU*, you need *ALTER* access to the *LOGR* resource profile named *MVSADMIN.LOGR* in the *FACILITY* general resource class. For example, use the following RACF command:

```
PERMIT MVSADMIN.LOGR CLASS(FACILITY) ACCESS(ALTER) ID(your_userid)
```

To define, delete, and update log streams (including log stream models) that are defined in coupling facility structures, you need:

- *ALTER* access to the appropriate log stream profile defined in the *LOGSTRM* general resource class
- *UPDATE* access to the coupling facility structure (*IXLSTR*) profile defined in the *FACILITY* general resource class (in this case, # profile names are prefixed with *IXLSTR*).

For example, if the log stream and structure resource profiles are defined to RACF with the following commands:

```
RDEFINE LOGSTRM log_stream_profile UACC(NONE) [NOTIFY]
```

```
RDEFINE FACILITY IXLSTR.structure_name_a UACC(NONE) [NOTIFY]
```

use the following RACF commands to give your userid the required authorizations to these two profiles:

```
PERMIT log_stream_profile CLASS(LOGSTRM) ACCESS(ALTER) ID
(your_userid)
```

```
PERMIT IXLSTR.structure_name_a CLASS(FACILITY) ACCESS(UPDATE) ID
(your_userid)
```

If SAF is not available or if there is no *CLASS(LOGSTRM)* or *CLASS(FACILITY)* class defined for the log stream or structure, no security checking is performed.

C.3 Listings referenced to in chapter 6

Listing 49: The default CICS region's SIT script COMMON

OS/390 – CICS.COMMON.SYSIN(COMMON)

CD – listings/chapter6/os390/scripts/cics/common/sysin/common

Listing 50: The CICS region's 2nd SIT script C001 – temporary version

CD – listings/chapter6/os390/scripts/cics/common/sysin/c001t

Listing 51: The CICS region's 2nd SIT script C001 – final version

OS/390 – CICS.COMMON.SYSIN(C001)

CD – listings/chapter6/os390/scripts/cics/common/sysin/c001

Listing 52: The CLIST CAT1JEDI secures Category-1 transactions

OS/390 – CICS.COMMON.RACF(CAT1JEDI)

CD – listings/chapter6/os390/scripts/cics/common/racf/cat1jedi

Listing 53: The CLIST CAT2JEDI secures Category-2 transactions

OS/390 – CICS.COMMON.RACF(CAT2JEDI)

CD – listings/chapter6/os390/scripts/cics/common/racf/cat2jedi

Listing 54: The CLIST CAT3JEDI secures Category-3 transactions

OS/390 – CICS.COMMON.RACF(CAT3JEDI)

CD – listings/chapter6/os390/scripts/cics/common/racf/cat3jedi

Listing 55: The CLIST MQSJEDI secures MQSeries CICS transactions

OS/390 – CICS.COMMON.RACF(MQSJEDI)

CD – listings/chapter6/os390/scripts/cics/common/racf/mqsjedi

Listing 56: The CLIST USERJEDI secures CICS User-transactions

OS/390 – CICS.COMMON.RACF(USERJEDI)

CD – listings/chapter6/os390/scripts/cics/common/racf/userjedi

Listing 57: The CLIST COM1JEDI secures CICS Resources subject to SP-type commands

OS/390 – CICS.COMMON.RACF(COM1JEDI)

CD – listings/chapter6/os390/scripts/cics/common/racf/com1jedi

Statement:

I declare that this master thesis was composed by myself and that the work contained herein is my own except where explicitly stated otherwise in the text. This work has not been submitted for any other degree or professional qualification except as specified.

Erklärung:

Ich, Tobias Busse, versichere, dass ich die vorliegende Arbeit selbstständig und nur unter Verwendung der angegebenen Quellen und Hilfsmittel angefertigt habe. Diese Arbeit wurde nicht für den Erhalt eines anderen wissenschaftlichen Grad veröffentlicht außer dem angegebenen.

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(Tobias Busse)