SAP Communication: CPI-C Programming (BC-CST-GW)

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SAP Communication: CPI-C Programming (BC-CST-GW)

SAP Communication: CPI-C Programming (BC-CST-GW)

In this documentation, you will learn how to implement program-to-program communication between SAP Systems (R/3 or R/2) and with external programs and systems using SAP's CPI-C interfaces.

CPI-C programming is only required in the following cases:

- Your program communicates with systems that do not support RFC (R/2 before Release 5.0D).
- You want to define your own protocol on the basis of CPI-C.
- You want to change an existing program which contains CPI-C calls.

The Remote Function Call interface further simplifies the implementation of communication. RFC is an SAP interface based on CPI-C. For more details on RFC, refer to the documentation Remote Communications [Extern].

For details on configuration, please refer to the documentation BC - SAP Communication Configuration [Extern].

The following topics are discussed in this documentation:

SAP Communication

This chapter explains basic terms and discusses communication in various forms of the SAP environment.

SAP Interfaces

Purpose

SAP program interfaces simplify and standardize communication between different systems and/or programs.

SAP communication interfaces exist at various levels. They are described in the following. The main subject of this documentation is the SAP communication interface CPI-C.

The following SAP communications interfaces are available:

- Communications Basis CPI-C [Seite 11]
- Remote Function Call (RFC) [Seite 13]
- Queue Application Programming Interface (Q-API) [Seite 14]

Communications Basis CPI-C

Definition

The *Common Programming Interface - Communications* (CPI-C) is a standard call interface for applications, which perform direct program-to-program communication.

CPI-C was first defined as a standardized communications interface by IBM in 1987, as part of the SAA standard.

CPI-C was modified by *X/Open* to include additional functions. SAP's CPI-C implementations support the *X/Open Developers' Specification - CPI-C*.

The main advantage of CPI-C is the easy portability of programs to various system platforms made possible by the common interface.

Use

The CPI-C communications interface essentially fulfills the following requirements of program-to-program communication:

- Communication setup
- Data exchange
- Data conversion (ASCII ↔ EBCDIC)
- Communication control
- Communication close

Structure

The CPI-C interface can be split into two function groups. This division does not, however, imply limitations in respect of possibilities to use and combine the functions. The function groups are there merely to guide the user:

- CPI-C Starter Set
- Advanced Function Calls

CPI-C Starter Set

These basic functions represent the minimum range of functions shared by two partner programs:

- Establishing a connection
- Data exchange
- Closing a connection

As these are the basic functions of a communication protocol, it is possible to reproduce the *CPI-C Starter Set* on protocols other than LU6.2.

The SAP CPI-C development library *cpictlib* is an example of mapping to TCP/IP.

Advanced Function Calls

These advanced functions essentially cover the following task areas:

- Data Conversion
- Synchronization and control
- Changes in communication characteristics
- Checking of communication characteristics
- Security functions

Integration

The CPI-C interface is available for both C and ABAP programs.

CPI-C Development Libraries

Function call interfaces for the C language.

These platform-specific and protocol-dependent libraries implement a series of function calls of the CPI-C communications interface. They also include SAP-specific function calls.

Function calls from the corresponding library enable communication between an external program and an ABAP program or an external program.

See also CPI-C interface in C [Seite 82].

CPI-C Interface in ABAP

This is the function call interface for ABAP.

It implements some function calls of the CPI-C interface.

This interface allows an ABAP program to communicate with an ABAP program from another SAP system (R/2 or R/3) or with a non-SAP program.

Further details are available in the section on CPI-C Implementation in ABAP [Seite 51].

A detailed description of the CPI-C interface is provided in the documentation on BC - SAP Communication: CPI-C Programming [Extern].

Remote Function Call (RFC)

Definition

This interface is logically above CPI-C. It simplifies the implementation of communication processes by relieving the programmer of the task of writing his own communication routines.

Use

The RFC interface enables function calls between two SAP systems (R/3 or R/2), or between an SAP system and an external one. The RFC library functions support the C programming language and Visual Basic (on Windows platforms).

In the case of asynchronous RFC, calls are also transmitted to remote systems when the target system is not active or momentarily cannot be reached (analog to Q-API).

For more details on this interface, refer to the following documentation:

Remote Communications [Extern]

Queue Application Programming Interface (Q-API)

Definition

Q-API is an interface for buffered data transfer. Data is transferred to the partner system using CPI-C.

This is a set of functions, which places the data temporarily in a database queue, to be processed later by a program running asynchronously.

Use

This SAP interface allows asynchronous data exchange between two systems (R/3, R/2 or an non-SAP system).

As of R/3 Release 3.0 you can use the transactional RFC for buffered data transfer.

The transactional RFC is not supported in R/2.

Communication in an IBM Host Environment (SNA)

Definition

A logical connection (Session [Extern]**Error! No bookmark name given.**) between two LUs (Logical Unit [Extern]**Error! No bookmark name given.**) is necessary for communication in a homogeneous SNA network. The SNA protocol LU6.2 is used when two application programs are to communicate via a session of this type. Active communication is known as a conversation [Extern].

A *conversation* between programs, which use different interfaces for the LU6.2 function calls, is possible.

Examples of such interfaces are:

- CPI-C, APPC [Extern], EXEC CICS...

One of the most important characteristics of the LU6.2 [Extern] protocol is that a transaction program [Extern] can call up a partner program on another system (Attach function). This allows connections to be set up dynamically and event-orientated data exchange between the two partners.

Integration

SAP offers a platform-specific development library for workstations which communicate with an R/2 SNA system.

A platform-specific SNA communications subsystem must be installed and properly configured on the workstation:

- SNAplusLink (HP)
- SNA Server (IBM)
- Transit (SNI)
- SNA Server (WindowsNT)

Communication between the workstation and host generally takes place via the SAP Gateway [Extern] (CPI-C Handler).

For information on hardware and software supported, refer to the following brochure: *SAP - Supported Network Products*.

Communication in a BS2000 Host Environment

Definition

As in the SNA world, a session [Extern] between two network users is used as a medium for data interchange.

In a BS2000 environment, program-to-program communication is possible with the following constellations:

- UTM on both partner systems

  A conversation [Extern] between two programs is based on UTM-D.

- DCAM with the SAP Gateway on the BS2000 host

  In addition to an R/3 System, any external system can communicate with the R/2 System via the SAP Gateway [Extern] and DCAM, providing the following requirements are met:

  – TCP/IP support

  – SAP communication interfaces (function libraries *cpictlib* or *librfc*)

  The SAP Gateway allows communication both with an UTM R/2 System and with a DCAM R/2 System.

For information on hardware and software supported, refer to the following brochure: *SAP - Supported Network Products*.

Detailed documentation on the SAP Gateway for BS2000 is supplied with the gateway, in the SAPGW.README file.

Communication in a TCP/IP Environment

In the following constellations, program-to-program communication is based on the TCP/IP transport protocol:

- R/3 ↔ R/3
- R/3 ↔ Non-SAP Program

  For non-SAP programs, SAP provides the platform-specific development library *cpictlib*.
- R/3 (or non-SAP program) ↔ R/2 in BS2000

  The SAP Gateway runs under *DCAM* (from V11) with *TCP/IP* and the Socket interface on the BS2000 host.

In all of these constellations, the SAP Gateway [Extern] (CPI-C Handler) is required.

For information on hardware and software supported, refer to the following brochure: *SAP-Supported Network Products*

Programming under Various Constellations

Various constellations are possible for communication between programs within the SAP world (R/2 and R/3), and between SAP programs and external programs.

Communication is based on various protocols, depending on constellation:

- SNA-LU6.2
- TCP/IP

If the R/2 host is a BS2000 System, the SAP Gateway runs under DCAM in BS2000 and communicates with R/3 or an external program on the basis of TCP/IP.

The SAP Gateway is always necessary for communication via one of the interfaces implemented by SAP.

The individual constellations are described in the following.

R/3 ↔ R/3 [Seite 19]

R/3 ↔ R/2 (MVS/VSE) [Seite 20]

R/3 ↔ R/2 (BS2000) [Seite 25]

R/3 ↔ Non-SAP Program [Seite 30]

R/2 ↔ R/2 [Seite 40]

R/2 ↔ Non-SAP Program [Seite 41]

C Program ↔ C Program [Seite 49]

Communication Between R/3 Systems

Purpose

An ABAP program in an R/3 System uses an RFC or CPI-C call to start an ABAP program in another R/3 System, and exchanges data with this program.

With this constellation, you must note the following guidelines:

- Using the RFC interface:
  - Choose the target system using transaction SM59.
  - The called function must be an ABAP function module, which has the “remote” ID in the function library.

  For more details on the RFC interface, refer to the documentation Remote Communications [Extern].
- Using the CPI-C interface
  - The calling ABAP program must build the data for the logon to the target system, convert it to EBCDIC and receive the response (possibly a denial) from the target system.
  - The side info table TXCOM must be configured in the calling R/3 System. For this, use transaction code SM54.

    For details on the configuration of TXCOM, refer to the relevant topic in the following documentation:

    BC SAP Communication: Configuration [Extern]
  - The target ABAP program must contain the form routine specified in the *connect* data.

  For details on CPI-C calls, refer to the topic CPI-C Implementation in ABAP [Seite 51].

Communication Between R/3 and R/2 (MVS/VSE)

Purpose

The following topics provide an overview about the prerequisites for the partner systems.

As of R/2 Release 5.0D, you can also use an RFC call instead of a CPI-C call.

The following limitation applies to an MVS/VSE host:

- CICS only as the DC system (at present)
- IMS as of Version 4.1 for complete LU6.2 support

These prerequisites depend on whether the calling system is R/3 or R/2:

From R/2 to R/3 [Seite 23] [Seite 21]

From R/3 to R/2 [Seite 21] [Seite 23]

From R/3 to R/2

Purpose

An ABAP program in an R/3 System uses an RFC or CPI-C call to start an ABAP program in an R/2 System on an MVS/VSE host, and exchanges data with this program.

The SAP Gateway builds connections to the R/2 host via LU6.2 using services of the SNA communication subsystem. Several communications requests can be processed via one SAP Gateway.

Prerequisites

With this constellation, you must note the following guidelines:

- Using the RFC interface:
  - There must be a SAP Gateway in use that supports SNA.
  - There must be an SNA communication subsystem.
  - The called function must be an ABAP function module, which has the “remote” ID in the function library.

  For more details on the RFC interface, refer to the documentation Remote Communications [Extern].
- Using the CPI-C interface
  - There must be a SAP Gateway in use that supports SNA.
  - There must be an SNA communication subsystem.
  - The ABAP target program on the R/2 host must contain the form routine specified in the *connect* data.
  - The calling ABAP program must build the data for the logon to the target system, convert it to EBCDIC and receive the response (possibly a denial) from the target system.
  - The side info table TXCOM must be configured in the calling R/3 System. For this, use transaction code SM54.

  For details on the configuration of TXCOM, refer to the relevant topic in the following documentation:
- Using the CPI-C interface
  - There must be a SAP Gateway in use that supports SNA.
  - There must be an SNA communication subsystem.
  - The ABAP target program on the R/2 host must contain the form routine specified in the *connect* data.
  - The calling ABAP program must build the data for the logon to the target system, convert it to EBCDIC and receive the response (possibly a denial) from the target system.

From R/3 to R/2

- The side info table TXCOM must be configured in the calling R/3 System. For this, use transaction code SM54.

For details on the configuration of TXCOM, refer to the relevant topic in the following documentation:

BC SAP Communication: Configuration [Extern]

Process flow

- Using the RFC interface:

  Once the above requirements have been met, select the target system with the Transaction SM59.

- Using the CPI-C interface

  For details on CPI-C calls, refer to the topic CPI-C Implementation in ABAP [Seite 51].

From R/2 to R/3

Purpose

An ABAP program in an R/2 System starts an ABAP program in an R/3 System and exchanges data with this program.

You can start the target program from the R/2 host via an SAP communications program.

Prerequisites

The SAP communications program and the SAP Gateway must be on a UNIX computer known in the SNA network. The target program, on the other hand, can be on a UNIX computer not in the SNA network.

Side info files must be configured on the UNIX computer known in the SNA network and on the Gateway host.

With this constellation, you must note the following guidelines:

- Using the RFC interface:
  - The side info tables XCOM and RFCD must be configured.

    The destination of the function call must match the corresponding entry in XCOM and RFCD.
  - The called function must exist as a function module in the ABAP function library and have the “remote” ID.

  For more details on the RFC interface, refer to the documentation *Remote Communications*.
- Using the CPI-C interface
  - The SAP Gateway must be in use.
  - The communications program must be known to the SNA software.
  - The User ID and the work directory of the program started are manufacturer-specific:

IBM:	The program runs under the user ID specified in the SNA definition, in the home directory of this user ID.
HP:	The program runs under the user ID sna (ID, under which the SNA kernel runs), in the directory containing the program.

IMS:

If you log on to an IMS security system, the session must not be closed. For this reason, the environment variable SAP_KEEP_SESSION was introduced.

For *SAP_KEEP_SESSION=1*, the session is retained despite the statement COMMUNICATION DEALLOCATE.

From R/2 to R/3

Process flow

1. The calling ABAP program reads the TP name in the XCOM table and starts the SAP communications program *gwhost* (for CICS) or *gwims* (for IMS) under this name on a computer known in the SNA network.
2. The communications program sets up a *Conversation* with the SAP Gateway.
3. The SAP Gateway starts the actual target program. The computer, on which it is located, does not have to be known in the SNA network.

The communications program simply passes on the data during the CPI-C dialog.

For details on the configuration of side info files, refer to the following topic in the documentation *BC SAP Communication: Configuration*:

- Side Information in R/2 on the MVS/VSE Host: XCOM [Extern]
- Parameters on SNA Subsystem Platform with R/2 [Extern]

Communication Between R/3 and R/2 (BS2000)

Purpose

The following topics provide an overview about the prerequisites for the partner systems.

These prerequisites depend on whether the calling system is R/3 or R/2.

From R/2 to R/3 [Seite 28] [Seite 26]

From R/3 to R/2 [Seite 26] [Seite 28]

As of R/2 Release 5.0D, you can also use an RFC call instead of a CPI-C call.

From R/3 to R/2

Purpose

An ABAP program in an R/3 System uses an RFC or CPI-C call to start an ABAP program in an R/2 System under DCAM or UTM on a BS2000 host, and exchanges data with this program.

Prerequisites

- Using the RFC interface:
- The SAP Gateway must run under DCAM in BS2000.
- The called function must be an ABAP function module, which has the “remote” ID in the function library.

  For more details on the RFC interface, refer to the documentation Remote Communications [Extern].

  Using the CPI-C interface
- The SAP Gateway must run under DCAM in BS2000.
- The target ABAP program must contain the form routine specified in the *connect* data.
- If you are using the CPI-C calls from ABAP, the calling ABAP program must build the data for the logon to the target system, convert it to EBCDIC and receive the response (possibly a denial) from the target system.
- The side info table TXCOM must be configured in the calling R/3 System. For this, use transaction code SM54.

  For details on the configuration of TXCOM, refer to the relevant topic in the following documentation:

  BC SAP Communication: Configuration [Extern]
- If there is a side info file SAPGW.DATA.SIDEINFO on the BS2000 host, an application can only be reached if the side info file contains an entry for this application.

  For details on configuration, please refer to the documentation *BC - SAP Communication: Configuration* under the topic Connection Setup to the R/2 System [Extern]

Process flow

- Using the RFC interface:

  Once the above requirements have been met, select the target system with the Transaction SM59.

  For more details on the RFC interface, refer to the documentation Remote Communications [Extern].
- Using the CPI-C interface

  For details on configuration, please refer to the documentation *BC - SAP Communikation: Configuration* under the topic Connection Setup to the R/2 System

From R/2 to R/3

Purpose

An ABAP program in an R/2 System starts an ABAP program in an R/3 System and exchanges data with this program.

You can start the target program from the R/2 host via an SAP communications program.

Prerequisites

With this constellation, you must note the following guidelines:

- Using the RFC interface:
  - The side info tables XCOM and RFCD must be configured.

    The destination of the function call must match the corresponding entry in XCOM and RFCD.
  - The called function must exist as a function module in the ABAP function library and have the “remote” ID.

  For more details on the RFC interface, refer to the documentation Remote Communications [Extern].
- Using the CPI-C interface
  - The SAP Gateway must be in use.

    Special Features under BS2000

    The tasks SAPGWHO (program *gwhost*) are started by the R/2 System at initialization. These tasks build the connection to an SAP Gateway under UNIX (not under BS2000).

Process flow

In BS2000 the SAPGWHO jobs (program *gwhost*) perform the functions of the communications program when connection is set up by the R/2 System.

The process consists of the following steps:

1. The calling ABAP program reads the TP name in table XCOM and starts the SAPGWHO jobs.
2. The communications program sets up a *Conversation* with a SAP Gateway on the UNIX computer.
3. The SAP Gateway starts the actual target program.

   Side info files must be configured on the UNIX computer and on the BS2000 host.

For details on the configuration of side info files, refer to the documentation

BC SAP Communication: Configuration under the following topic: Connection Setup by the R/2 System [Extern].

Communication Between R/3 and an Externally Registered Program

Purpose

The SAP program interfaces allow an R/3 System to communicate and exchange data with an external program.

As well as the external programs that are always started anew when they are needed, there is also the new program type Registered Program [Seite 39].

The following topics provide an overview about the prerequisites for the partner systems.

These prerequisites depend on whether R/3 is the calling system or the called system:

From an External Program to R/3 [Seite 36] [Seite 31]

From R/3 to an External Program (registered program) [Seite 31] [Seite 36]

From R/3 to an External Program (registered program)

Purpose

An ABAP program in an R/3 System starts a non-SAP program on another system and exchanges data with this program.

The external program may also be a Registered Program [Seite 39].

Communication is possible with the following external target programs:

- ANSI-C programs on UNIX platforms by RFC or CPI-C call
- Visual Basic programs on Windows and WindowsNT platforms by RFC

Prerequisites / Process flow

With this constellation, you must note the following guidelines:

- Using the RFC interface:
  - Choose the target system using transaction SM59.
  - The called function must be an ABAP function module, which has the “remote” ID in the function library.
  - A C target program must have the following structure:

```
:
    #include "saprfc.h"
    :
    main(int argc,char **argv)
    {
      :
      Rfc_Handle handle;
      handle=RfcAccept(argv)
      :
    }
```

    To link the C program, use the RFC library *librfc.a*.

  - A Visual Basic target program must be structured as follows:

```
:
    Sub Main()
    gCommand$ = Command$
    :
    hRfc = RfcAcceptExt(gCommand$)
    :
    End Sub
```

    To link the Visual Basic program, use the *librfc.lib* (Windows) or *ntlibrfc.lib* libraries.

    The following DLLs are used:

    - librfc.dll
    - librfc2.dll

- nidll.dll (for Windows only)

For more details on the RFC interface, refer to the documentation Remote Communications [Extern].

- Using the CPI-C interface
  - Table TXCOM in the calling R/3 System must contain the following parameter values:

    Symbolic destination

    Logical unit of the partner: Host name

    Transaction program of the partner

    Communication types

E	Partner is an external program
R	Partner is a registered program

```
DEST1  is0001 cpict2  E
```

    Use transaction code SM54 to maintain TXCOM.

    For details on the configuration of TXCOM, refer to the relevant topic in the following documentation:

    BC SAP Communication: Configuration [Extern]

  - A C target program must have the following structure.

Non-registered program	Registered program

```
  .
  .
< poss. host type
define, see Define
Variables for Host Types
[Seite 130] >
  .
  .
     #define SOCK 1
     #include
"cpic.h"
  .
  .
     main(int
argc,char **argv)
     {
   .
   .

SAP_CMACCP(argv);
   .
   .
      CMACCP(..);
  .
   .
     }
```

```
.
  .
<poss. computer
type define >
     :
  .
     #define
SOCK 1
     #include
"cpic.h"
  .
  .
     main(int
argc,char
**argv)
     {

SAP_CMREGTP(arg
v);
   .
   .

SAP_CMACCPTP(ar
gv);
   .
   .

CMACCP(..);
  .
   .
     }
```

To link the C program, use the function library *pictlib.o.*

The function SAP_CMACCP [Seite 112] is used to pass the parameters needed to establish the connection to the CPI-C interface.

If an error occurs, SAP_CMALLC gives a return code not equal to CM_OK. After calling SAP_CMACCP, you can use CPI-C programming as usual.

The pointer passed when SAP_CMACCP is called cannot point to data in the stack.

This is because the pointer is also used in the subsequent CPI-C functions.

- If the gateway host and the target host are the same:

  UNIX:

  The program must be in the search path of the of the User ID of the SAP Gateway and be startable with the User ID. (HP-UX: Gateway host and target host must always be the same.)

  WindowsNT:

From R/3 to an External Program (registered program)

The program must be in the work directory of the SAP Gateway.

OS/2:

The program is in the work directory of the SAP Gateway or it is defined in the configuration file config.sys via the PATH variable.

- If the gateway host and the target host are not the same:

  The SAP Gateway starts the C program on the target host. The following conditions must be met:

  UNIX:

  The file.*rhosts* must be available in the HOME directory of the User ID of the SAP Gateway..*rhosts* must contain the name of the gateway host.

  The User ID, under which the SAP Gateway is running, must be known on the target host.

  The target program or a link to it must be available in the HOME directory.

CPI-C:	limited to 8 characters
RFC:	no limitation, relative or explicit path

  OS/2:

  The IP address of the respective partner computer must exist in the hosts file on both computers.

  The program is in a path defined in the configuration file *config.sys* via the PATH variable.

- The started program can also be a shell script or a command procedure, which calls the actual CPIC-C program. In this case, all parameters of the shell script must be passed to the C program.

  Example:

  Command file for OS/2:

```
@REM ***********************
@REM * CPICPGM.CMD for OS/2
@REM ***********************
@SETLOCAL

@REM set up environment
@SET CPIC_TRACE=1
      :
@REM start Remote Partner Program
D:\CPIC\CPICPGM.EXE %1 %2 %3
      :
@ENDLOCAL
```

  C shell script for UNIX:

```
#!/bin/csh
.
<Shell commands>
.
```

```
<cpic-c program> $argv
.
```

From an External Program to R/3

Purpose

A non-SAP program uses an RFC or CPI-C call to start an ABAP program in an R/3 System, and exchanges data with the ABAP program.

Prerequisites / Process flow

With this constellation, you must note the following guidelines:

- Using the RFC interface:
  - A calling C program (ANSI-C) must be structured as follows:

```
:
    #include "saprfc.h"
    :
    main(int argc,char **argv)
    {
      :
      Rfc_Handle handle;
      handle=RfcOpen(RFC_OPTIONS *options????)
      :
    }
```

    To link the C program, use the RFC library *librfc.a*.
  - A calling Visual Basic program must be structured as follows:

```
:
    Sub Main()
    gCommand$ = Command$
    :
    hRfc = RfcOpenExt(gCommand$)
    :
    End Sub
```

    To link the Visual Basic program, use the *librfc.lib* (Windows) or *ntlibrfc.lib* libraries.

    The following DLLs are used:

    - librfc.dll
    - librfc2.dll
    - nidll.dll (for Windows only)
  - The called function must be an ABAP function module, which has the “remote” ID in the function library.

  For more details on the RFC interface, refer to the documentation Remote Communications [Extern].
- Using the CPI-C interface
  - The SAP Gateway must be in use.
  - The calling program (ANSI-C) must be structured as follows:

```
:
< poss. host type define, see Define Variables for Host Types [Seite 130]
>
    :
    #define SOCK 1
    #include "cpic.h"
    :
    main(int argc,char **argv)
    {
      :
      SAP_CMINIT(argv,<P2>,<P3>,<P4>);
      :
      CMINIT(..);
      :
    }
```

To link the C program, use the function library *cpictlib.o.*

- Parameterization

  Via SAP_CMINIT [Seite 111]:

  For communication with the gateway, you must use the function SAP_CMINIT to pass the following parameters to the CPI-C interface:

P2:	Gateway host
P3:	Gateway service
P4:	Protocol type/topology of the target program: C, I or E

C:	Partner is the R/2 program
I:	Partner is the R/3 program and can be reached via TCP/IP
E:	Partner is an external program and can be reached via TCP/IP

  The necessary constants are defined in the C header *cpic.h*.

  If an error occurs, SAP_CMINIT delivers a return code not equal to CM_OK.

  Side Info File:

  You can also maintain these parameters in the side information file. In this case, call the function SAP_CMINIT as follows:

  ```
  SAP_CMINIT(argv,(PCPIC_CHAR)0,(PCPIC_CHAR)0,NO_PROTOCOL);
  ```

  After calling SAP_CMINIT you can use CPI-C programming as usual.

  You can also specify some parameters with SAP_CMINIT and read some from the side information file.

- You must include target system and platform-dependent entries in the side information file.

  For details on the configuration of the side information file, refer to the relevant topic in the following documentation:

  BC SAP Communication: Configuration [Extern]

- If timeouts occur when establishing a connection, you can use the environment variable CPIC_TIMEOUT to extend the wait time. CPIC_TIMEOUT specifies the time in seconds, which the gateway waits for the external program logon.

  The pointer passed when SAP_CMACCP is called cannot point to data in the stack.

  This is because the pointer is also used in the subsequent CPI-C functions.

Registered Program

Definition

A registered program is an external program that logs on to the Gateway once (**registration**); the Gateway then starts a process and sets up a TCP/IP line. The program is then executed, if required.

Use

Using a registered program is particularly advantageous for performance if it is a program that is used very frequently. It avoids having to repeatedly start a new process.

Integration

A registered program can be stopped by another program with the CANCEL call (i.e. registration is cancelled), if it is not active at that moment.

Communication Between R/2 Systems

Purpose

Between R/2 Systems, program-to-program communication is possible with the following restrictions:

Restrictions for MVS/VSE hosts

Communication is only possible on MSE/VSE hosts when CICS is used as the data communications system. Local communication in R/2 is not possible because CICS does not support a local conversation via SNA-LU6.2.

Restrictions for BS2000 hosts

Communication between R/2 Systems on BS2000 is possible if both systems are operated under UTM.

Prerequisites

With this constellation, you must note the following guidelines:

- When using the RFC interface (from 5.0D):
  - The side info tables XCOM and RFCD must be configured.

    The destination of the function call must match the corresponding entry in XCOM and RFCD.
  - The called function must be an ABAP function module, which has the “remote” ID in the function library.
- Using the CPI-C interface
  - The calling ABAP program must build the data for the logon to the target system, convert it to EBCDIC and receive the response (possibly a denial) from the target system.
  - The table XCOM must be configured in the calling R/2 System.

    For details on the configuration of XCOM, refer to the relevant topic in the following documentation:

    BC SAP Communication: Configuration [Extern]
  - The target ABAP program must contain the form routine specified in the *connect* data.

Process flow

For more details on the RFC interface, refer to the documentation Remote Communications [Extern].

For details on CPI-C calls, refer to the topic CPI-C-Implementation in ABAP [Seite 51].

Communication Between R/2 and an Externally Registered Program

Purpose

Communication between the R/2 System and external programs is also supported by the SAP program interfaces.

The following topics provide an overview about the prerequisites for the R/2 host and the partner computer.

These prerequisites depend on whether R/2 is the calling system or the called system:

From R/2 to an External Program (registered program) [Seite 42]

From an External Program to R/2 [Seite 46]

As of R/2 Release 5.0D, you can also use an RFC call instead of a CPI-C call.

The following limitation applies to an MVS/VSE host:

- CICS only as the DC system (at present)
- IMS as of Version 4.1 for complete LU6.2 support

From R/2 to an External Program (registered program)

Purpose

An ABAP program in an R/2 System starts an ABAP program in an R/3 System or an non-SAP program, and exchanges data with this program.

You can start the target program from the R/2 host via an SAP communications program.

Communication is possible with the following external target programs:

- ANSI-C programs on UNIX platforms by RFC or CPI-C call
- Visual Basic programs on Windows and WindowsNT platforms by RFC

Prerequisites

With this constellation, you must note the following guidelines:

- Using the RFC interface:
  - The side info tables XCOM and RFCD must be configured.

    The destination of the function call must match the corresponding entry in XCOM and RFCD.
  - The called function must exist as a function module in the ABAP function library and have the “remote” ID.
  - A C target program must have the following structure:

```
:
    #include "saprfc.h"
    :
    main(int argc,char **argv)
    {
      :
      Rfc_Handle handle;
      handle=RfcAccept(argv)
      :
    }
```

    To link the C program, use the RFC library *librfc.a*.
  - A Visual Basic target program must be structured as follows:

```
:
    Sub Main()
    gCommand$ = Command$
    :
    hRfc = RfcAcceptExt(gCommand$)
    :
    End Sub
```

    To link the Visual Basic program, use the *librfc.lib* (Windows) or *ntlibrfc.lib* libraries.

    The following DLLs are used:

    - librfc.dll

- librfc2.dll
- nidll.dll (for Windows only)

For more details on the RFC interface, refer to the documentation Remote Communications [Extern].

- Using the CPI-C interface
  - The SAP Gateway must be in use.
  - The target program must have exactly the same structure as described in the previous section.
  - A C target program must have the following structure:

Non-registered program	Registered Program
. . < poss. host type define, see Define Variables for Host Types [Seite 130] > . . #define SOCK 1 #include "cpic.h" . . main(int argc,char **argv) { . . SAP_CMACCP(argv); . . CMACCP(..); . . }	. . <poss. host type define > : . #define SOCK 1 #include "cpic.h" . . main(int argc,char **argv) { SAP_CMREGTP(argv); . . SAP_CMACCPTP(argv); . . CMACCP(..); . . }

  - To link the C program, use the function library *cpictlib.o.*

    The function SAP_CMACCP [Seite 112] is used to pass the parameters needed to establish the connection to the CPI-C interface.

If an error occurs, SAP_CMACCP [Seite 112] gives a return code not equal to CM_OK. After calling SAP_CMACCP, you can use CPI-C programming as usual.

The pointer passed when SAP_CMACCP is called cannot point to data in the stack.

This is because the pointer is also used in the subsequent CPI-C functions.

- The communications program must be known to the SNA software.
- The User ID and the work directory of the program started are manufacturer-specific:

IBM:	The program runs under the user ID specified in the SNA definition, in the home directory of this user ID.
HP:	The program runs under the user ID sna (ID, under which the SNA kernel runs), in the directory containing the program.

Special Features under BS2000

The tasks SAPGWHO (program *gwhost*) are started by the R/2 System at initialization. These tasks build the connection to an SAP Gateway under UNIX (not under BS2000).

IMS:

If you log on to an IMS security system, the session must not be closed. For this reason, the environment variable SAP_KEEP_SESSION was introduced.

For *SAP_KEEP_SESSION=1*, the session is retained despite the statement COMMUNICATION DEALLOCATE.

Process flow

The communication process depends on the host you are using:

- R/2 System on MVS/VSE Host
- R/2 System on BS2000 Host

R/2 System on MVS/VSE Host

The SAP communications program and the SAP Gateway must be on a UNIX host known in the SNA network. The target program, on the other hand, can be on a UNIX host not in the SNA network.

The process consists of the following steps:

1. The calling ABAP program reads the TP name in the XCOM table and starts the SAP communications program *gwhost* (for CICS) or *gwims* (for IMS) under this name on a host known in the SNA network.
2. The communications program sets up a *Conversation* with the SAP Gateway.
3. The SAP Gateway starts the actual target program. The host, on which it is located, does not have to be known in the SNA network.

The communications program simply passes on the data during the CPI-C dialog.

Side info files must be configured on the UNIX host known in the SNA network and on the Gateway host.

For details on the configuration of side info files, refer to the following topic in the documentation *BC SAP Communication: Configuration*:

- Side Information in R/2 on the MVS/VSE Host: XCOM [Extern]
- Parameters on SNA Subsystem Platform with R/2 [Extern]

R/2 System on BS2000 Host

In BS2000 the SAPGWHO jobs (program *gwhost*) perform the functions of the communications program when connection is set up by the R/2 System.

The process consists of the following steps:

1. The calling ABAP program reads the TP name in table XCOM and starts the SAPGWHO jobs.
2. The communications program sets up a *Conversation* with a SAP Gateway on the UNIX host.
3. The SAP Gateway starts the actual target program.

   Side info files must be configured on the UNIX host and on the BS2000 host.

For details on the configuration of side info files, refer to the following topic in the documentation *BC SAP Communication: Configuration*: under the topic:

Connection Setup by the R/2 System.

From an External Program to R/2

Purpose

A non-SAP program uses an RFC or CPI-C call CMINIT/CMALLC [Seite 89] to start an ABAP program in an R/3 System, and exchanges data with the ABAP program.

Prerequisites / Process flow

With this constellation, you must note the following guidelines:

- Using the RFC interface:

  The RFC interface is available for R/2 as of Release 5.0D.

  – A calling C program (ANSI-C) must be structured as follows:

```
:
    #include "saprfc.h"
    :
    main(int argc,char **argv)
    {
      :
      Rfc_Handle handle;
      handle=RfcOpen(RFC_OPTIONS *options????)
      :
    }
```

  To link the C program, use the RFC library *librfc.a*.

  – A calling Visual Basic program must be structured as follows:

```
:
    Sub Main()
    gCommand$ = Command$
    :
    hRfc = RfcOpenExt(gCommand$)
    :
    End Sub
```

  To link the Visual Basic program, use the *librfc.lib* (Windows) or *ntlibrfc.lib* libraries.

  The following DLLs are used:

  - librfc.dll
  - librfc2.dll
  - nidll.dll (for Windows only)

  – The called function must be an ABAP function module, which has the “remote” ID in the function library.

  For more details on the RFC interface, refer to the documentation Remote Communications [Extern].

- Using the CPI-C interface

  – The SAP Gateway must be in use.

- The calling program (ANSI-C) must be structured as follows:

```
:
< poss. host type define, see Define Variables for Host Types [Seite 130]
>
    :
    #define SOCK 1
    #include "cpic.h"
    :
    main(int argc,char **argv)
    {
      :
      SAP_CMINIT(argv,<P2>,<P3>,<P4>);
      :
      CMINIT(..);
      :
    }
```

  To link the C program, use the function library *cpictlib.o.*

- Parameterization

  Via SAP_CMINIT [Seite 111]:

  For communication with the gateway, you must use the function SAP_CMINIT to pass the following parameters to the CPI-C interface:

P2:	Gateway host
P3:	Gateway service
P4:	Protocol type/topology of the target program: C, I or E

C:	Partner is the R/2 program
I:	Partner is the R/3 program and can be reached via TCP/IP
E:	Partner is an external program and can be reached via TCP/IP

  The necessary constants are defined in the C header *cpic.h*.

  If an error occurs, SAP_CMINIT delivers a return code not equal to CM_OK.

  Side Info File:

  You can also maintain these parameters in the side information file. In this case, call the function SAP_CMINIT as follows:

```
SAP_CMINIT(argv,(PCPIC_CHAR)0,(PCPIC_CHAR)0,NO_PROTOCOL);
```

  After calling SAP_CMINIT you can use CPI-C programming as usual.

  You can also specify some parameters with SAP_CMINIT and read some from the side information file.

  You must include target system and platform-dependent entries in the side information file.

  For details on the configuration of the side information file, refer to the relevant topic in the following documentation:

  BC SAP Communication: Configuration [Extern]

From an External Program to R/2

If timeouts occur when establishing a connection, you can use the environment variable CPIC_TIMEOUT to extend the wait time. CPIC_TIMEOUT specifies the time in seconds, which the gateway waits for the external program logon.

The pointer passed when SAP_CMACCP is called cannot point to data in the stack.

This is because the pointer is also used in the subsequent CPI-C functions.

Communication Between C Programs

Purpose

A C program uses a CPI-C call CMINIT/CMALLC [Seite 89] to start a C program on another host, and exchanges data with this program via CPI-C.

RFC is not supported for this constellation.

Prerequisites / Process flow

With this constellation, the following requirements must be met:

- The SAP Gateway must be in use.
- If no local side information file was maintained, you must make the following entries in the side information file on the gateway host:

  ```
  DEST=<symbolic destination>

  LU=<name of the target host>

  TP=<name of the target host>
  ```

- The target program (ANSI-C) must be structured as follows:

  ```
  :
  < poss. host type define, see Define Variables for Host Types [Seite 130] >
    .
      #define SOCK 1
      #include "cpic.h"
      :
      main(int argc,char **argv)
      {
        :
        CMACCP(..);
        :.
      }
  ```

  To link the C program, use the function library *cpictlib.o.*

- The calling program (ANSI-C) must be structured as follows:

  ```
  :
  < poss. host type define, see Define Variables for Host Types [Seite 130] >
      :
      #define SOCK 1
      #include "cpic.h"
      :
      main(int argc,char **argv)
      {
        :
        CMINIT(..);
        :
      }
  ```

To link the C program, use the function library *cpictlib.o.*

CPI-C Implementation in ABAP

Purpose

Communication statements of the *CPI-C Starter Set* are implemented in the ABAP programming language. They are suitable for setting up simple communication.

This allows an ABAP program to actively set up a connection to one or more external application programs in order to send data directly to these programs.

Conversely, an external program can set up a connection to an SAP System and send a start request for an ABAP program. A correct logon to the SAP System is necessary for this type of connection setup.

The ABAP statements are initiated by the key word COMMUNICATION. The key word is followed by a function statement, which determines the communication operation to be performed. The function statement is followed by further parameters.

Features

CPI-C calls and their meaning

CPI-C Call in C	CPI-C Call in ABAP	Explanation
CMINIT	COMMUNICATION INIT	Initialize connection
CMALLC	COMMUNICATION ALLOCATE	Set up connection
CMACCP	COMMUNICATION ACCEPT	Accept connection
CMSEND	COMMUNICATION SEND	Send Data
CMRCV	COMMUNICATION RECEIVE	Receive data
CMDEAL	COMMUNICATION DEALLOCATE	Close the connection

- The return code of the statement in the field SY-SUBRC is made available for all variants.

  As of R/2 Release 5.0 and in R/3, the parameter RETURNCODE <rc> is supported as an option. With this, you receive a return value.

- Symbolic values (constants, return codes) are defined in the INCLUDE member RSCPICDF (hexadecimal).
- Only the most important return values (return codes) are listed in the description of the statements.

  If you want to perform a detailed problem analysis, you should also analyze the entries in the system log and the system-specific traces.

See also:

Agreements Between Sender and Recipient [Seite 53]

CPI-C Implementation in ABAP [Seite 67]

Agreements Between Sender and Recipient

The information exchange process is controlled by both communications partners. All the necessary agreements concerning type, method and the contents of the information flow must be agreed:

Setting the Send/Receive Mode

Purpose

CPI-C works in *two-way-alternate mode*. This means that at any one time, only one of the communications partners is authorized to send data. Both communications partners must therefore agree on how to alternate between send and receive (possibly depending on the DC system).

Process flow

The program, which builds the conversation [Extern], has send authorization at first. It can call the following functions:

- COMMUNICATION SEND

  Send Data
- COMMUNICATION RECEIVE

  Return the send authorization and wait for data from the partner
- COMMUNICATION DEALLOCATE

  Close the connection

By calling the receive command, you can pass the send authorization to the partner program, for example, to request an acknowledgement. The receiving program should therefore always check whether it has received the send authorization (see parameter STATUSINFO under COMMUNICATION RECEIVE: Receive Data [Seite 76]).

Synchronization

Purpose

The ABAP communications interface (based on the *CPI-C Starter Set*) has no explicit functions for synchronization of both partners. The *Advanced Function Calls* CMCFM/CMCFMD are not implemented in ABAP.

Both communications partners must perform the synchronization with send and receive commands on the application level.

Synchronization is necessary because a send request does not necessarily trigger the immediate sending of data.

Process flow

Different communications subsystems buffer data first and only send it physically when certain bufer limits are exceeded, a status change is made or the connection is closed.

Synchronization means:

- Sending as yet unsent data to the partner (flush)
- Requesting an acknowledgement from the partner
- The partner sending an acknowledgement
- Waiting for the acknowledgement to be received

The easiest method involves passing the send authorization to the partner program after sending one or more data blocks in order to request an acknowledgement. It is recommendable to use a RECEIVE call after no more than 7 SEND calls. The larger the data blocks, the less SEND calls you should use before the next RECEIVE call. The partner can return the send authorization (acknowledgement) immediately. In addition, a response (data) can be sent in order to differentiate between positive and negative acknowledgements.

Certain restrictions apply for setting up communication via LU6.2 from IMS (up to Version 3.1).

When changing from *COMMUNICATION SEND* to *COMMUNICATION RECEIVE*, any unsent data is transferred to the communications partner.

For each *COMMUNICATION SEND* there must be at least one *COMMUNICATION RECEIVE* in the partner system.

Setting the Size of Transfer Units

You must define the size of the send/receive buffer within the application program in accordance with the size of the data to be transmitted. If you have agreed to use different buffer sizes, this may result in data loss if the receiver buffer is too small. The CPI-C implementation in ABAP in R/2 does not allow remaining data to be collected with receive commands. R/3 does not have this restriction.

To achieve optimum performance, the transfer unit size you choose should be as large as possible (parameter LENGTH under COMMUNICATION SEND: Send Data [Seite 74]).

After you have received data, you should check whether the data in the buffer is complete (see parameter DATAINFO under COMMUNICATION RECEIVE: Receive Data [Seite 76]).

Selecting Data Types and Structures

The receive program must be able to recognize which type of data it can receive and whether this data is complete and correct.

An additional logon log can also be agreed between the sender and the receiver, for example, in order to request data again, to provide notification of a processing problem, or simply to send an acknowledgement to the partner. This type of control sequence must be distinguishable from pure data, for example, by defining a special log header (type, record type, number...).

When organizing communication between heterogeneous systems, please note that representation of one data type can be different in each system, and the receiver of this format may not be able to process the format directly. Examples of this are whole numbers, packed numbers and floating point numbers.

In this case, you should consider defining a common transfer format. The simplest form of this would be conversion of data into a character string.

Data Conversion

Between communications systems, which work with the ASCII character set and systems using the EBCDIC character set, data conversion must normally be performed by the application program, unless the partner system is used only for archiving binary data.

It may be necessary to make special considerations for country-specific code pages. You can build your own conversion tables within an ABAP program and access them using the TRANSLATE command.

```
TRANSLATE <buffer> USING <tab>.

TRANSLATE <buffer> FROM CODEPAGE <code_1>
                                  TO CODEPAGE <code_2>.
```

Remotely Attachable ABAP Program

Prerequisites

To process an external communications request, it is necessary to establish a connection to a service transaction of the SAP Basis system.

In the R/2 System, this connection is established to transaction X1SA (BS2000, CICS) or xxxX1SA (IMS).

In the R/3 System, the connection is established to the SAP dispatcher via the SAP Gateway.

The Service transaction needs a logon sequence to identify the client, the user and the ABAP program. The SAP Basis system then starts the ABAP program. The activated ABAP program must be executable (type 1 or M) and have at least one FORM routine.

This logon is part of the SAP logon protocol CPI-C. If logon is performed incorrectly, the SAP Basis system closes the connection with an appropriate error message.

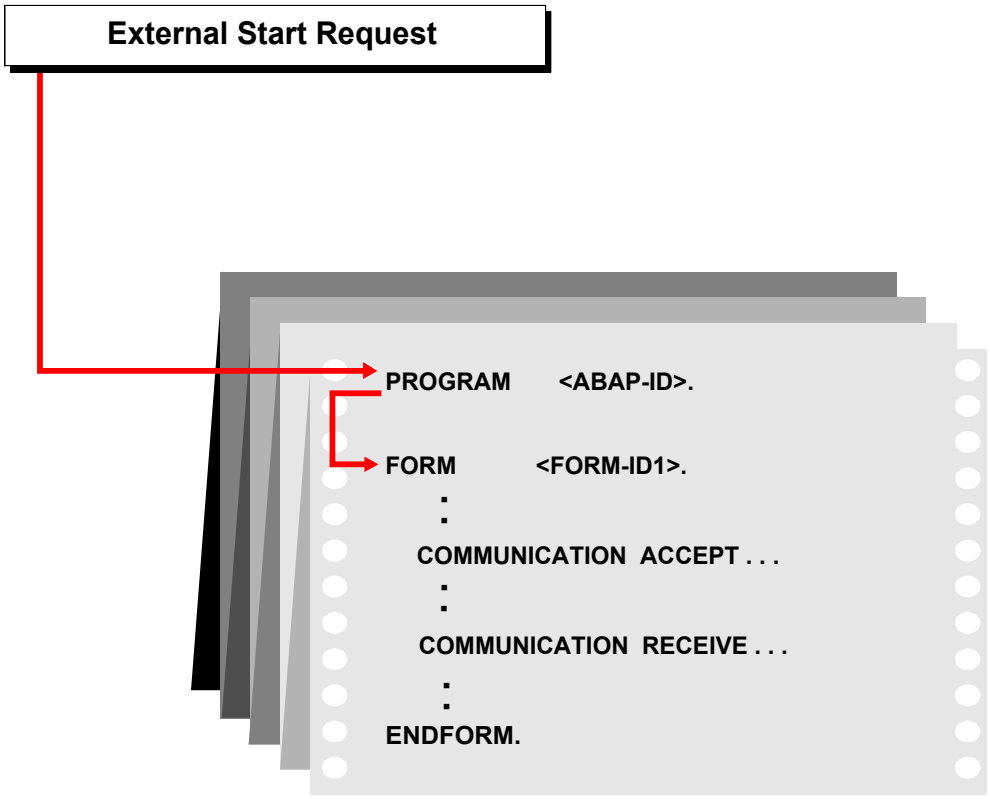
Procedure

A subroutine (FORM routine), which is specified in the program start request, must be defined in an ABAP program. This routine is triggered automatically. Within the FORM routine, PERFORM can be used to call further subroutines (including external ones) or to establish communications links with other partners.

The main part of an ABAP program is not executed for CPI-C connections. It can therefore contain a different processing logic for normal online operation.

An activated FORM routine can only perform **one** ACCEPT command, after which it is in receive status.

Remotely Attachable ABAP Program



An ABAP program can contain several such subroutines, which can be accessed via different logon sequences. This allows you to build up a function library for CPI-C processing.

Special Features of ABAP in R/2

If you want to create a remotely attachable ABAP CPI-C program in an R/2 System, you must know that some ABAP key words are not permitted or are processed differently than in normal online operation. This is because no online terminal is available for screen output, as for an update program. You must note the following:

Screen change

A session or screen change cannot be initiated within an SAP system during a conversation [Extern]. This means that you cannot call subsequent key words in the remote ABAP program, because this causes the *conversation* and the program to terminate.

- CALL MENU...
- CALL SCREEN...
- CALL DIALOG...
- CALL TRANSACTION... (without USING...) (zulässig with Zusatz "USING <Dynprotabelle> Mode 'S'/'N' ", Zusatz verfügbar ab R/2 5.0)
- SUBMIT REPORT... (permitted from R/2 Release 5.0)

TRANSFER

You can use the TRANSFER command to write data to the SAP spool component (from R/2 Release 5.0)

WRITE

The key word WRITE is ignored or redirected to a spool member if the statement NEW-PAGE PRINT ON NO DIALOG is specified first (from R/2 Release 4.3J, 4.4D, 5.0).

BREAK-POINT

The statement BREAK-POINT writes log informatin to the SAP system log (from R/2 Release 4.3J, 4.4D, 5.0).

MESSAGE

Messages of type S, I or W are ignored. Messages of type E or A cause a program termination and an entry in the system log.

SAP Logon Protocol for External CPI-C Programs

Definition

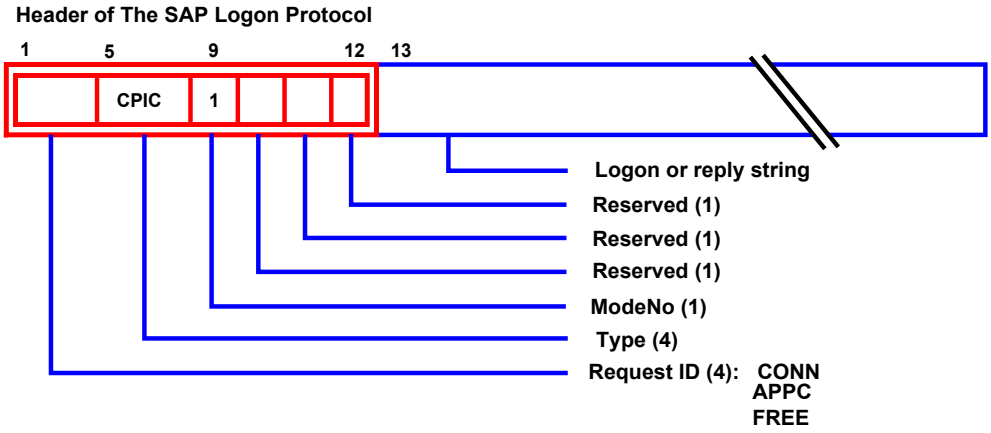
The information exchanged between an external program and the transaction program (R/2: X1SA, R/3: Dispatcher service) for the logon is determined in the SAP system.

The SAP logon protocol consists of the **protocol header** (12 bytes) and the actual **logon** to the SAP System.

Structure

General Protocol Header

The protocol header, the first 12 bytes of the logon sequence, has the following structure:



Protocol header description:

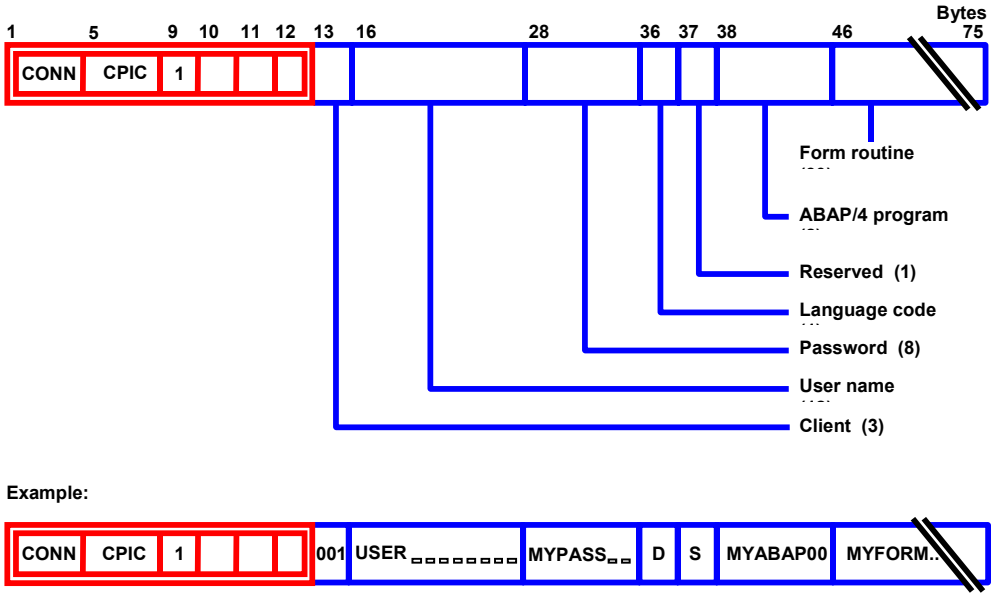
External logon description:	Description
RequestID	Request ID for internal SAP communications administration CONN = Logon/start request APPC = Positive acknowledgement FREE = negative acknowledgement /termination message
Type	Logon protocol type CPIC = for ABAP CPI-C communication
ModeNo	Mode number within the SAP system 1 = Default value
Reserved	' ' = Default value

CONNCPIC1

External Logon to the SAP System

For a correct logon, a CONNECT message must be sent to the transaction program in the desired SAP target system. This logon/start request must always be sent in EBCDIC code.

Logging on to The SAP System



Example:

External logon to the SAP system

External logon description:	Description	No. of characters	Example
Protocol header		12	CONNCPIC1□□□
Client	Client in the SAP System	3	001
User name		12	USER
Password	User password (PASS not permitted)	8	MYPASS□□
Language	For messages from the SAP system D = German E = English .	1	D
Reserved	Not used for CPI-C	1	
ABAP program	Partner program	08	MYABAP00
ABAP form	Subroutine	30	MYFORMABC

```
CONNCPIC1□□□001USER□□□□□□□□MYPASS□□D□MYABAP00MYFORMABC..
```

- If you are using an external security system (RACF, ACF2, TOP SECRET..), transfer of user and client ID via SAP SignOn Exit (SONEX) for CPI-C connections is not supported. A valid user/password combination must therefore be available
in the SAP system.
- From R/2 Release 5.0 and in R/3, only specific user IDs are permitted (user master record type CPIC).

Messages From the SAP System

After a CONNECT request is sent from an external system, the SAP system sends a response. The type of message depends on whether the logon was correct or not.

Positive response

After a connection request (CONN...) is sent with valid logon data, the SAP system returns the request to start CPI-C data transfer. This acknowledgement is always sent in EBCDIC format.

Within the SAP system, the specified ABAP FORM routine has already been activated and performed up to the first RECEIVE statement. This routine then waits for data from the partner.

Positive response: APPCCPIC1□□□

Negative response

After a connection request (CONN...) is sent with invalid logon data, the SAP system termintes the *conversation* and sends an error message if the request had a valid format.

The negative response from the SAP system consists of the general protocol header beginning with FREE..., an error number and an error text (see the second example in the above illustration).

Negative response:

External logon description:	Description	Example
Protocol header	(12)	FREE□□□1□□□
Error number	SAP error number from table 100 (5)	38110
Error message	SAP error text from table 100 (5)	ABAP program... not found

Establishing a Connection via an ABAP Program

Purpose

You can activate one or more connections from an ABAP program, and start an external (transaction)program, in the same way as you start an ABAP program from an external system. Certain restrictions apply for setting up communication via LU6.2 from IMS (up to Version 3.1).

Process flow

An external partner program is accessed in accordance with the CPI-C standard as a symbolic name (symbolic destination). This name is used during the initialization call (INIT) to determine the communications parameters, which are needed to establish the connection (ALLOCATE). You must maintain these parameters in the side information table (R/2 host: XCOM, R/3: TXCOM). Amongst other things, they contain system-specific information.

Once the connection is established, the program has send status. Data can now be sent to the partner.

Parallel Connections

If you want to establish several parallel connections, you must ensure that the following call sequence is adhered to:

```
COMMUNICATION INIT

COMMUNICATION ALLOCATE

...

COMMUNICATION INIT

COMMUNICATION ALLOCATE

...
```

The sequence **`COMMUNICATION INIT... COMMUNICATION INIT... COMMUNICATION ALLOCATE... COMMUNICATION ALLOCATE`** is not permitted because it causes the first defined communications parameters to be overwritten.

Restricted Use of Key Words (R/2)

The ABAP key words listed below cannot be called during a communications session because this causes the *conversation* to be terminated. The reason for this lies in the internal SAP administration for mode and screen changes.

- CALL MENU
- CALL DIALOG
- CALL SCREEN
- CALL TRANSACTION... (without USING...)
- SUBMIT REPORT
- LEAVE
- MESSAGE

Debugging (R/2)

When a BREAKPOINT is reached, field contents can be displayed, but the connection is also broken so that a screen change can take place.

Debugging is not permitted under UTM because it violates the UTM rules for distributed transaction processing and causes the task to be terminated with 83Z/KS01.

CPI-C Implementation in ABAP

Purpose

The following statements are available for implementing communication at the CPI-C level in ABAP:

They are explained here individually.

The in ABAP are then listed.

COMMUNICATION INIT: Initialization

Use

The statement COMMUNICATION INIT initializes a connection. You must specify a symbolic name to identify the partner.

Integration

The statement COMMUNICATION INIT must always be followed by the statement COMMUNICATION ALLOCATE.

Activities

Syntax

```
COMMUNICATION INIT ID <conv_id>
                      DESTINATION <dest>
                    [ RETURNCODE <rc> ]
```

Parameter Values

<conv_id>

Conversation ID (output, type C(8))

An ID is returned to identify the *conversation*. You must specify the this ID in all subsequent communications statements for this *conversation*.

<dest>

Conversation ID (output, type C(8)

This name must also be in the side information file.

<rc>

Return code (output, type X(2))

Alternatively, you can check the value directly via SY-SUBRC.

Return Codes

Value	Explanation
CM_OK	
CM_PROGRAM_PARAMETER_CHECK	Entry in side info table incorrect
CM_PRODUCT_SPECIFIC_ERROR	• LU is not defined • SAP transaction is in long-running status • (UTM, additional system log message 818) • No further ID available

```
DATA: CONV_ID(8) TYPE C,
```

```
        DEST(8) TYPE C VALUE 'PARTNER',
        RC LIKE SY-SUBRC.
  :
COMMUNICATION INIT ID CONV_ID
        DESTINATION DEST
        RETURNCODE RC.
IF RC <> CM_OK....
```

COMMUNICATION ALLOCATE: Set up connection

Use

COMMUNICATION ALLOCATE builds a conversation [Extern] with the partner defined in the statement COMMUNICATION INIT. A session to the partner system is built and a start request for the partner program (for example, X1SA) is sent.

Activities

Syntax

```
COMMUNICATION ALLOCATE ID <conv_id>
              [ RETURNCODE <rc> ]
```

Parameter Values

<conv_id>

Conversation ID (input, type C(8))

<rc>

Return code (output, type X(2))
Alternatively, you can check the value directly via SY-SUBRC.

Return Codes

Value	Explanation
CM_OK	
CM_ALLOCATE_FAILURE_NO_RETRY	Resource or configuration problem (UTM: Also system log message 781)
CM_ALLOCATE_FAILURE_RETRY	Temporary problem (for example,: partner is not active)
CM_PROGRAM_PARAMETER_CHECK	Invalid *conversation* ID
CM_PROGRAM_STATE_CHECK	COMMUNICATION INIT call was not made

```
DATA: CONV_ID(8) TYPE C,
      DEST(8) TYPE C VALUE 'PARTNER',
      RC LIKE SY-SUBRC.
COMMUNICATION INIT ID CONV_ID
              DESTINATION DEST
              RETURNCODE RC.
:
COMMUNICATION ALLOCATE ID CONV_ID
```

```
                                    RETURNCODE RC.

        IF RC <> CM_OK....
```

COMMUNICATION ACCEPT: Accept connection

Use

COMMUNICATION ACCEPT accepts the requested connection. Initializations are performed internally and an ID for the *conversation* is returned.

Integration

COMMUNICATION ACCEPT is only permitted within an ABAP FORM routine and can only be called once. After the function call, the program is in receive status.

Activities

Syntax

```
COMMUNICATION ACCEPT ID <conv_id> [ RETURNCODE <rc> ]
```

Parameter Values

<conv_id>

Conversation [Extern]ID (output, type C(8))

To identify the *conversation*, an ID is returned. This ID must be specified in all subsequent communications statements for this *conversation*.

<rc>

Return code (output, type X(2))

Alternatively, you can check the value directly via SY-SUBRC.

Return Codes

Value	Explanation
CM_OK	
CM_PROGRAM_STATE_CHECK	• No connection request from a partner. • Statement is not coded in a FORM routine.

```
DATA: CONV_ID(8) TYPE C,
      DEST(8) TYPE C VALUE 'PARTNER',
      RC LIKE SY-SUBRC.
FORM TEST
   COMMUNICATION ACCEPT ID CONV_ID
                        RETURNCODE RC.
IF RC <> CM_OK....
          :
```

```
ENDFORM.
```

COMMUNICATION SEND: Send Data

Use

Data is sent to the communications partner. The type and structure of the data can be agreed upon with the communications partner. The length of the CPI-C buffer is restricted to 32000 Bytes (maximum).

Due to this restriction, it is recommendable to work with a buffer of 28000 Bytes.

Integration

The program, which builds the conversation [Extern], has send authorization at first. If a program has send authorization, it can call the following functions:

- COMMUNICATION SEND

  Send Data
- COMMUNICATION RECEIVE

  Return the send authorization and wait for data from the partner
- COMMUNICATION DEALLOCATE

  Close the connection

Prerequisites

For CPI-C communication in an R/2 IMS environment via the LU6.1 Adapter, the length of the send buffer should not be greater than the LONG MESSAGE in IMS. (Recommendation: Send buffer length <= LONG MESSAGE - 100)

To achieve optimum performance, the transfer unit you choose should be as large as possible (see LENGTH parameter).

Activities

Syntax

```
COMMUNICATION SEND ID <conv_id>
                     BUFFER <buf>
                   [ LENGTH <slen>     ]
                   [ RETURNCODE <rc> ]
```

Parameter Values

<conv_id>

Conversation ID (input, type C(8)

<buf>

Data buffer (input, type C(?) or structure): Range of the data to be sent

<slen>

No. of characters to be sent (entry, type P)

If the length is not specified explicitly, the defined buffer length is used internally and filled with X'00' or blanks depending on the data type.

<rc>

Return code (output, type X(2))

Alternatively, you can check the value directly via SY-SUBRC.

Return Codes

Value	Explanation
CM_OK	
CM_PROGRAM_STATE_CHECK	Program is not in send status
CM_DEALLOCATED_ABEND	Partner has closed/interrupted the connection (UTM: Also SYSLOG message 781)

```
DATA: CONV_ID(8),
      BUF(72),
      SLEN TYPE P,
      RC LIKE SY-SUBRC.
      :
BUF = 'Hello World'.
LEN = 11.
COMMUNICATION SEND ID CONV_ID
                  BUFFER BUF
                  LENGTH SLEN
                  RETURNCODE RC.
IF RC <> CM_OK....
```

COMMUNICATION RECEIVE: Receive data

Use

The statement COMMUNICATION RECEIVE causes the program to wait for data from the partner. Incoming data is placed in the available buffer. In addition to the data, information on the completeness of the data and the communication status is reported.

If a program has send status and transmits COMMUNICATION RECEIVE, it passes the send authorization to the partner. The communications direction can be changed several times.

Activities

Syntax

```
COMMUNICATION RECEIVE ID <conv_id>
                      BUFFER <buf>
                      DATAINFO <di>
                      STATUSINFO <si>
                    [ HOLD ]
                    [ RECEIVED <n> ]
                    [ LENGTH <rlen>  ]
                    [ RETURNCODE <rc> ]
```

Parameter Values

<conv_id>

Conversation ID (input, C(8))

<buf>

Data buffer (output, type C(?) or structure): Data range/structure, which contains the received data

<di>

Data information (output, type X(4))

Data fully buffered, or not fully buffered if the buffer defined is too small.

CM_NO_DATA_RECEIVED

CM_COMPLETE_DATA_RECEIVED

CM_INCOMPLETE_DATA_RECEIVED

<si>

Status information (output, type X(4))

Send authorization received or not (IMS: Always set)

CM_SEND_RECEIVED

CM_NO_STATUS_RECEIVED

HOLD

If you use COMMUNICATION RECEIVE with parameter HOLD (as of R/3 Release 2.1), no roll-out and roll-in will be performed for RECEIVE. The previously requested task will be held instead.

<n>

Data length (output, type X(4))

Number of received characters in the buffer

<rlen>

Maximum length of the receivable buffer (input, type P)

If none is defined, the length of the buffer is used internally.

<rc>

Return code (output, type X(2))

Alternatively, you can check the value directly via SY-SUBRC.

Return Codes

Value	Explanation
CM_OK	
CM_DEALLOCATED_ABEND	Partner has closed the connection UTM
CM_DEALLOCATED_NORMAL	Partner has closed the connection normally

```
DATA: CONV_ID(8) TYPE C,
      BUF(255),
      DI(4) TYPE X,
      SI(4) TYPE X,
      RL(4) TYPE X,
      RC LIKE SY-SUBRC.
COMMUNICATION RECEIVE ID CONV_ID
                      BUFFER BUF
                      DATAINFO DI
                      STATUSINFO SI
                      HOLD
                      RECEIVED RLEN
                      RETURNCODE RC.
IF RC <> CM_OK....
```

COMMUNICATION DEALLOCATE: Close the connection

Use

A conversation [Extern] with a communications partner is closed and system resources in use are released. This statement can only be called in send status.

Activities

Syntax

```
COMMUNICATION DEALLOCATE ID <conv_id>
                         [ RETURNCODE <rc> ]
```

Parameter Values

<conv_id>

Conversation ID (input, type C(8))

<rc>

Return code (output, type X(2))

Return Codes

Value	Explanation
CM_OK	
CM_PROGRAM_STATE_CHECK	Program is not in send status
CM_PROGRAM_PARAMETER_CHECK	Invalid *conversation* ID

```
DATA: CONV_ID(8) TYPE C,
      RC LIKE SY-SUBRC.
COMMUNICATION DEALLOCATE ID CONV_ID RETURNCODE RC.
IF RC <> CM_OK....
```

Only the ABAP program, not the external partner program, can close the connection.

Return Codes

```
************************************************************
* Defines for ABAP CPI-C Communication
*
* Note(s):
*
*    1) ABAP supports CPI-C Starter Set only
*       Standard Values marked with "< are used
*    2) Values are in hexadecimal representation
*
************************************************************

* reference fields
DATA: INT2(2) TYPE X,
      INT4(4) TYPE X.

* return_code (LIKE SY-SUBRC.
DATA: CM_OK                             LIKE INT2 VALUE '0000',
                CM_ALLOCATE_FAILURE_NO_RETRY     LIKE INT2 VALUE
'0001',
                CM_ALLOCATE_FAILURE_RETRY        LIKE INT2 VALUE
'0002',
                CM_CONVERSATION_TYPE_MISMATCH    LIKE INT2 VALUE
'0003',
                CM_SECURITY_NOT_VALID            LIKE INT2 VALUE
'0006',
                CM_SYNC_LVL_NOT_SUPPORTED_PGM    LIKE INT2 VALUE
'0008',
                CM_TPN_NOT_RECOGNIZED            LIKE INT2 VALUE
'0009',
                CM_TP_NOT_AVAILABLE_NO_RETRY     LIKE INT2 VALUE
'000A',
                CM_TP_NOT_AVAILABLE_RETRY        LIKE INT2 VALUE
'000B',
                CM_DEALLOCATED_ABEND             LIKE INT2 VALUE
'0011',
                CM_DEALLOCATED_NORMAL            LIKE INT2 VALUE
'0012',
                CM_PARAMETER_ERROR               LIKE INT2 VALUE
'0013',
                CM_PRODUCT_SPECIFIC_ERROR        LIKE INT2 VALUE
'0014',
                CM_PROGRAM_ERROR_NO_TRUNC        LIKE INT2 VALUE
'0015',
                CM_PROGRAM_ERROR_PURGING         LIKE INT2 VALUE
'0016',
                CM_PROGRAM_ERROR_TRUNC           LIKE INT2 VALUE
'0017',
                CM_PROGRAM_PARAMETER_CHECK       LIKE INT2 VALUE
'0018',
                CM_PROGRAM_STATE_CHECK           LIKE INT2 VALUE
'0019',
```

Return Codes

```
                  CM_RESOURCE_FAILURE_NO_RETRY     LIKE INT2 VALUE
'001A',
                  CM_RESOURCE_FAILURE_RETRY        LIKE INT2 VALUE
'001B',
                  CM_UNSUCCESSFUL                  LIKE INT2 VALUE
'001C'.

* data_received
DATA: CM_NO_DATA_RECEIVED            LIKE INT4 VALUE '00000000',
                  CM_DATA_RECEIVED               LIKE INT4 VALUE
'00000001',
                  CM_COMPLETE_DATA_RECEIVED      LIKE INT4 VALUE
'00000002',
                  CM_INCOMPLETE_DATA_RECEIVED    LIKE INT4 VALUE
'00000003'.

* status_received
DATA: CM_NO_STATUS_RECEIVED          LIKE INT4 VALUE '00000000',
                  CM_SEND_RECEIVED               LIKE INT4 VALUE
'00000001',
                  CM_CONFIRM_RECEIVED            LIKE INT4 VALUE
'00000002',
                  CM_CONFIRM_SEND_RECEIVED       LIKE INT4 VALUE
'00000003',
                  CM_CONFIRM_DEALLOC_RECEIVED    LIKE INT4 VALUE
'00000004'.

* request_to_send_received
DATA: CM_REQ_TO_SEND_NOT_RECEIVED    LIKE INT4 VALUE '00000000',
                  CM_REQ_TO_SEND_RECEIVED        LIKE INT4 VALUE
'00000001'.

* conversation_type
DATA: CM_BASIC_CONVERSATION          LIKE INT4 VALUE '00000000',
                  CM_MAPPED_CONVERSATION         LIKE INT4 VALUE
'00000001'. "<

* deallocate_type
DATA: CM_DEALLOCATE_SYNC_LEVEL       LIKE INT4 VALUE '00000000', "<
                  CM_DEALLOCATE_FLUSH            LIKE INT4 VALUE
'00000001',
                  CM_DEALLOCATE_CONFIRM          LIKE INT4 VALUE
'00000002',
                  CM_DEALLOCATE_ABEND            LIKE INT4 VALUE
'00000003'.

* error_direction
DATA: CM_RECEIVE_ERROR               LIKE INT4 VALUE '00000000',
                  CM_SEND_ERROR                  LIKE INT4 VALUE
'00000001'.

* fill
DATA: CM_FILL_LL                     LIKE INT4 VALUE '00000000',
                  CM_FILL_BUFFER                 LIKE INT4 VALUE
'00000001'.
```

```
* prepare_to_receive_type
DATA: CM_PREP_TO_RECEIVE_SYNC_LEVEL  LIKE INT4 VALUE '00000000',
                  CM_PREP_TO_RECEIVE_FLUSH       LIKE INT4 VALUE
'00000001',
                  CM_PREP_TO_RECEIVE_CONFIRM     LIKE INT4 VALUE
'00000002'.

* receive_type
DATA: CM_RECEIVE_AND_WAIT            LIKE INT4 VALUE '00000000', "<
                  CM_RECEIVE_IMMEDIATE           LIKE INT4 VALUE
'00000001'.

* return_control
DATA: CM_WHEN_SESSION_ALLOCATED      LIKE INT4 VALUE '00000000', "<
                  CM_IMMEDIATE                   LIKE INT4 VALUE
'00000001'.

* send_type
DATA: CM_BUFFER_DATA                 LIKE INT4 VALUE '00000000', "<
                  CM_SEND_AND_FLUSH              LIKE INT4 VALUE
'00000001',
                  CM_SEND_AND_CONFIRM            LIKE INT4 VALUE
'00000002',
                  CM_SEND_AND_PREP_TO_RECEIVE    LIKE INT4 VALUE
'00000003',
                  CM_SEND_AND_DEALLOCATE           LIKE INT4 VALUE
'00000004'.

* sync_level
DATA: CM_NONE                        LIKE INT4 VALUE '00000000', "<
                  CM_CONFIRM                     LIKE INT4 VALUE
'00000001'.
```

CPI-C Interface in C

The CPI-C interface in C can be split into the following areas:

CPI-C Development Libraries [Seite 83]
Implemented CPI-C Function Calls [Seite 88]
Define Variables for Computer Types [Seite 130]
Linking an SAP Development Library [Seite 87]

CPI-C Development Libraries

Purpose

SAP provides optional platform-specific CPI-C libraries (CPI-C Subsets) for workstations, which you can use for the development of communications programs in the C language.

You can use these libraries to create "more portable" communications programs. This allows communication between SAP systems and external systems, which support CPI-C. The following communications options are available:

- R/3 ↔ C program
- R/2 ↔ C program

Features

These libraries implement the calls of the *CPI-C Starter Set*, parts of the *Advanced Function Calls* and SAP-specific calls.

The file *cpic.readme* contains up-to-date information on the delivered files and using the example programs.

The following files are available:

- Header file for CPI-C
- Development libraries:
  - *cpicslib* for SNA communication, see Libraries Based on LU6.2: cpicslib [Seite 84]
  - *cpictlib* for TCP/IP communication, see Libraries Based on TCP/IP: cpictlib [Seite 86]
- Test programs for CPI-C communication, a calling program and a callable program:
  - in ABAP
  - in C

  (See Working with the Test Programs in the documentation SAP Communication: Configuration)
- Example of a side info file

Libraries Based on LU6.2: cpicslib

Definition

SAP-CPI-C development libraries based on the communications protocol SNA-LU6.2 have the name *cpicslib* and a platform-specific extension.

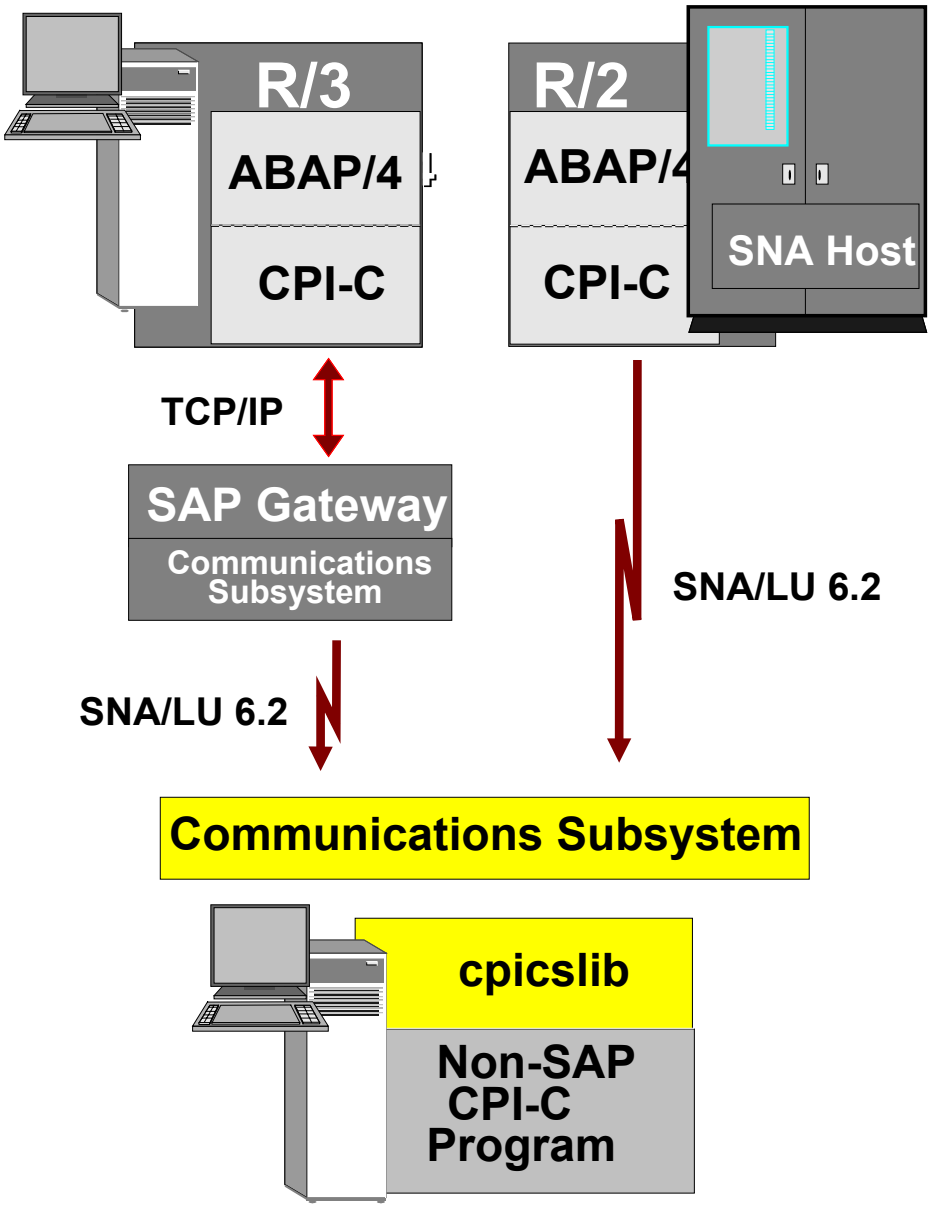
The CPI-C functions of *cpicslib* are mapped directly to LU6.2 level.

Use

For communication with an R/3 System, you need a communications subsystem on both computers and the SAP Gateway on the R/3 computer.

Depending on your requirements, you can alternatively use the manufacturer-specific interface (for example, LU6.2/APPC) directly for communication with the R/2 host.

In both cases the application program communicates via the communications subsystem with the ABAP program on the R/2 host (without the SAP Gateway).

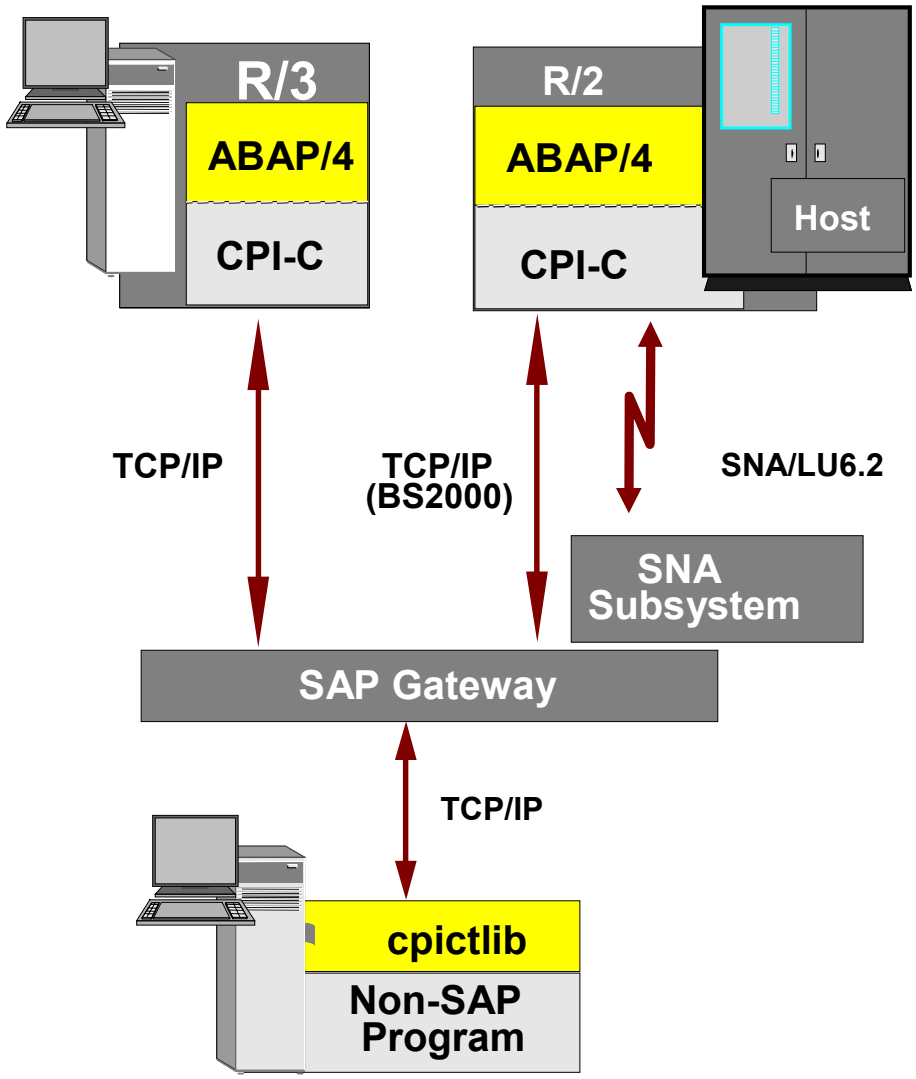

R/3
ABAP/4
CPI-C
R/2
ABAP/4
CPI-C
SNA Host
TCP/IP
SAP Gateway
Communications Subsystem
SNA/LU 6.2
SNA/LU 6.2
Communications Subsystem
cpicslib
Non-SAP CPI-C Program

Libraries Based on TCP/IP: cpictlib

The respective SAP-CPI-C development library based on the communications protocol TCP/IP has the name *cpictlib* and a platform-specific extension.

These libraries are based on the available TCP/IP implementations of different manufacturers.

This is the library that communicates with partner programs (R/2, R/3 ABAP program, external program) via the SAP Gateway.



Linking an SAP Development Library

Prerequisites

If you use functions of one of the two SAP development libraries in your C program, link the library with your program.

If you have not specified the computer type in your program with the statement *define*, you must specify it when you compile the program. The define variables are described in Define Variables for Host Types [Seite 130].

Procedure

Under UNIX, you link an SAP development library with your program as follows:

```
cc  -D<Define variable> <Program name> <SAP library> -o <Executable
file>
```

```
cc  -DSAPonHP_UX  cpict1.c  cpictlib.o  -o cpict1
```

With SNC support (as of Release 3.1G) you must specify the dynamic link option on certain platforms.

Implemented CPI-C Function Calls

Definition

Implemented CPI-C function calls are available for programming a conversation between different programs (on different systems).

The following categories of CPI-C function calls are implemented in the libraries:

CPI-C Starter Set [Seite 89]

Advanced Function Calls [Seite 99]

SAP-Specific CPI-C Functions [Seite 110]

CPI-C Starter Set

Definition

These are the basic functions required for a simple conversation.

Use

Communication between two partner programs via the calls of the *CPI-C Starter Set* runs as follows:

1. Establish connection (session/conversation)
   - Initialization of the communications parameters (via the side information)
   - Build a logical connection (session):
   - Start request from the remote transaction program
   - Both partners are given a conversation ID.
2. Send/receive information
   - Send data
   - Receive data/status messages
3. Close connection

   Close conversation

Structure

The *CPI-C Starter Set* consists of the following function calls:

Call	Task
CMINIT [Seite 91]	Initialize connection
CMALLC [Seite 94]	Allocate conversation
CMACCP [Seite 92]	Accept conversation
CMSEND [Seite 95]	Send data
CMRCV [Seite 96]	Receive data
CMDEAL [Seite 98]	Deallocate conversation

These functions are all of type CM_RETCODE.

CPI-C works in *Two Way Alternate Mode* (half-duplex mode).

Only one of the programs has send authorization at any one time. This authorization can be transferred to the partner (status).

The program, which builds communication, has send authorization first.

The send authorization is transferred by transmitting a receipt acknowledgement (CMRCV) in send status. Then, the partner program is authorized to send. Multiple change of communications direction is possible.

CPI-C Starter Set

The program with the send authorization can call the following functions:

- CMSEND Send data
- CMRCV from the partner
- CMDEAL Close the connection

A side information table with connection parameters must be available in the calling system. CMINIT needs these connection parameters.

CMINIT

The call CMINIT initializes values for a connection. A unique value (*conversation ID*) is returned to the program. This value must be specified in all subsequent calls. A symbolic address must also be specified.

Syntax

```
CMINIT ( conv_id, dest, rc)
```

Parameters

conv_id

Conversation ID A unique value returned by the routine.

dest

Symbolic name This input value must match an entry in the side info table.

The entry contains parameters to build the connection.

rc

Return code CM_OK : Routine was executed without errors.

The return code contains the same value as rc.

CMACCP

Use

Before a program can connect with a target program, the target program must already be active and the call CMACCP must have been made. This also sets initial values. However, beforehand the logical name SAPCPICSYMDEST has to be defined that corresponds to the symbolic address for CMINIT. A unique value (*conversation ID*) is returned to the program. This value must be specified in all subsequent calls.

Activities

Syntax

```
CMACCP ( conv_id,  rc)
```

Parameters

conv_id

This unique value is returned by the routine.

rc

Return code (output value)

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

Registering Programs at the SAP Gateway Without Changing the Source Code

If you specify relevant parameters when calling the target program, the program is registered at the gateway with the CMACCP call.

The CMACCP call analyzes the arguments passed. CMACCP then performs the calls SAP_CMREGTP and SAP_CMACCTP (see SAP_CMREGTP, SAP_CMACCPTP, SAP_CMUNACCPTP, SAP_CMUNREGTP und SAP_CMNOREGTP [Seite 123]).

This means you can use registered programs without makting changes to the source code. You must link such programs with the most recent library.

Transfer parameters:

TP:	Transaction program name
GWHOST	Gateway platform
GWSERV	Gateway service
TIMEOUT	Time limit in seconds (optional) If you do not specify this parameter, no timeout occurs and the program waits until the next request.

Calling the program:

```
cpict2 TP=cpict2 GWHOST=hs0011 GWSERV=sapgw00
```

CMALLC

Use

This call builds a connection with the partner program.

Activities

Syntax

```
CMALLC ( conv_id, rc)
```

Parameters

conv_id

The conversation ID is the input value for an initialized conversation.

rc

Return code (output value)

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMSEND

Use

This call sends data to the partner program. The maximum number of characters, which can be sent with one call is limited to 32000.

If a program has send authorization, it can call the following functions:

- CMSEND Send data
- CMRCV Pass send authorization and wait for data from the partner
- CMDEAL Close the connection

Activities

Syntax

```
CMSEND (conv_id, buffer, send_length, request_to_send_received, rc)
```

Parameters

conv_id

ID of the *conversation*, via which data is to be sent (input value)

buffer

Buffer to be sent

send_length

The number of characters to be sent (input value)

request_to_send_received

Variable indicating whether the partner wants to send data (return code). This variable can have two possible values:

- CM_REQ_TO_SEND_NOT_RECEIVED
- CM_REQ_TO_SEND_RECEIVED

rc

Return code (output value)

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMRCV

Use

The call CMRCV prepares a program to receive data from its partner program.

If a program passes CMRCV in send mode, the program passes the send authorization to the partner program. The communications direction can be changed several times.

Activities

Syntax

```
CMRCV (conv_id, buffer, requested_length, data_received,
       received_length, status_received,
       request_to_send_received, rc)
```

Parameters

conv_id

ID of the conversation, via which data is to be received (input value)

buffer

Buffer, to which the received data is written (input value)

requested_length

Maximum number of characters that can be received (input value)

data_received

This variable (return code) indicates whether the program has received data.

If the program has received data, the variable contains information on the data received. The variable can have the following values:

- CM_NO_DATA_RECEIVED
- CM_DATA_RECEIVED (nur Basic Conversation)
- CM_COMPLETE_DATA_RECEIVED
- CM_INCOMPLETE_DATA_RECEIVED

received_length

Variable containing the number of characters received (return code)

status_received

This variable indicates whether the program has received status information (return code).

If the program has received status information, the variable contains information on the status of the conversation. The variable can have the following values:

- CM_NO_STATUS_RECEIVED
- CM_SEND_RECEIVED

- CM_CONFIRM_RECEIVED
- CM_CONFIRM_SEND_RECEIVED
- CM_CONFIRM_DEALLOC_RECEIVED

request_to_send_received

Variable indicating whether the partner wants to send data (return code). This variable can have two possible values:

- CM_REQ_TO_SEND_NOT_RECEIVED
- CM_REQ_TO_SEND_RECEIVED

rc

Return code (output value)

CM_OK: Routine was executed without errors.

CM_DEALLOCATE_NORMAL: Connection was closed correctly by the partner program.

The return code contains the same value as rc.

CMDEAL

Use

The call CMDEAL closes the connection with the partner program and releases system resources. This call can only be used if the local program is in send status.

Activities

Syntax

```
CMDEAL ( conv_id, rc)
```

Parameters

conv_id

ID of the conversation to be closed (input value)

rc

Return code (output value)

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

Advanced Function Calls

Definition

In addition to the calls of the *CPI-C Starter Set*, the following *Advanced Function Calls* are also available (with platform-specific restrictions):

Use

Available Advanced Function Calls

Function	Task
CMCFM [Seite 100]	Requests receipt acknowledgement from partner
CMCFMD [Seite 101]	Sends receipt acknowledgement to partner
CMCNVO [Seite 102]	Converts data buffer from ASCII to EBCDIC
CMCVNI [Seite 103]	Converts data buffer from EBCDIC to ASCII
CMSCSP [Seite 104]	Sets the *Conversation Security Password*
CMSCST [Seite 105]	Sets the *Conversation Security Type*
CMSCSU [Seite 106]	Sets the *Conversation Security User ID*
CMSPLN [Seite 107]	Sets the logical unit (LU) of the partner LU
CMSTPN [Seite 108]	Sets the transaction program name
CMSSL [Seite 109]	Sets the synchronization level

All functions are of type CM_RETCODE.

The syntax of the *Advanced Function Calls* is described in the following topics.

The functions CMCFM and CMCFMD are not available in *cpictlib*.

CMCNVO and CMCNVI are necessary because the R/2 System on the host only expects data in EBCDIC format, whereas the workstation generally only processes ASCII data.

CMSCST, CMSCSU, CMSCSP and CMSTPN (only for IMS) are necessary, if the LU6.2 partner system uses an external security system (for example, RACF on the host).

The standard definition of the SAP-CPI-C interface and the return codes of the individual CPI-C calls are defined in the file *cpic.h*.

CMCFM

Use

The call CMCFM requests the partner program to acknowledge the receipt of data.

Activities

Syntax

```
CMCFM (conv_id, request_to_send_received, rc)
```

Parameters

conv_id

ID of the conversation to be acknowledged (input value)

request_to_send_received

Variable indicating whether the partner wants to send data (return code).

This variable can have two possible values:

- CM_REQ_TO_SEND_NOT_RECEIVED
- CM_REQ_TO_SEND_RECEIVED

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMCFMD

Use

The call CMCFMD sends a receipt acknowledgement to the partner.

Activities

Syntax

```
CMCFMD ( conv_id, rc)
```

Parameters

conv_id

ID of the conversation to be acknowledged (input value)

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMCNVO

Use

The call CMCNVO converts a data buffer from ASCII to EBCDIC. It uses the library function LIB$TRAASCEBC.

Activities

Syntax

```
CMCNVO (buffer, length, rc)
```

Parameters

buffer

Buffer to be converted

length

Number of characters to be converted (input value)

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

(for UNIX)

Under UNIX, you can define your own conversion table. The SAP standard tables are contained in Conversion Tables EBCIDC ↔ ASCII [Seite 219].

CMCVNI

Use

The call CMCVNI converts a data buffer from EBCDIC to ASCII. It uses the library function LIB$TRAEBCASC.

Activities

Syntax

```
CMCNVI (buffer, length, rc)
```

Parameters

buffer

Buffer to be converted (input value)

length

Number of characters to be converted (input value)

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

(for UNIX)

Under UNIX, you can define your own conversion table. The SAP standard tables are contained in Conversion Tables EBCIDC ↔ ASCII [Seite 219].

CMSCSP

Use

The call CMSCSP sets the password for *conversation security*.

Activities

Syntax

```
CMSCSP ( conv_id, security_password, security_password_length, rc)
```

Parameters

conv_id

ID of the conversation, for which the password is to be set (input value)

security_password

Conversation security password (input value)

security_password_length

Length of the password (input value)

Possible values: 0 to 8

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMSCST

Use

The call CMSCST sets the *conversation security type*.

Activities

Syntax

```
CMSCST (conv_id, security_type, rc)
```

Parameters

conv_id

ID of the conversation, for which the *conversation security type* is to be set (input value)

security_type

indicates which user information the program sends to its partner (input value)

Possible values are:

- CM_SECURITY_NONE:
  Neither the user ID nor the password are sent to the partner program.
- CM_SECURITY_SAME:
  The user ID is sent to the partner.
- CM_SECURITY_PROGRAM:
  The user ID and the password are sent to the partner.

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMSCSU

Use

The call CMSCSU sets the user ID for the conversation.

Activities

Syntax

```
CMSCSU (conv_id, user_id, user_id_length, rc)
```

Parameters

conv_id

ID of the conversation, for which the user ID is to be set (input value)

user_id

User ID (input value)

user_id_length

Length of the user ID (input value)

Possible values: 0 to 8

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMSPLN

Use

The call CMSPLN sets the Logical Unit (LU) of the partner Logical Unit.

Activities

Syntax

```
CMSPLN (conv_id, partner_lu, partner_lu_len, rc)
```

Parameters

conv_id

ID of the conversation, for which the Logical Unit of the partner is to be set (input value)

partner_lu

Name of the Logical Unit of the partner system (input value)

partner_lu_len

Length of the Logical Unit (input value)

Possible values: 1 to 8.

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMSTPN

Use

The call CMSTPN sets the name of the remote transaction program.

Activities

Syntax

```
CMSTPN (conv_id, tpname, tpname_len, rc)
```

Parameters

conv_id

ID of the conversation, for which the name of the remote transaction program is to be set (input value)

tpname

Name of the remote transaction program (input value)

tpname_len

Length of the name

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

CMSSL

Use

This call sets the synchronization level.

Activities

Syntax

```
CMSSL (conv_id, sync_level, rc)
```

Parameters

conv_id

ID of the conversation, for which the synchronization level is to be set (input value)

sync_level

Synchronization level to be set (input value)

Possible values are:

- CM_NONE: No synchronization
- CM_CONFIRM: Sync_level CONFIRM

rc

Return code

CM_OK: Routine was executed without errors.

The return code contains the same value as rc.

SAP-Specific CPI-C Functions

Definition

The SAP-specific CPI-C functions pass additional parameters to the SAP-CPI-C interface, which cannot be mapped to the standard CPI-C parameters.

Use

The following SAP-specific CPI-C functions are provided:

Via SAP_CMINIT [Seite 111]:	Passes on gateway parameters
SAP_CMACCP [Seite 112]	Passes on accept parameters
SAP_CMPERR [Seite 113]:	Displays error information
SAP_CMLOGON [Seite 114]	Creates logon string
SAP_CMCERR [Seite 116]:	Identifies error information
SAP_CMLOADCONVTAB [Seite 117]:	Loads the conversion table specified
SAP_CMMODCONVTAB [Seite 118]:	Modifies the current conversion table
SAP_CMTIMEOUT [Seite 119]:	Specifies a timeout value
SAP_CMHANDLE [Seite 120]	Returns the socket handle
SAP_CMGWHOST [Seite 121]:	Determines the gateway host
SAP_CMGWSERV [Seite 122]:	Determines the gateway service
Functions for Registered CPI-C Programs [Seite 123] SAP_CMREGTP SAP_CMACCPTP SAP_CMUNACCTP SAP_CMUNREGTP SAP_CMNOREGTP SAP_CMCANCREGTP	 Registers the program with the SAP-Gateway Ready for connection setup No longer ready for connection setup Deregisters the program Determines the number of registered programs Logs registered program off Gateway
SNC Function Calls [Seite 128] SAP_CMSNCMODE SAP_CMSNCNAME SAP_CMACLKEY SAP_CMNAMETOACLKEY SAP_CMACLKEYTONAME	Only relevant if you use the *Secure Network Communications* interface to third-party security systems SNC status of a connection (SNC_ON/SNC_OFF) Returns the SNC name of the partner Returns the ACL key of the partner Converts the SNC name to an ACL key Converts the ACL key to an SNC name
SAP_CMGETVERSION	Returns the internal version of the CPI-C-development library

SAP_CMINIT

Use

SAP_CMINIT passes the following additional parameters to the SAP-CPI-C interface:

- Host, on which the SAP Gateway is running
- Service, to which the SAP Gateway responds
- Protocol type of the connection to be built

These values are needed to build the connection to the SAP Gateway.

The header file *cpic.h* indicates the prototypes.

In the following cases, SAP_CMINIT delivers a return code not equal to CM_OK:

- The specified service is too long.
- The specified host name is too long.
- None of the values C, I, E or G was specified for the protocol.

Integration

- You do not need to use the call SAP_CMINIT if you have defined all the parameters in the side information table.

  For reasons of compatibility, you should always define the parameters in this table.
- The above parameters are not needed for the CPI-C development library *cpicslib*, which is based on SNA.

  The function SAP_CMINIT always returns the value CM_OK in this environment.

Activities

```
main (argv, argc)
..
  SAP_CMINIT(argv, "compu01", "sapgw00", INT_SOCK_COMM);
..
```

The SAP Gateway runs on the host *compu01* and responds to the service *sapgw00*. An internal communication is built. The partner program is therefore an ABAP program in an R/3 System.

SAP_CMACCP

Use

The parameters needed in the called program to build the connection are passed as call parameters with both *cpicslib* and *cpictlib*. For this reason, the CPI-C interface needs to access the argument vector. By calling the function SAP_CMACCP, the address of the argument vector is passed to the CPI-C interface.

The header file *cpic.h* indicates the prototypes. SAP_CMACCP always returns the value CM_OK.

```
main (argv, argc)
..
  SAP_CMACCP(argv);
..
```

Integration

Registering Programs at the SAP Gateway Without Changing the Source Code

If you specify relevant parameters when calling the target program, the program is registered at the gateway with the SAP_CMACCP call.

The SAP_CMACCP call analyzes the arguments passed. SAP_CMACCP then performs the calls SAP_CMREGTP and SAP_CMACCTP (see Functions for Registered CPI-C Programs [Seite 123]).

This means you can use registered programs without makting changes to the source code. You must link such programs with the most recent library.

Transfer parameters:

TP	Transaction program name
GWHOST	Gateway platform
GWSERV	Gateway service
TIMEOUT	Time limit in seconds (optional) If you do not specify this parameter, no timeout occurs and the program waits until the next request.

Calling the program:

```
cpict2 TP=cpict2 GWHOST=hs0011 GWSERV=sapgw00
```

SAP_CMPERR

Use

If you are using the SAP-specific function SAP_CMPERR and an error occurs, a short description of the error is output.

```
CM_RETCODE return_code;
  ..
    CMALLC(conv_id,&return_code);
    if (return_code != CM_OK)
    {
       printf("SAP-INFO: %s\n", SAP_CMPERR());
    }
  ..
```

SAP_CMLOGON

Use

The function SAP_CMLOGON builds the logon sequence (connect string), which is needed to log on to an R/2 or an R/3 System. When the connection is built (allocate), this character sequence must be the first data sent to the target system.

Features

Parameters of the function SAP_CMLOGON:

Buffer	Pointer to the buffer of the calling program
len	Length of the user buffer
reqid	From { "CONN", "FREE", "APPC",.. }
reqtype	From { "DYNP", "RDIA", "RODC", "CPIC", "GRAF",.. }
amode	No. of the alternative mode, from { 1,.., 6 }
mand	Client
name	User name
code	Password
lang	Logon language
prog	Program to be started
modn	Form to be started
rc	Return code

To build the connect string, you have two alternatives:

- In the calling program:

  The calling program must specify a valid pointer as the parameter *buffer*, which points to a sufficiently large buffer.

- In a static area of the function SAP_CMLOGON:

  The parameter *buffer* must have the value 0.

Activities

```
CPIC_CHAR buf[200];
  CPIC_INT  len;
..
  len = sizeof(buf);

  SAP_CMLOGON(buf,
      &len,
      "CONN",
```

```
                "CPIC",
                '1',
                "000",
                "SMITH",
                "SECRET",
                'E',
                "EXAMPLE",
                "TEST",
                &return_code);
        ..
```

The logon character string for user "SMITH" with the password "SECRET" in client "000" is built in the buffer *buf*. In alternative mode "1", the ABAP form "TEST" is started in program "EXAMPLE". After the call, the parameter *len* contains the length of the generated logon seqence. This character string can then be sent using CMSEND.

SAP_CMCERR

Use

SAP_CMCERR checks whether the data received from the R/2 or R/3 System constitutes an error message. If it does, the message is formatted for output and a pointer is returned to the error text. If the data does not contain an error message, SAP_CMCERR returns the value 0.

```
PCPIC_CHAR s;

..
<Build connect string and send to R/2 or R/3>
..
CMRCV(conv_id, input, &requested_length, &data_received,
    &received_length, &status_received,
    &request_to_send_received, &return_code);

if ((return_code != CM_OK) &&
    (return_code != CM_DEALLOCATED_NORMAL))
{
    printf("CMRCV: %d\n",return_code);
    printf("SAP-INFO: %s\n", SAP_CMPERR());
    exit(1);
}

if (return_code == CM_DEALLOCATED_NORMAL)
{
   if ((s = SAP_CMCERR(input, &received_length)) !=
(PCPIC_CHAR *)0)
   {
    printf("CPIC-Login-Error: %s\n", s);
    exit(1);
   }
    else
    {
     printf("CMRCV: %d\n",return_code);
     printf("SAP-INFO: %s\n", SAP_CMPERR());
     exit(1);
    }
}
..
```

SAP_CMLOADCONVTAB

Use

SAP_CMLOADCONVTAB loads the specified conversion table and overwrites the previous conversion table. All subsequent CMCNVI and CMCNVO calls work with the new conversion table.

```
CM_RETCODE return_code;
..
SAP_CMLOADCONVTAB("my_conv_table", &return_code);
..
```

SAP_CMMODCONVTAB

Use

You can use SAP_CMMODCONVTAB to modify a contiguous area in the current conversion table. This allows you to change the conversion of individual characters. You can only change either the ASCII → EBCDIC table or the EBCDIC → ASCII table.

```
CM_RETCODE return_code;
..
SAP_CMMODCONVTAB(EBCDIC_TABLE, 193, "4243", &return_code);
..
```

The above modification results in the following (not very useful) conversion:

EBCDIC character	→	ASCII character
A	→	B
B	→	C

All subsequent CMCNVI and CMCNVO calls work with the modified conversion table.

SAP_CMTIMEOUT

Use

SAPCMTIMEOUT controls the behaviour of the “blocking” CPI-C functions.

Blocking CPI-C functions are functions, which normally only return to the caller if the return code was sent by the SAP Gateway.

This can sometimes take a long time. In environments such as WINDOWS, this would cause the whole PC to be blocked. You can use SAP_CMTIMEOUT to specify a time in milliseconds, after which the function returns. If a timeout is set, CM_SAP_TIMEOUT_RETRY is returned as a return code. The function must then be called again (see also function SAP_CMHANDLE [Seite 120]).

```
CM_RETCODE return_code;
    CPIC_INT   timeout;


  ..
    timeout = 10;
    SAP_CMTIMEOUT(timeout, &return_code);
  ..
```

Possible values for timeout:

- SAP_CMBLOCK:

  No timeout

  CPI-C functions wait "indefinitely" for the return code (default setting)

- Value >= 0 :

  Timeout in milliseconds; The value zero caused an immediate timeout.

SAP_CMHANDLE

Use

SAP_CMHANDLE returns the *socket handle*, via which the CPI-C interface reads the return codes and data from the SAP Gateway. This *handle* and the function SAP_CMTIMEOUT (see above) allow the CPI-C interface to be operated without blocking. The *handle* can, for example, be used for the function *Select*. This makes it possible to wait for more than one event. An event is the arrival of CPI-C data.

Integration

The function SAP_CMHANDLE can only be used in connection with the function CMINIT or CMACCP.

```
CM_RETCODE return_code;
CPIC_INT   gwhandle;


..
SAP_CMHANDLE(&gwhandle, &return_code);
..
```

SAP_CMGWHOST

Use

For CPI-C programs, which are started by the CPI-C interface, this function checks the argument vector to find the gateway host computer.

Integration

You can only use this function after calling the function SAP_CMACCP.

```
Example: CM_RETCODE return_code;
CPIC_CHAR  *gwhost, *gwserv;

SAP_CMACCP(argv);
..
SAP_CMGWHOST (&gwhost,&return_code);
..
SAP_CMGWSERV (&gwserv,&return_code);
..
```

SAP_CMGWSERV

Use

For CPI-C programs, which are started by the CPI-C interface, this function checks the argument vector to find the gateway service.

Integration

You can only use this function after calling the function SAP_CMACCP.

```
Example: CM_RETCODE return_code;
CPIC_CHAR  *gwhost, *gwserv;

SAP_CMACCP(argv);
..
SAP_CMGWHOST (&gwhost,&return_code);
..
SAP_CMGWSERV (&gwserv,&return_code);
..
```

Functions for Registered CPI-C Programs

Use

You can use these functions to write a CPI-C program which, unlike “normal” CPI-C programs, is not started after the connection is established but which starts and then waits for a connection to be established.

This means that a single run of the program can accept several connections. This is particularly useful for programs which are executed very frequently, since it avoids the repeated overhead of starting up.

Features

The following SAP-specific functions are available for registered programs:

- SAP_CMREGTP
- SAP_CMACCPTP
- SAP_CMUNACCPTP
- SAP_CMUNREGTP
- SAP_CMNOREGTP
- SAP_CMCANCREGTP

For a short description refer to the chapter SAP-Specific CPI-C Functions [Seite 110].

The process consists of the following steps:

1. Registering the program

   The SAP_CMREGTP function registers a program with a TP name with the SAP Gateway. A socket handle is then returned.

   The TP name is the name of the program that waits for a connection setup.

2. Accept connection

   The SAP_CMACCPTP function waits for the connection to be established. You can specify a timeout period for the function.

   If the function times out without establishing a connection, then it terminates with the return code CM_SAP_TIMEOUT_RETRY.

   The return code CM_DEALLOCATED_NORMAL indicates that the registered program was terminated by the Gateway. Possible causes are:

   – The Gateway itself terminated.

   – Another program executed the call SAP_CMCANCREGTP().

   If the connection is successfully established then the Conversation ID is returned, and this is used in the subsequent CPI-C communication.

   After the connection has been broken, SAP_CMACCPTP() can be called again. The program does not need to be restarted each time.

If there is data at the socket handle, then you just need to call SAP_CMACCPTP(). The SELECT function can be used to check for this.

If the program is to perform other tasks without being interrupted, you can reset the registration status using the function SAP_CMUNACCPTP. The program will then not be addressed by the gateway. Calling SAP_CMACCPTP changes the status from INIT to WAITING, and makes the programm wait for a new connection setup.

3. Terminating the program

   The SAP_CMUNREGTP function deregisters the program and cancels the connection to the SAP Gateway.

   You can use the function SAP_CMCANCREGTP [Seite 127] to cause the Gateway to terminate a registered program. In contrast to the function SAP_CMUNREGTP the program to be terminated does not have to be logged on the Gateway by you (SAP_CMREGTP). Instead you can stop any program.

   Both functions will only terminate programs that have the status INIT or WAITING.

```
      CM_RETCODE        return_code;
        CPIC_CHAR        *tpname;
        CPIC_CHAR        *gwhost;
        CPIC_CHAR        *gwserv;
        PCONVERSATION_ID convid;
        CPIC_INT          handle;
        CPIC_INT          timeout;

SAP_CMREGTP(tpname,gwhost,gwserv,&handle,&return_code);
for(;;)
{
SAP_CMACCPTP(handle,timeout,convid,&return_code);
  CMRCV(...);
  CMSEND(...);
  CMDEAL(...);
}
SAP_CMUNREGTP(handle,&return_code);
```

Note the contrast to “normal” CPI-C programs which are started after the connection has been established:

```
main (int argv, char ** argc)


CM_RETCODE        return_code;

CONVERSATION_ID convid;

..
SAP_CMACCP(argv);
CMACCP(convid,&return_code);
CMRCV(...);
CMSEND(...);
CMDEAL(...);
```

Example program which resets the registration status:

```
SAP_CMREGTP(tpname, gwhost, gwserv, &handle, &return_code);
SAP_CMACCPTP(handle, timeout, convid, &return_code);

If ( return_code == CM_SAP_TIMEOUT_RETRY)
{

  /* timeout, some other action not */
  /* to be interrupted */

SAP_CMUNACCPTP(handle,&return_code);

…

  SAP_CMACCPTP(handle, timeout, convid, &return_code);

}

…
```

Determining the Number of Programs Registered at the Gateway

You can use the function SAP_CMNOREGTP() to find out how often a program has been registered with a specific name at the SAP Gateway. The total number and the program status are returned:

total	Number of registered programs (total of programs in INIT,WAITING und RUNNING status)
init	Number of registrations in INIT status, which means, not waiting for tasks
waiting	Number of registrations in WAIT status, which means, available for new tasks
running	Number of registrations in RUNNING status, which means, currently working on tasks

```
CM_RETCODE  return_code;
   CPIC_CHAR  *tpname;
   CPIC_CHAR  *gwhost;
   CPIC_CHAR  *gwserv;
   CPIC_INT    total;
   CPIC_INT    init;
   CPIC_INT    waiting;
   CPIC_INT    running;

SAP_CMNOREGTP(tpname,gwhost,gwserv,
         &total,&init,&waiting,&running,
         &return_code);
```

The function module GWY_GET_NO_REG_PROGRAMS provides the same functionality in the R/3 System.

Changing Statuses of Registered Programs

SAP_CMREGTP(2):	INIT
SAP_CMACCPTP (call):	INIT → WAITING
SAP_CMACCPTP (rc=timeout):	WAITING → RUNNING

Functions for Registered CPI-C Programs

SAP_CMACCPTP (connection setup):	WAITING → RUNNING
SAP_CMUNACCPTP	WAITING → INIT
CMDEAL:	RUNNING → INIT

Communication with a registered program requires protocol type R.

SAP_CMCANCREGTP

Use

You can use the function SAP_CMCANCREGTP() to cause the Gateway to terminate a registered program. Both functions will only terminate programs that have the status INIT or WAITING. Running programs are not affected. The return code CM_DEALLOCATED_NORMAL is sent to the registered program in the SAP_CMACCPTP call.

Syntax

```
SAP_CMCANCREGTP(tpname,gwhost,gwserv,&total,&canceled,&returncode);
```

Parameters

tpname Transaction program name

gwhost Gateway host

gwserv Gateway service

total Total no. of registrations

canceled No. of terminated programs

returncode Return code

Integration

The function module GWY_CANCEL_REG_PROGRAMS provides the same functionality in the R/3 System.

SNC Function Calls

Use

Secure communication via the CPI-C interface is provided through SAP's **SNC** interface (**S**ecure **N**etwork **C**ommunication).

SNC supports third-party security systems (such as Kerberos, SECUDE, etc.). This provides for a secure Authentification of the partners and secure data transfer.

You can activate the SNC functions via environment variables or entries in the side information file (see the side information basics in the documentation SAP Communication: Configuration [Extern]).

Features

The following SNC function calls are available:

- SAP_CMSNCMODE

  Returns the SNC status of a connection.

  Possible values: SNC_ON

  SNC_OFF

  ```
  SAP_CMSNCMODE( convid, &snc_mode, &return_code);
  ```

- SAP_CMSNCNAME

  Returns the SNC name of the partner that has set up the connection.

  ```
  SAP_CMSNCNAME( convid, sncname, sncname_len, &return_code);
  ```

- SAP_CMACLKEY

  Returns the SNC ACL key of the partner that has set up the connection.

  ```
  SAP_CMACLKEY(convid, aclkey, aclkey_len, &return_len,
  &return_code);
  ```

- SAP_CMNAMETOACLKEY

  Converts the SNC name to an ACL key.

  ```
  SAP_CMNAMETOACLKEY(snclib, sncname, aclkey, len, &return_len,
  &return_code);
  ```

- SAP_CMACLKEYTONAME

  Converts the ACL key to an SNC name.

  ```
  SAP_CMACLKEYTONAME(snclib, aclkey, aclkey_len, sncname,
  &return_code);
  ```

- SAP_CMINIT3

  Analog to SAP_CMINIT [Seite 111], but with SNC data

- SAP_CMREGTP2

Analog to SAP_CMREGTP, but with SNC data (see Functions for Registered CPI-C Programs [Seite 123]). Converts the ACL key to an SNC name.

```
SAP_CMACLKEYTONAME(snclib, aclkey, aclkey_len, sncname,
&return_code);
```

Define Variables for Host Types

Use

The header file *cpic.h* is host-independent. So that the target-host-specific parameter type is used, you must specify the host type before including the header file.

You can specify the host type in one of two ways:

- Statement *define* in the C program (see the example below)
- Parameter specification in the compiler call

  (see Linking an SAP Development Library [Seite 87])

Features

Supported host systems:

Define variable	Host
SAPonBULLDPX2	BULL DPX/2 300 with B.O.S.
SAPonMIPS	DEC Station 3100 with ULTRIX
	Magnum3000 with RISC BOS
SAPonHP_UX	HP/9000-400 with HP-UX
	HP/9000 (PA-RISC) with HP-UX
SAPonRS6000	IBM RS6000 AIX
SAPonAS400	AS/400 with OS/400
SAPonMVS	IMS with MVS
SAPonOS2_2x	PS/2 with OS/2
SAPonMX3I	MX 300 (INTEL) with SINIX V5.4 in System V mode
SAPonMX3N	MX 300 with SINIX V5.2 in System V mode
SAPonMX5I	MX 500 (INTEL) with SINIX V5.4 in System V mode
SAPonRM600	RM600 (MIPS) with SINIX V5.4 in System V mode
SAPonWX2I	WX 200 with SINIX Open Desktop V1.0
SAPonBS2	BS2000
SAPonVMS	OpenVMS

HP/9000-400 with HP-UX:

```
#define SAPonHP-UX 1
...
```

```
#define SOCK 1
#include "cpic.h"
...
main(..)
..
```

Asynchronous Data Transfer With Q-API

Asynchronous Data Transfer is based on various queue interfaces.

Queue Interface in the R/3 System [Seite 139]

Queue Interfaces in the R/2 System [Seite 148]

Queue Interface for C Programs: RFC to R/3 [Seite 171]

Data Transfer

Definition

Synchronous Data Transfer

Data is transferred directly (simultaneously, synchronously) from program to program via CPI-C communication.

Both communications partners must be available at the same time. Because the central SAP system in a typical SAP installation does not run round the clock, but the linked systems are frequently in operation 24 hours a day, asynchronous data transfer is necessary.

Synchronous data transfer has the following disadvantages:

- Transfer is not possible is the partner system or the line is not available.
- A data backlog in the reciever system causes a data backlog in the sender system. Processing in the application is delayed.
- If a connection is broken, it may be necessary to perform a recovery in both systems.

Asynchronous Data Transfer

With asynchronous, or buffered, data transfer, data is temporarily stored in a sequential queue.

Asynchronous transfer has the following advantages:

- Wait times in the sender system are avoided.
- A recovery is automatically performed in the sender system.
- Transfer need not be performed during online time. This avoids placing unnecessary load on the system and thus helps to reduce costs.

The *Queue Application Programming Interface* (Q-API) is an SAP interface for asynchronous data transfer.

Data is buffered sequentially and processed immediately or later by an asynchronously running process.

One possible processing method is to send data to an external partner system via CPI-C. Data units that belong together can be stored in accordance with transaction and sent to a communications partner.

Data is buffered in queues before it is transferred to the target system.

In an R/3 System, the queues are stored in a relational database. All R/3 database systems are supported.

The ABAP interface is implemented as follows:

• In R/3:	ABAP Function Modules
• In R/2:	
Release 4.3H - 4.4:	ABAP calls to Assembler routines
Release 5.0:	ABAP key words

Data Transfer

The C interface to R/3 is implemented as a library which uses R/3 function modules through a *Remote Function Call* (RFC).

Integration

The following topics explain the basic terms and concepts of the SAP interface Q-API.

- Queues [Seite 135]
- Queue Attributes [Seite 136]
- Queue Element [Seite 137]
- Queue Unit [Seite 138]

Queues

Definition

Data elements from an application program are stored for transfer in a queue.

A queue is identified uniquely by a name, which is either defined by the application program or assigned automatically by the queue administration (time stamp) if you do not specify a name explicitly.

The attributes of a queue are determined when the queue is first opened via Queue Attributes [Seite 136].

Integration

Two tables are relevant for internal database administration.

- Table APQI

  This table is used as a queue directory. Each queue has one table entry, which contains its attributes and administration data.

- Table APQD

  This table is used as a data pool, in which the actual data objects are stored.

Queue Attributes

Definition

The attributes and parameters of a queue are set by the queue attributes when it is opened for the first time in write mode. The queue directory entry is created automatically.

Structure

Within an R/3 System, the queue parameters can be displayed and administered via queue administration (SM38).

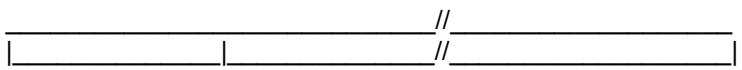
- Queue name

  A maximum of 20 characters or a time stamp
- Can be described: Unique or multiple/parallel
- Data object and processing type recognition
- SAP-specific parameters for the logon protocol
  - Client
  - User password
  - ABAP program/form
- Processing parameters
  - Program
  - Start mode
  - Date/time
  - User password for Express Mail

Queue Element

Definition

A queue element (block) consists of a fixed header for queue administration and a variable data section.



Header Variable data section

Application data are stored transparently in the variable data section, so that any data objects can be stored in the queue.

Segmenting is supported for data structures, which exceed the maximum length of the variable data section. This data is stored, in a form that the application can recognize, divided into several logical storage blocks, and passed on complete to the application when it is called again. The application program makes available a sufficiently large reciever buffer.

Note on ABAP:

- The maximum data object size is defined via the Data Dictionary field APQD-VARDATA.
- The maximum buffer size is restricted to the ABAP data range.

Queue Unit

Definition

If several data elements belong to the same processing unit, this unit is known as a transaction-oriented data unit or *Queue unit*.

Each relevant data element must retain a specific sequence ID:

Q_SINGLE (S)	Individual element
Q_FIRST (F)	First element
Q_MIDDLE ()	Not first/last element
Q_LAST (L)	Last element

A processing program, which is active at a later time, can only delete the data in a queue unit, if the last data object has been acknowledged as processed.

Queue Interface in the R/3 System

Definition

The R/3 System provides ABAP function modules as an interface for asynchronous data transfer. Before it is transferred, the data is stored temporarily in a relational database in queues.

As of R/3 Release 3.0 you can use the transactional RFC for buffered data transfer.

For more information, refer to the documentation Remote Communications [Extern].

Use

Depending on how you use the parameters, the transfer program starts automatically or must be started manually via *System* → *Services* → *Queue* (transaction code SM38). Transaction code SM38 administers and displays queues and their processing logs.

A driver program transfers data at a particular time. The name of the driver program is RSQAPI20.

You must include the file *RSQAPIDF* in your program. It contains data definitions which enhance the readability of ABAP queue transfer programs.

The sample program for R/3 [Seite 205] shows how data is written in a queue.

Structure

You can use the following function modules with their relevant parameter values.

ABAP Function Modules

• QUEUE_OPEN [Seite 140]	Open a queue
• QUEUE_PUT [Seite 142]	Place data in a queue
• QUEUE_GET [Seite 143]	Read data from a queue
• QUEUE_DELETE [Seite 146]	Delete data from a queue
• QUEUE_CLOSE [Seite 144]	Closing a queue
• QUEUE_ERASE [Seite 145]	Delete queue
• QUEUE_SCHEDULE [Seite 147]	Schedule queue processing

QUEUE_OPEN

Use

To open a queue, call the function module QUEUE_OPEN with a sequence of EXPORTING parameters:

```
CALL FUNCTION 'QUEUE_OPEN'
        EXPORTING NAME  =  name
                  TYPE  =  type
                ...
```

Parameters

Assign a value to each of the folowing parameters:

Parameters	Type	Explanation
NAME	C(20)	Queue name
TYPE	C(1)	Queue attribute ' ': Unique: A new queue will be generated, even if a queue with the same name already exists. A : Appendable: An appendable queue is generated or opened (default)
OPENMODE	C(1)	Queue mode: W : Open a queue to write (default) R : Open a queue to read; explicit delete D : Open a queue to read and delete O : Open a queue to read only
DESTINATION	C(8)	Symbolic name of the target system (Table TXCOM)
DATATYPE	C(4)	Data type/processing log: CPIC XTAB ' ' (binary)
CLIENT	C(3)	Client in the SAP target system
USERID	C(12)	User in the SAP target system
PASSWORD	C(8)	User password
PROGRAM	C(8)	Program in the SAP target system
FORM	C(30)	Form routine in the ABAP partner program
DRIVER	C(8)	Name of the driver program

START	C(1)	Start mode A: Automatic (in Online mode only) M: Manual E: Event-oriented P: Periodically event-oriented
DATE	D(8)	Queue processing date
TIME	T(6)	Processing time
ERASE	C(1)	Delete ID If you set a character other than a blank, the queue is deleted after processing.
QSTATE	C(1)	Queue status ' ': No status C: Queue will be created F: Queue has been finished E: Queue error

If you do not specify a name for a queue, you can retrieve a name by extending the call to the function module QUEUE_OPEN.

```
CALL FUNCTION 'QUEUE_OPEN'
       EXPORTING...
       IMPORTING NAME  = QUEUE.
```

QUEUE_PUT

Use

To write to a queue, call the function module QUEUE_PUT with a sequence of EXPORTING parameters:

```
CALL FUNCTION 'QUEUE_PUT'
        EXPORTING NAME   =  name
                  STATE  =  state
                  LENGTH =  length
                  BUFFER =  buffer.
```

Parameters

Assign a value to each of the folowing parameters:

Parameters	Type	Explanation
NAME	C(20)	Name of the queue to write to
STATE	C(1)	Start/end of a *Queue unit* S : Only a single element is written to the queue F : First element in the queue Element is not the first, only or last L : Last element in the queue
LENGTH	I(4)	No. of bytes in the buffer to pass
BUFFER		Buffer to pass (like DDIC field APQD-VARDATA)

QUEUE_GET

Use

To read data from a queue, you must first call the function module QUEUE_GET with a sequence of parameter. The data buffer must have the same type and length as the DDIC field APQD-VARDATA. Larger data objects cannot currently be imported using this module.

```
FUNCTION 'QUEUE_GET'
         EXPORTING
           NAME     = Queue Name
           OPENMODE= Open Mode
           UNIT     = Queue Unit
           POS      = Queue Element

         IMPORTING
           BUFFER   = User Data
           LENGTH   = Length of Data
           STATE    = State of Unit/Message
           UNIT     = Unit
           POS      = Element

         EXCEPTIONS
           EOQ
           BUFFER_ERROR
           INVALID_PARAMETER
           MEMORY_ERROR
           Q_ERROR
           SQL_ERROR.
```

QUEUE_CLOSE

Use

To close a queue, call the function module QUEUE_CLOSE with the EXPORTING parameter NAME.

```
CALL FUNCTION 'QUEUE_CLOSE'
       EXPORTING NAME  =  name
                 OPENMODE  =  'W'.
```

QUEUE_ERASE

Use

You delete a queue by calling the QUEUE_ERASE function module with the EXPORTING parameter NAME.

```
CALL FUNCTION 'QUEUE_ERASE'
       EXPORTING NAME  =  name.
```

QUEUE_DELETE

Use

You can use the function module QUEUE_DELETE to delete data (unit) from a queue. This is done typically after processing is complete. End the call for this module with COMMIT WORK.

```
CALL FUNCTION 'QUEUE_DELETE'
        EXPORTING
          NAME    = Name of Queue
          UNIT    = Unit
        EXCEPTIONS
          INVALID_PARAMETER
          Q_ERROR
          SQL_ERR.
COMMIT WORK.
```

QUEUE_SCHEDULE

Use

You can use the function module QUEUE_SCHEDULE to schedule the queue processing program in R/3 background processing. This module is called internally at QUEUE_CLOSE, if you select the processing mode Q_AUTOSTART and if the queue has been opened in write mode.

Automatic processing of a queue is handled by scheduling the assigned ABAP program (driver) in the *R/3 background job scheduling system*.

Start mode A is **not** possible from an update task. Here, you must call the function module explicitly from the dialog task.

```
CALL FUNCTION 'QUEUE_SCHEDULE'
       EXPORTING
         NAME    = Name of Queue
         PROGRAM = Name of processing Program
         START   = Start Mode
         DATE    = Date of Processing
         TIME    = Time of processing
         COMMITX = implicit Commit of Logical Unit of Work (LUW)
       EXCEPTIONS
         INVALID_PARAMETER
         SCHEDULE_PROBLEM.
```

Integration

Queue processing

Automatic queue processing is handled by scheduling of the assigned ABAP program (driver) in the *R/3 background scheduling system* (transaction code SM36), where it can be monitored. Messages are logged in the background processing environment.

You can call a queue processing program manually via queue administration or directly.

For event-oriented processing, SAP_QEVENT is internally triggered by event parameter *Name of Queue.*

A scheduled batch job is required which starts a variant of the processing program and waits for this event.

These actions are largely performed automatically when creating a queue via the queue transaction SM38.

Queue Interfaces in the R/2 System

Definition

On the R/2 host, the queues are stored in a file called DOUT.

Q-API is integrated into the ABAP language and available in the Assembler environment.

Depending on what parameters you set for the Q-API functions, the transfer program is started automatically or must be started manually using the SAP transaction TMQD.

Use

For queue administration, you can use the following transactions:

TMQD:

Use this transaction (Queue display) to display an overview of the queues available in the system and start asynchronous transfer programs with a manual start ID.

TMQM:

This transaction (Queue maintenance) is for the system administrator and should only be available to a limited group. You can use this transaction to change and delete queues.

A queue is treated as a file. It can be opened, written to and closed:

- Opening a queue

  When a queue is opened, the queue attributes are set.

- Writing to a queue

  An important feature of the queue write function is that control is returned to the executing program without data transfer having been required to take place. This allows data to be passed to queues from the SAP system online and in update mode.

- Closing a queue

  When all the data is entered in the queue, the queue is closed.

Asynchronous data transfer is implemented in different ways in R/2 Systems. For more details, refer to the following sections:

- Queue Interface for Release 5.0 [Seite 149]:

  ABAP key words

- Queue Interface for Release 4.3H / 4.4 :

  ABAP CALLs to Assembler routines

- Special Features in BS2000 [Seite 156]
- Error Messages of the SAP Transfer Program [Seite 191]
- SAP ACCOUNTING Interface SAPSTEC (as of Release 4.3J, 4.4C and 5.0A) [Seite 166]

Queue Interface for Release 5.0

Definition

In R/2 Release 5.0, some functions in the Q-API library are implemented by specific ABAP key words.

For more information, refer to the following topics:

- ABAP Key Words [Seite 150]
- Queue Parameters [Seite 151]
- ABAP Statements [Seite 155]
- Sample Programs for R/2 Release 5.0 [Seite 208]

  The ABAP sample programs contain functions and parameters which are dependent on the transfer data type.

  - Data transfer in RODC format
  - Data transfer from the SAP spool in CPIC format
  - Data transfer in CPIC format

ABAP Key Words

The ABAP program interface for asynchronous communication via queues (DOUT queues) contains key words (functions) to open, close and write to DOUT queues.

- OPEN QUEUE <qparm>,
- TRANSFER <record> TO QUEUE <qparm>,
- CLOSE QUEUE <qparm>

Queue Parameters

Definition

Before you perform the functions, you must fill the queue parameter string <*qparm*>. The structure of <*qparm*> is defined in the *Data Dictionary* as a table without database QPARM.

Use

The queue parameter string can be considered as a reference to an open queue (command OPEN QUEUE) in the buffer file DOUT. If you want to write to several DOUT queues, you can select which queue to write to.

Structure

The parameter string <*qparm*> consists of the following groups:

- Parameters for the Queue Name
- Parameters for the Transfer Program
- SAP-specific Parameters

The following topics list these parameters.

Parameters for the Queue Name

The following parameters determine the queue name:

- QDEST CHAR(8):

  Target system, for which you want to build the CPIC connection.

- QAPPL CHAR(8):

  Transaction program in the target system, which is started via the CPI-C connection (for example, the CICS transaction X1SA if the target system is an R/2 System).

- QDTYP CHAR(4):

  The types of data to be transferred.

  The transfer program delivered by SAP supports the following data types:

RODC:	data is in Remote ODC format.
CPIC:	data is unformatted and user-defined.
SPLD:	Corresponds to the CPIC format where data is stored intermediately in an SAP spool file instead of the queue.

- QMAND CHAR(3):

  Client in the target system

  Use this parameter only if the target system is an SAP system.

- QABAP CHAR(8):

  Name of the ABAP/4 program, in which the form routine to be performed is defined.

Queue Parameters

Use this parameter only if the target system is an SAP system and the transfer data type is CPIC or SPLD.

- QMODU CHAR(30):

  Name of the form routine to be performed.

  Use this parameter only if the target system is an SAP system and the transfer data type is CPIC or SPLD.

Parameters for the Transfer Program

The following parameters control the transfer program Y1SA.

- QMODE CHAR(1):

  Queue open mode:

I: open queue for input

O: open queue for output (default)

U: open queue for update

If you do not specify an open mode (blank), the queue is opened for output (default setting).

Currently only this default setting is supported.

- QSTRT CHAR(1):

  Start mode of the transfer programs:

A: Automatic

The transfer program is started after each *queue unit*. The *queue unit* is controlled with the parameters QFIRS and QLAST.

M: Manual

You start the transfer program interactively using the start function of the SAP transaction TMQD or TMQM.

- QCORR CHAR(1):

  Responsibility for correction of a transfer error:

S: Sender

R: Receiver

Currently only receiver correction responsibility is supported.

- QUPTA CHAR(1):

  Synchronous/asynchronous update in the SAP system

S: Synchronous

A: Asynchronous

The values are only permitted if the target system is an SAP system and data type RODC is used:

- QSTDA DATE(8):

Start date of the transfer programs
for automatic start in format "YYYMMDD"

- QSTTI TIME(6):

  Start time of the transfer programs
  for automatic start in format "HHMMSS"

  You can start the transfer program manually or automatically as well as at a specified start date and time. If the specified start time is before the automatic start time, the SAP transfer program is started immediately.

- QFIRS CHAR(1):

  ID for the first record in a *queue unit*.

- QLAST CHAR(1):

  ID for the last record in a *queue unit*.

  Transfer data can be grouped into *queue units*.

  The transfer data in a *queue unit* is only deleted from the queue after all the transfer data in the *queue unit* has been sent and acknowledged.

  If an error occurs, transfer begins with the first unit of the *queue unit*. A *queue unit* is identified by the values of the two parameter fields QFIRS, QLAST:

QFIRS	QLAST	Y	N	First transfer record
Y	Y	Only transfer record		
N	N	Middle transfer record		
N	Y	Last transfer record		

  You must ensure that the *queue unit* control entries are always closed correctly (with QLAST). An incorrectly identified *queue unit* will result in data being transferred incorrectly several times.

- QTREI CHAR(8):

  Name of the transfer program

  If no name is specified (blank), the name of the SAP transfer program is automatically used (for example, in CICS environment: Y1SA, in a BS2000 environment RSDRIVER).

  If you specify a name, it will be interpreted as the name of a user-defined transfer program.

  User-defined transfer programs can be started automatically or manually.

SAP-specific Parameters

It is a good idea to use the SAP-specific parameters if the target system is an SAP system.

- QDUSR CHAR(12):

  User ID in the SAP system.

  Enter a user name here in accordance with the data type (RODC/CPIC).

- QDPAS CHAR(8):

Queue Parameters

Password for user ID in the SAP system.

The following parameters can be used if the data type RODC is also used.

- QDTRC CHAR(4):

  SAP transaction code

  Transaction code of the SAP transaction to be started via RODC (for example, TS02).

- QDPGM CHAR(8):

  Program name of the corresponding transaction
  (for example, SAPPG02).

- QDDYN CHAR(4):

  Screen number of the corresponding transaction
  (for example, 0041, the first screen in transaction TS02)

ABAP Statements

Use

The following ABAP statements are relevant for data transfer:

- COMMIT WORK

  This statement is used to save all database changes. It corresponds to the Q-API function QCOMMIT. The transfer data is placed, related to transaction, in the queue as a *queue unit*.

- ROLLBACK WORK

  The function ROLLBACK WORK resets a queue transaction. It corresponds to the Q-API function QROLLBACK.

  If a system failure occurs, the data elements of a *queue unit*, which were not closed with COMMIT WORK, are removed from the database and database locks are reset. This ensures that a queue can never contain incomplete *queue units*.

Transfer in BS2000

Definition

In a BS2000 environment the driver program is an ABAP program named RSDRIVER. In the following, it is referred to as the driver. The driver can only work in a running SAP online system. An external driver is not available.

Use

You can start the driver in one of the following ways:

1. Automatically after the message queue has been created
2. Manually via the administrative transactions TMQD and TMQM
3. Manually by calling up the program in dialog
4. Remotely from another application (via a free CPI-C connection)

UTM Special Features

In cases 1 and 2 processing is asynchronous,while in cases 3 and 4 it is synchronous.

Asynchronous processing requires special prommamming, because distributed transaction processing within an asynchronous UTM transaction is possible only with UTM V3.3/UTM-D V2.0.

With earlier versions, distributed transaction processing can be simulated with asynchronous messages.

See also:

BS2000 R/2 Host: UTM-UTM Connection

Structure

You will find more information in the following topics:

- Asynchronous Driver Communication [Seite 157]
- Extensions [Seite 164]
- Notes on Installation [Seite 163]
- Queue Transfer Without Buffering [Seite 162]

Asynchronous Driver Communication

Purpose

For transfer in BS2000 [Seite 156] you can start the driver in such a way that processing runs asynchronously. This has the advantage of avoiding blocking.

Two cases can be identified:

- Recipient is not an SAP System [Seite 160]
- Recipient is an SAP System [Seite 161]

Process flow

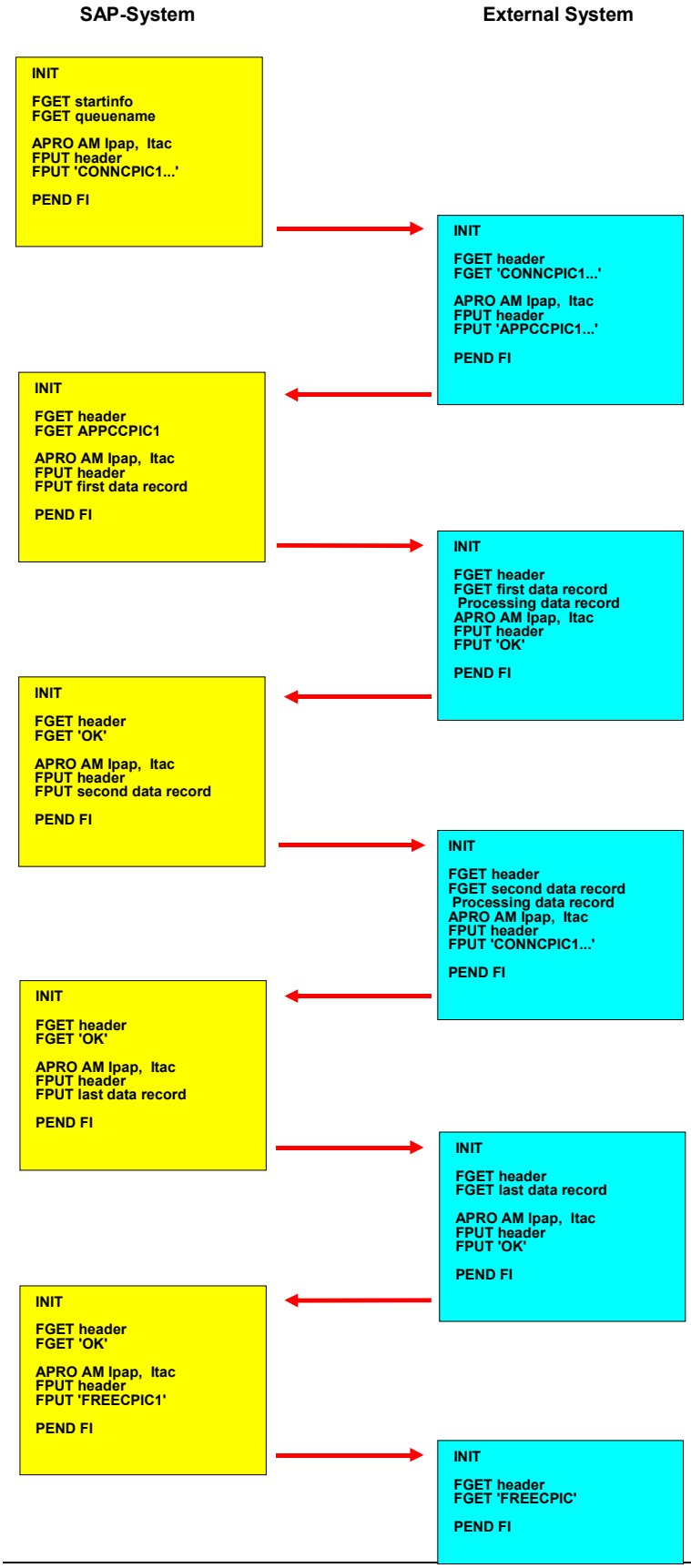
Each communication message from the driver is initiated by a special header message, which must be read with a separate FGET. This header is to be kept and sent unchanged as a separate message (the first message) when responding to the SAP driver (FPUT header).

The driver report begins communication with an SAP logon message (CONN message) when logging on to to another SAP system. If the application addressed is not a SAP system, then this logon must be acknowledged by the message 'APPCCPIC1 '. This logon can be suppressed from 5.0E if user and password are not specified when creating the queue.

Then the driver sends the first message of the first LUW (that has not yet been completely dispatched) and waits for an acknowledgement of receipt. Each message received with a length greater than zero is taken to be an acknowledgement. However, it has become customary to use the character string ‘OK’ for an acknowledgement. If there are other messages, the driver now sends the next message. When all the messages of an LUW have been sent and individually acknowledged by the partner system, the LUW in the file DOUT is deleted. If there is another LUW available, transfer is continued with the first data record of the next LUW.

The following diagram illustrates the communication process asynchronous driver - receiving program.

Asynchronous Driver Communication



Recipient is not an SAP System

Purpose

If the receiving application is not an SAP System, the asynchronous driver requires an additional message header containing address information. The SAP APC protocol must also be observed.

Process flow

Message Header Structure

Field	Type/Length	Explanation
UTMDAIND	C8	Indicator for message header (set by the SAP-System)
UTMDPAPPL	C8	Application name of the SAP System (set by the SAP-System)
UTMDPPROC	C8	Processor name of the SAP application (set by the SAP-System)
UTMDPCNVD	X4	CONVID of the driver in the SAP System (set by the SAP-System)
UTMDSAPPL	C8	Application name of the partner application (set only if the SAP System is also the receiving system, otherwise not used)
UTMDSPROC	C8	Processor name of the partner application (set only if the SAP System is also the receiving system, otherwise not used)
UTMDSCNVD	X4	CONVID in the receiving system (set only if the SAP System is also the receiving system, otherwise not used)

If the partner application receives a message with this message header from the SAP driver, it must use this header at the beginning of each APC confirmation message.

The message header is not part of the driver message. It must be removed before any further processing is made. Therefore, the message header is sent as a separate UTM partial message. The first FGET receives the message header, while the second FGET receives the driver message.

Recipient is not an SAP System

Purpose

If an SAP System is the recipient of an APPQ transfer, you must make an entry in the XCOM table for the argument *UTMPPROC,UTMPAPPL*. Thus, the sender can be addressed (as PLU in this case) via its LPAP and LTAC names.

Prerequisites

The driver can only transfer an LUW (Logical Unit of Work) correctly if both systems remain active until the driver stops.

Process flow

You cannot continue with a transfer in a later session. If you do not observe this, you may receive confirmation messages from the partner by a driver that is no longer active. These messages cannot be addressed and thus are lost. As a DOUT LUW is considered as transferred only after all messages have been confirmed, the LUW continues to exist. If the driver for this queue is started again, the LUW is transferred again beginning with the first element. The recipient has to take this into account.

You should also consider that a check is made for a related XCOM entry as soon as a queue is opened. They key fields are the fields QPARM-QDEST (R/2 Release 5.0) and the corresponding field of the NAME Parameter of the ABAP/4 call using CALL (Releases 4.3 and 4.4).

Queue Transfer Without Buffering

If you are using UTM-D, you can send messages via Q-API to other UTM applications without buffering them in the DOUT file.

UTM-D makes sure that a message is received once only. An LUW is sent as a series of UTM partial messages of an asynchronous UTM-D transaction.

The partner application is addressed via the LPAP and LTAC names contained in the XCOM table. To choose this procedure, set the communication type (CType) in the XCOM table to D.

- You cannot use this procedure in a separate update task using Q-API, as this task is not a UTM task.
- If table XCOM exists in several clients (not recommendable in BS2000), all entries not equal to 0 in one client must also exist in Client 0.

Notes on Installation

In Client 0, you must create an SAP user record as follows:

Name:	RSDRIVER
Password:	DOUT
Transaction authorization	TM39

If spool files are to be sent from SPOOL, the same user must exist in all clients in which there are spool files. This is due to the fact that the driver is started in the corresponding client.

Extensions

Definition

Extensions are available for the following R/2 Releases:

- Release 5.0D
- Release 5.0E
- Release 5.0F
- Release 5.0G

These extensions are described in the following topics.

Release 5.0D

If you are using UTM Version 3.3, your system assumes that you are also using UTM-D V2.0. In this case, the driver operates synchronously without the additional protocol.

If you do not want to use the synchronous procedure due to the changes involved, you can keep the asynchronous procedure by stating communication type A in the XCOM table.

On system startup, any activity indicators still existing in the queues are reset. Queues are deleted if all of their LUWs have been transferred. New driver processes are started for queues that were started automatically and still contain LUWs to be transferred. These actions are performed before the APLZ restart.

Normally, a driver process stops as soon as the all queue elements have been transferred. However, queue elements are often inserted at the end of the queue while queue elements at the beginning are read out by the driver and sent to the recipient at the same time.

If the transfer is not continuous, it often happens that there are no more queue elements in the queue and the driver process stops. Fractions of a second later, new elements are placed in the queue. A new driver process has to started. This requires considerable time and resources (setting up a connection, creating a mode, performing user authorization checks, providing ABAP runtime environment, etc.).

It may be me more efficient to not letting the driver stop as a queue gets empty but to inform the partner program about the state of the queue. The partner program can go into a waiting state and then try to receive more queue elements. In this processing mode, waiting only occurs with the partner program.

To change the driver to this procedure, you must set the NONSTOP variable to 1.

You can use the non-stop procedure only if you start the driver remotely. Message SU031 reports that the queue is empty.

Release 5.0E

If a connection or a driver process abnormally ends, the queue activity indicator is automatically reset. No manual intervention with Transaction TMQM is required. The partner application can thus continue reading out elements from the queue at a later point of time.

Release 5.0F

Asynchronous communication can be set up from an SAP report to an UTM partner, and messages can be sent. Here, the report only makes an ALLOCATE call and any SEND calls required. RECEIVE calls, of course, are not permitted.

Release 5.0G

You can use the communications type in table XCOM to control whether the UTM transaction is to be exited by SAP when communication is started (PEND RE is the standard) or to be kept open (PEND KP). The communications type K controls PEND KP. Keeping the transaction open has advantages with regard to error handling.

If you are using UTM-D V2.0, synchronous communication can be started even when the SAP transaction already has the long-running status. To do this, you simply have to assign transaction code Y2SA to transaction class 10. If the DOUT driver is also working synchronously, you must also assign Y1SA to class 10.

To disentangle asynchronous driver communication from general asynchronous communication (which can considerably hinder driver processes), an additional transaction code (Y3SA) and a new class (14) were defined for general asynchronous communication.

SAP ACCOUNTING Interface SAPSTEC (as of Release 4.3J, 4.4C and 5.0A)

Definition

ACCOUNTING data is transferred via the SAP ACCOUNTING interface SAPSTEC. The SAP transfer program writes an ACCOUNTING record before it terminates.

The two topics below cover the following subjects:

- Data structure

  In which structure is data passed to the SAPSTEC interface?

- Fields

  What meaning and value ranges do the fields have?

Structure

Data structure

```
*****************************************************************
*                                                               *
*        S T C D U M M Y                                        *
*                                                               *
*        THIS DUMMYSECTION DESCRIBES THE LAYOUT OF THE          *
*        S A P - STATISTIC RECORD IN CICS ENVIRONMENT.          *
*                                                               *
*****************************************************************
         SPACE 1
         RAPPL OPSYS=BS2
         AIF   (&APPLOK).$STCD01
DFHEISTG DSECT
.$STCD01 ANOP
STCBEG   DS    0A
STCLEN   DS    H               LENGTH OF RECORD
         DS    XL2             RESERVED (V RECORD)
STCTASK  DS    CL2             SAP TASK TYPE:
*                              D1, D2,...  DIALOG
*                              V1, V2,...  POSTING TASK
*                              N1, N2,...  ODC TASK
*                              L1, L2,...  BACKGROUND TASK
*                              X1, X2,...  LU6.2 COMMUNICATION
*                              S1, SS      SPOOL TASK
STCFLAG1 DS    X               FLAG BYTE 1
STC1DIA  EQU   X'80'           RECORD OF DIALOG TASK
STC1VBT  EQU   X'40'           RECORD OF VB-TASK
STC1SPL  EQU   X'20'           RECORD OF SPOOL TASK
STC1SYS  EQU   X'10'           SYSTEM RECORD
STC1BDC  EQU   X'08'           BATCH INPUT
STC1SCD  EQU   X'04'           SCHEDULED TRANSACTION
STCMANDT DS    XL1             MANDANT
STCDATE  DS    PL4             DATE (PACKED), ZCSADATP
```

```
STCTIME  DS    PL4              END TIME OF TRANSACTION (PACKED)
STCTIMTR DS    PL4              START TIME OF TRANSACTION(EIB,PACK)
STCRESP  DS    XL4              RESPONSE TIME OF TRANSACTION(MS)
STCCTIM  DS    XL4              CPU TIME OF TRANSACT (BS2000 ONLY)
STCATIM  DS    XL4              TIME, TASK WORK AREA IS USED (MS)
STCTCODE DS    CL4              SAP TRANSACTION CODE
STCREPID DS    CL8              IF ABAP: REPORT ID
STCLTERM DS    CL8              TERMINAL ID
STCACCT  DS    CL12             ACCOUNT NUMBER
*

*........CALL STATISTICS, NUMBER OF CALLS.....................
*
STCREADU DS    F                READ FOR UPDATE
STCREAD  DS    F                READ
STCSET   DS    F                SET
STCGET   DS    F                GET
STCWRITE DS    F                REWRITE
STCINSRT DS    F                INSERT
STCDELET DS    F                DELETE
STCLOAD  DS    F                PGM LOAD
STCSYNC  DS    F                SYNCPOINT
STCROLLB DS    F                ROLLBACK
STCCALL  DS    F                OTHER CALLS
*

*........TIMER, I/O COUNTER...................................
*
STCEXDA  DS    H                DATA EXCP'S             * TRACE -
STCEXIN  DS    H                INDEX EXCP'S            * STATISTICS
STCEXES  DS    H                ESDS EXCP'S, DLI ONLY   * ONLY
STCPLOAD DS    H                PHYSICAL LOADS
STCEXTI  DS    F                TIME OF EXCP'S (10**-6 S)
STCPLOTI DS    F                LOAD TIME      (10**-6 S)
STCZWAIT DS    F                ZTTA WAIT TIME (10**-3 S)
STCSWAIT DS    F                SGOC WAIT TIME (10**-3 S)
STCMILN  DS    F                LENGTH OF INPUT MESSAGE (BYTES)
STCMOLN  DS    F                LENGTH OF OUTPUT MESSAGE (BYTES)
STCPOLN  DS    F                LENGTH PRINTER OUTPUT MESS. (BYTES)
STCROLAL DS    F                MAX. ALLOCATED ROLL AREA    (BYTES)
STCRULEN DS    F                MAX. USED ROLL AREA         (BYTES)
STCRCLEN DS    F                MAX. USED ROLL AREA AFTER COMPRESS.
STCPRLEN DS    F                MAX. SIZE OF LOADED PROGRAMS
*
*........DB CALL STATISTICS FOR TRACE.........................
*
STCDB1   DS    F                   APPENDAGE 1:
STCDB1D  DS    F                               DIRECT ACCESS
STCDB1S  DS    F                               SEQUENTIAL ACCESS
*
STCDB2   DS    F                   APPENDAGE 2:
STCDB2D  DS    F                               DIRECT ACCESS
STCDB2S  DS    F                               SEQUENTIAL ACCESS
```

SAP ACCOUNTING Interface SAPSTEC (as of Release 4.3J, 4.4C and 5.0A)

```
*
STCDB3   DS    F                   APPENDAGE 3:
STCDB3D  DS    F                               DIRECT ACCESS
STCDB3S  DS    F                               SEQUENTIAL ACCESS
*
STCDB4   DS    F                   APPENDAGE 4:
STCDB4D  DS    F                               DIRECT ACCESS
STCDB4S  DS    F                               SEQUENTIAL ACCESS
*
STCDB5   DS    F                   APPENDAGE 5:
STCDB5D  DS    F                               DIRECT ACCESS
STCDB5S  DS    F                               SEQUENTIAL ACCESS
*

*........QUEUE NAME IN DOUT.................................
         ORG   STCPRLEN
STCDTQNA DS    CL64
*
*........TIMER FOR ALL SAP DB CALLS (8*10**-6 S).............
*
STCRUT   DS    F                   READ/UPDATE TIMER
STCROT   DS    F                   READ/ONLY TIMER
STCST    DS    F                   SET TIMER
STCGT    DS    F                   GET TIMER
STCWRT   DS    F                   REWRITE TIMER
STCINT   DS    F                   INSERT TIMER
STCDET   DS    F                   DELETE TIMER
STCCALT  DS    F                   OTHER CALLS
*
*........TASK RELATED INFORMATION............................
*
STCVWAIT DS    F                   WAIT ON SYNCHRONOUS UPDATE (MS)
STCTWAIT DS    F                   CPIC: WAIT ON TERMINAL INPUT (MS)
STCDNR   DS    F                   DYNPRO NO. OF DIALOG STEP
STCETIM  DS    F                   CREATION TIME OF APLZ RECORD
STCROLL  DS    F                   ROLL KEY
STCRTABS DS    F                   RTAB CALLS SEQUENTIAL
STCRTABD DS    F                   RTAB CALLS DIRECT
STCNRTC  DS    F                   NO. OF RTC/RTN'S
STCLRTC  DS    F                   LONGEST INTERVAL BETWEEN RTC'S (MS)
STCIMOD  DS    F                   # CREATED INTERNAL MODI
STCTCPU  DS    XL8                 TIME STAMP CPU MEASUREMENT
STCEND   EQU   *
STCLENG  EQU   *-STCBEG
```

Fields

The fields have the following meaning and value ranges for SAP-ACCOUNTING-EXIT:

STCTASK

‘QM’ identifies the ACCOUNTING records written by the SAP transfer program

STCFLAG1:

not significant

STCMANDT

not significant

STCDATE

Date on which the transfer program was started (packed date format 'DDMMYY')

STCTIME

Time at which the transfer program was ended (packed time format 'HHMMSS')

STCTIMTR

Time at which the transfer program was started (Release 4.3: packed time format 'HHMMSS' Release 5.0: ms after midnight)

STCRESP

Period for which the transfer program was activated (time between the start time and end time of the transfer program in ms)

STCCTIM

not significant

STCATIM

not significant

STCTCODE

not significant

STCREPID

not significant

STCLTERM

Conversation identifier that the transfer program uses for identifying the LU6.2 connection to the target system

STCACCT

not significant

STCREADU

No. of ‘read for update’ operations

STCREAD

No. of ‘read’ operations

STCSET

not significant

STCGET

not significant

STCWRITE

No. of ‘rewrite’ operations

STCINSRT

SAP ACCOUNTING Interface SAPSTEC (as of Release 4.3J, 4.4C and 5.0A)

No. of ‘insert’ operations

STCDELET

No. of ‘delete’ operations

STCLOAD

No. of ‘PGM load’ operations

STCSYNC

No. of ‘syncpoint’ operations

STCROLLB

No. of ‘rollback’ operations

STCCALL

No. of ‘other calls’

STCMOLN

Total no. of bytes transferred by the SAP transfer program (sum of bytes from the transferred SAP protocol information and the user data)

STCDTQNA

Name of the transferred DOUT queue

STCTWAIT

Total wait time of the transfer program in ms (consists of the wait time for the connection set up and the wait time when receiving transfer buffers)

Queue Interface for C Programs: RFC to R/3

Definition

You can use the SAP interface *Remote Function Call* (RFC) to call the function modules of the queue interface in R/3 from external C programs to place data in - or read data from - a queue. The necessary functions are provided by the RFC library.

Use

For details of the SAP interface RFC, see the documentation Remote Communications [Extern].

For details of the Q-API function modules, see Queue Interface in the R/3 System [Seite 139].

An ABAP program calls a queue function module in another R/3 System (C11) as follows:

```
CALL FUNCTION 'QUEUE_OPEN'
     DESTINATION 'C11'
     EXPORTING NAME     = 'TESTQUEUE'
               OPENMODE = 'W'
               TYPE     = 'A'.
```

Accordingly, a C program calls the same queue function module in the R/3 System as follows:

```
  /***
   */

   #include "saprfc.h"

   char               queue[20] = 'TESTQUEUE';
   char               openmode  = 'W';
   char               qtype     = 'A';
   int                rc;
   char              *exception ;
   RFC_OPTIONS        rfc_options;
   RFC_PARAMETER      exporting[5],importing[5];
   RFC_HANDLE         handle    = RFC_HANDLE_NULL;

        :
   rfc_options.destination = "C11";
   handle = RfcOpen( &rfc_options);   /* link to RFC Partner
*/
        :

   exporting[0].name = "NAME";
   exporting[0].nlen = 4;
   exporting[0].type = TYPC;
   exporting[0].addr = queue;
   exporting[0].leng = 20;
```

```
            exporting[1].name = "OPENMODE";
            exporting[1].nlen = 8;
            exporting[1].type = TYPC;
            exporting[1].addr = &openmode;
            exporting[1].leng = 1;

            exporting[2].name = "TYPE";
            exporting[2].nlen = 4;
            exporting[2].type = TYPC;
            exporting[2].addr = &qtype;
            exporting[2].leng = 1;

            exporting[3].name = (char *)0; /* no more export parameters
          */

            importing[0].name = NULL;      /* no import parameter(s)
          */
            tables[0].name    = NULL;      /* no internal table(s)
          */
            exception         = NULL;      /* default exception
          handling*/

            rc = RfcCallReceive( handle,
                                 "QUEUE_OPEN",
                                 exporting,
                                 importing,
                                 tables,
                                &exception);
           ...
           ...
```

An ABAP/4 program calls a queue function module in another R/3 System (C11) as follows:

```
      CALL FUNCTION 'QUEUE_OPEN'
           DESTINATION 'C11'
           EXPORTING NAME     = 'TESTQUEUE'
                     OPENMODE = 'W'
                     TYPE     = 'A'.
```

Accordingly, a C program calls the same queue function module in the R/3 System as follows:

```
         /***
          */

          #include "saprfc.h"

          char               queue[20] = 'TESTQUEUE';
          char               openmode  = 'W';
          char               qtype     = 'A';
          int                rc;
          char              *exception ;
          RFC_OPTIONS        rfc_options;
          RFC_PARAMETER      exporting[5],importing[5];
```

```
RFC_HANDLE          handle    = RFC_HANDLE_NULL;

     :
rfc_options.destination = "C11";
handle = RfcOpen( &rfc_options);   /* link to RFC Partner */
     :

exporting[0].name = "NAME";
exporting[0].nlen = 4;
exporting[0].type = TYPC;
exporting[0].addr = queue;
exporting[0].leng = 20;

exporting[1].name = "OPENMODE";
exporting[1].nlen = 8;
exporting[1].type = TYPC;
exporting[1].addr = &openmode;
exporting[1].leng = 1;

exporting[2].name = "TYPE";
exporting[2].nlen = 4;
exporting[2].type = TYPC;
exporting[2].addr = &qtype;
exporting[2].leng = 1;

exporting[3].name = (char *)0; /* no more export parameters */

importing[0].name = NULL;      /* no import parameter(s)    */
tables[0].name    = NULL;      /* no internal table(s)      */
exception         = NULL;      /* default exception handling*/

rc = RfcCallReceive( handle,
                     "QUEUE_OPEN",
                     exporting,
                     importing,
                     tables,
                    &exception);
...
...
```

Data objects which are read from a queue by an ABAP program must not exceed the field length of field APQD-VARDATA, which is defined in the *Data Dictionary*.

Using SAP Test Programs

In the following topics, you will learn how to test your CPI-C communication with the SAP test programs.

Available SAP Test Programs

Definition

The following test programs are available:

Test programs

Programs	Programs Written in C	ABAP programs
Calling	ccpict1	acpict1
Callable	ccpict2	acpict2

Use

The test programs undertake CPI-C communication.

Each calling program (C or ABAP) can call one of the callable programs (C or ABAP).

These test programs therefore let you check program-to-program communication for all constellations.

ABAP test programs in R/2:

The SAP test programs are delivered with the CPI-C development libraries. The ABAP programs are directly available in new Releases of R/2 Systems. Otherwise you must upload these programs in your R/2 System.

Structure

There are some special features for ABAP programs and programs written in C.

Programs Written in C

The names of the C programs end with t or s. These letters specify which protocol the communication is based on.

`ccpict1s`	SNA is the protocol
`ccpict1t`	TCP/IP is the protocol

You must create a side info file in your work directory before starting the calling C program (see section “Side Information Tables” in the documentation BC - SAP Communication: Configuration [Extern]).

The calling C program records the program activities on the screen (stdout). The C program called creates the trace file `cpict2t.trc`.

You can activate the CPI-C trace function before the start of the calling C program as follows:

- `CPIC_TRACE=2` in the side info file
- Environment variable `CPIC_TRACE=2`

Available SAP Test Programs

Program-to-program communication normally takes place via the SAP gateway. You do not need the SAP gateway if the platform of each partner program supports the SNA protocol LU6.2. This is possible with the following constellations:

- C program ↔ R/2 program
- C program ↔ C program

Here, use the SNA-specific C programs.

ABAP programs

Both the calling and callable ABAP programs can be found in an R/2 or R/3 System.

The calling ABAP program records the program activities on the screen.

Specifying Program Parameters

Explanation You must specify parameters for the calling program. The calling program can be an ABAP or C program.

ABAP program

When executing the ABAP program, you must specify the following program parameters:

DEST	<destination>	destination according to TXCOM/XCOM
ABAP	<' '/X>	X, if the partner is acpict2
CONVERT	<' '/X>	X, if conversion is required
USER	<user>	SAP user name
PWD	<Password>	password

Testing a Connection [Seite 179] only details those program parameters which require an entry.

Program Written in C

When executing a program written in C, you must specify the following program parameters:

dest	**<destination>**	destination according to sideinfo
abap		if the partner is acpict2
conv		if conversion is required
usr	**<user>**	SAP user name
pwd	**<Password>**	password

Requirements for Starting an External Partner Program

There may be several reasons why a called CPI-C program cannot be started.

First decide what type of program it is:

- A local program
- A remote program started via *Remote Shell*

Starting a Local Target Program

The SAP Gateway starts a local CPI-C program via *fork/exec*.

To avoid errors, ensure the following two conditions are met:

- The program is located in the search path of the Gateway ID.
- It is executable for the Gateway ID.

Log on with the Gateway ID and check whether the program to be started is in the search path of the Gateway ID:

UNIX:	`which <program>`

Starting the Target Program via *Remote Shell*

A program is started on a remote computer via *Remote Shell*. For this, the following requirements must be met on the remote computer.

- The Gateway ID must exist.
- The Gateway compter must be entered in the.*rhosts* file. The.*rhosts* file must be located in the HOME directory or in the path of the Gateway ID.
- The program to be started must be installed in the HOME directory of the Gateway ID.

Log on with the Gateway ID and check, using Remote Shell, whether the authorizations necessary for calling a remote program exist, and that this is in the search path of the Gateway ID:

UNIX:	`remsh <host> date`
	`which <program>`

The Gateway processes in BS2000 are used exclusively for switching connections to R/2 Systems.

You cannot, for example, start programs outside the R/2 System in the BS2000 host via the SAP Gateway.

Testing Connections

When testing connections, you must specify various parameters, depending on whether the calling program is an ABAP/4 program or a C program:

You will find more information in the following topics:

Calling Program: ABAP Program in R/3 [Seite 180]

Calling Program: ABAP Program in R/2 [Seite 181]

Calling Program: C Program [Seite 183]

Calling Program: ABAP Program in R/3

You call the test program **acpict1** with transaction SE38.

Partner: ABAP Program in R/3

Define the following program parameters:

DEST <dest> ABAP X USER <user name> PWD <Password>

You must define the following parameters in the TXCOM side info table.

```
DEST  LU                TP                        Prot <dest> <R/3 host>
      <Dispatcher service>    I
```

Partner: ABAP Program in R/2

Define the following program parameters:

DEST <destination> ABAP X CONVERT X USER
<user name> PWD <Password>

In the TXCOM side info table, you only have to define the DEST and Prot parameters (LU and TP are ignored):

```
DEST  LU    TP    Prot <dest> -     -     C
```

You must define the following parameters in the side info table on the gateway platform:

```
DEST          =<dest>
LU                  =<Logical unit>
TP                  =X1SA
```

Partner: Program Written in C

Define the following program parameter:

DEST <destination according to TXCOM>

You must define the following parameters in the TXCOM table:

```
DEST        LU                TP          Prot <dest> <partner host>
      ccpict2t    E
```

Calling Program: ABAP Program in R/2

You call the `acpict1` test program with transaction TM38.

Partner: ABAP Program in R/3

Define the following program parameters:

DEST	*<destination>*
ABAP	*X*
CONVERT	*X*
USER	*<user name>*
PWD	*<Password>*

Here, the SAP communications programs *gwhost* for CICS or *gwims* for IMS are required for communication. Details on this can be found under “Parameters on the SNA Subsystem” in the documentation BC SAP Communication: Configuration [Extern].

In a BS2000 host, *gwhost* is required (Job SAPGWHO). For more information, see the section “Connection Setup by the R/2 System” in the documentation BC SAP Communication: Configuration [Extern].

You must define the following parameters in the XCOM side info table:

DEST	LU	TP
<dest>	<LU>	<Alias for gwhost or gwims>

You must define the following parameters in the side info table on the gateway platform:

DEST	=<Alias for gwhost or gwims>
GWHOST	=<SAP gateway host>
GWSERV	=<SAP gateway service>
PROTOCOL	=I
LU	=<R/3 host>
TP	=<SAP dispatcher service>

Partner: ABAP Program in R/2

Define the following program parameters:

DEST	<destination>
ABAP	X
CONVERT	X
USER	<user name>
PWD	<Password>

You must define the following parameters in the XCOM side info table:

DEST	LU	TP

Calling Program: ABAP Program in R/2

<dest>	<LU>	X1SA

- Communication between R/2 Systems is only possible on IBMhosts when CICS is used as the data communications system.
- Local communication on an R/2 IBM host is not possible. CICS does not support a local *Conversation* via SNA-LU6.2.
- A local *Conversation* is possible for SNI UTM systems.

Partner: Program Written in C

As the partner is not an SAP program, you only have to specify the following program parameter:

DEST	<destination>

Here, the SAP communications programs *gwhost* for CICS or *gwims* for IMS are required for communication. Details on this can be found under “Parameters on the SNA Subsystem Platform with R/2” in the documentation BC - SAP-Communication: Configuration [Extern].

In a BS2000 host, *gwhost* is required (Job *SAPGWHO*). For more information, see the section “Connection Setup by the R/2 System” in the documentation BC - SAP Communication: Configuration [Extern].

You must define the following parameters in the XCOM side info table:

DEST	LU	TP
<dest>	<LU>	<Alias for gwhost or gwims>

You must define the following parameters in the side info table on the gateway platform:

```
DEST=<Alias for gwhost or gwims>
GWHOST=<SAP gateway host>
GWSERV=<SAP gateway service>
PROTOCOL=E
LU=<partner host>
TP=ccpict2t
```

Calling Program: Program Written in C

Call the **ccpict1t** C program with the appropriate parameters.

Partner: ABAP Program in R/3

You must define the following parameters in the sideinfo file for the calling program:

DEST	=<user defined destination>
LU	=<R/3 host, on which acpict2 is running>
TP	=<SAP dispatcher service>
GWHOST	=<SAP gateway host>
GWSERV	=<SAP gateway service>
PROTOCOL	=I

You call the **ccpict1t** test program as follows:

```
ccpict1t -dest <DEST according to sideinfo> -abap -usr <SAP user name>
-pwd <password>
```

Partner: ABAP Program in R/2

You must define the following parameters in the sideinfo file for the calling program:

DEST	=<user defined destination>
GWHOST	=<SAP gateway host>
GWSERV	=<SAP gateway service>
PROTOCOL	= C

You must define the following parameters in the sideinfo file for the SAP gateway:

DEST	=<user defined destination>
LU	= <Logical unit>
TP	= X1SA
PROTOCOL	=C

Note the platform-specific special features of side info entries (see BC - SAP Communication: Configuration [Extern]).

You call the ccpict1t test program as follows:

```
ccpict1t -dest <DEST in sideinfo> -abap -conv -usr <SAP user name> -pwd
<password>
```

Partner: Program Written in C

You must define the following parameters in the sideinfo file for the calling program:

DEST	=<user defined destination>
LU	=<host, on which ccpict2 is to run>

Calling Program: Program Written in C

TP	= ccpict2
GWHOST	=<SAP gateway host>
GWSERV	=<SAP gateway service>
PROTOCOL	=E

You call the ccpict1t test program as follows:

```
ccpict1t -dest <user defined destination>
```

Error Analysis

Error analysis is described in the following topics:

Function SAP_CMPERR

Use

If you use the function SAP_CMPERR in the SAP development library for your C program, you get a short error description if an error occurs.

```
CM_RETCODE return_code;
 ..
    CMALLC(convid,&return_code);
    if (return_code != CM_OK)
    {
     printf("SAP-INFO: %s\n", SAP_CMPERR());
    }
 ..
```

Error Analysis Under OS/2

Purpose

CPI-C Trace

You can run an SAP trace while programs communicate via the CPIC interfaces.

You can activate and deactivate the trace via the environment variable:

```
CPIC_TRACE = [1,2,3]
```

For each process that the SAPCPIC interface uses, a log file with the name CPxxxxx.TRC is created. xxxxx is the number of the process.

Error Log File

If an error occurs during communication, this error is logged in the file CPxxxxx.ERR with xxxxx = number of the process, in which the error occurred.

Error Messages

If an error occurs during communication, the error is logged. The error messages are output as described in the APPC/LU6.2 guide. In addition, SAP has defined a series of error messages, which are listed below.

These error messages are not CPI-C return codes, and cannot therefore be intercepted in the program.

They simply provide additional information in the trace or error log, which should facilitate error recovery.

SAP_TABLE_NOT_FOUND:

The file SAPCPIC.TBL was not found (CMINIT) or SAPCPIC.TBL cannot be accessed.

SAP_INVALID_DESTINATION:

The specified symbolic destination was not found in SAPCPIC.TBL (CMINIT, CMACCP).

SAP_TOO_FEW_ARGUMENTS:

Not all fields in SAPCPIC.TBL are filled for a particular symbolic destination sind.

SAP_NO_FREE_SIDE_TABLE_SLOT:

An attempt was made to exceed the maximum number of simultaneously active SNA conversations.

SAP_CANT_GET_LOCAL_PGM_NAME:

The attempt to determine the name of the local program failed. The corresponding OS/2 return code is in the error log.

SAP_INVALID_CPIC_CV_ID:

An invalid conversation ID was passed to a SAPCPIC interface function.

Error Analysis Under OS/2

SAP_CANT_GET_SIDE_INFO_SEM, SAP_CANT_LOCK_SIDE_INFO_SEM, SAP_CANT_RELEASE_SIDE_INFO_SEM:

SAP's CPI-C interface works internally with system semaphores. These three errors indicate that either the creation, locking or release of a system semaphore failed. The interface cannot continue to work correctly.

The corresponding OS/2 return code is in the error log.

SAP_CANT_GET_PROCESS_PID:

The attempt to determine the number of a process failed. The corresponding OS/2 return code is in the error log.

SAP_CANT_GET_INFOSEG:

The attempt to get OS/2 system information failed. The corresponding OS/2 return code is in the error log.

SAP_TOO_MANY_CPIC_TBL_ENTRIES:

More connections are defined in SAPCPIC.TBL than the SAPCPIC interface can administer. The current maximum value = 100 connections.

SAP_CANT_GET_SIDE_INFO_SHM, SAP_CANT_GET_DISPLAY_INFO_SHM:

The SAPCPIC interface works internally with shared memory. These two errors indicate that the creation of shared memory areas failed. The interface cannot continue to work correctly. The corresponding OS/2 return code is in the error log.

SAP_NO_FREE_SESSION_AVAILABLE:

All SNA connections defined for a particular symbolic destination are in use, i.e., all SNA sessions have conversations.

SAP_INVALID_LU_NAME:

An invalid local SNA Logical Unit name was entered in SAPCPIC.TBL for a particular symbolic destination.

SAP_INVALID_PLU_NAME:

An invalid local SNA Partner Logical Unit name was entered in SAPCPIC.TBL for a particular symbolic destination.

SAP_INVALID_MODE_NAME:

An invalid SNA mode name name was entered in SAPCPIC.TBL for a particular symbolic destination.

Error Analysis Under UNIX and WindowsNT

Purpose

CPI-C Trace

If the function SAP_CMPERR is not sufficient for error analysis, you must activate the CPI-C trace. You have several options:

- Set the shell variable CPIC_TRACE
- Entry in the side information file
- Via the target program for R/2 host-to-workstation communication

These options are described below.

0:	No trace
1:	Error trace
2:	Trace flow and shortened data trace
3:	Trace flow and complete data trace

The trace will be in a trace file (*CPICTRC<PID>*) in the current work directory.

The trace function for the called program can only be activated via the shell variable CPIC_TRACE.

If you want to check a configuration file, you can use the CPI-C test programs *cpict1* and *cpict2*.

Activation via Environment Variable

The environment variable has priority over an entry in the side information file.

You can use the environment variable CPIC_TRACE to activate a trace function, as in the following:

UNIX: `setenv CPIC_TRACE 3`

Activation via the Side Information File

If, for example, you want to record an error trace, make the following entry in the side information file:

```
CPIC_TRACE=2
```

Activation via the Target Program

If you want to start an R/3 or C program on a remote workstation from an R/2 host, you normally set the trace level using the environment variable CPIC_TRACE. If this is not possible, (for example, if.*login* or.*cshrc* are not processed), define the trace level in the side information file using the variable CPIC_TRACE.

The trace level set in this way can be activated via the called program using the following function:

```
CMSetCPICTrace()
```

Error Analysis Under UNIX and WindowsNT

```
main()
     {
    .
      CMSetCPICTrace();
    .
      SAP_CMACCP();
    .
      CMACCP();
    .
    .
     }
```

Error Messages of the SAP Transfer Program

Definition

Error messages are sent by the receiving program to the transfer program. The transfer program enters the messages in the corresponding fields of the queue administration information record.

In addition to these error messages, these fields also contain messages regarding local errors of the transfer program.

Structure

If local error situations occur with the transfer program, the following error messages are entered in the queue administration information record:

'AKCS PARTNER DOES NOT RESPOND '

When establishing a connection (for example, EXEC CICS ALLOCATE), the wait for the connection is terminated after a certain wait time because the target system is not active (for example, the Communications Manager is not started on the workstation).

'ATCV INVALID FUNCTION FOR CURRENT LU6.2 STATE '

The LU6.2 function called by the transfer program cannot be executed with the current status of the connection to the target system (for example, the target application is not adhering to the send and receive sequence defined by the transfer data type).

'AISS LU6.2 SECURTITY ERROR '

The target application, to which the transfer program is to build a connection, is performing an authorization check, which is not met by the transfer program (for example, in the Communication Manager on the workstation, *conversation security* is active for the started transaction program ('remotely attachable transaction program')).

'E001 CANNOT ALLOCATE LU6.2 SESSION '

The attempt to establish a connection is rejected by the network (for example, the specified target system is not known).

'E002 CANNOT CONNECT PROCESS '

The connection to the transaction program in the target system is rejected (for example, the specified transaction program is not defined as a startable transaction program).

'E003 CANNOT SEND BUFFER WITH INVITE '

Error sending data to the target transaction program.

'E004 CANNOT RECEIVE BUFFER '

Error receiving data from the target transaction program (for example, the specified transaction program is not defined as a startable transaction program).

'E005 CANNOT FREE LU6.2 SESSION '

Error establishing a connection with the target transaction program.

'E006 CANNOT SEND BUFFER '

Error sending data to the target transaction program.

Error Messages of the SAP Transfer Program

'E007 FREE SESSION INDICATOR RECEIVED '

The target transaction has already established the connection although the transfer program has not yet completed processing. The target application is not adhering to the send and receive sequence defined by the transfer data type or an error situation has occurred, in which it can no longer communicate the error with an error message buffer.

'E008 CANNOT SEND BUFFER WITH LAST WAIT '

Error sending data to the target transaction program.

'E009 CONVERSATION PARTNER DO NOT INVITE TO SEND '

The target transaction is not returning the send authorization to the transfer program. The target application is not adhering to the send and receive sequence defined by the transfer data type.

'E014 EIBERRCD RECEIVED '

The transfer program has received an error message from the LU6.2 function that was performed. The EIBERRCD error is displayed as an 8-digit number after the string 'E014'. The cause of the error is described in the *CICS/OS/VS Intercommunications Facilities Guide*.

'E021 CANNOT RECEIVE RETURN BUFFER '

Error receiving data from the target transaction program.

'E025 ACCESSING DOUT TO GET DATA TO BE SEND '

Internal error accessing the queue to update send data or status information.

'E034 ACCESSING DOUT TO SET PROCESS INACTIVE INDICATOR'

Internal error during access to update status information.

'E039 CANNOT UPDATE APQI/APQD RECORD '

Internal error accessing the queue

to update send data or status information.

'E040 CANNOT DELETE APQD RECORDS '

Internal error accessing the queue to update send data.

'E304 CANNOT UNLOCK/ENDBR DOUT AFTER RETRIEVING PARAM '

Internal error during access to update status information.

'E305 WARNING NO INPUT PARAMETER RECEIVED '

The transfer program was not started by a
'EXEC CICS START' command.

'E306 CANNOT RETRIEVE COMMAREA '

The transfer program was started interactively instead of by a 'EXEC CICS START' command. The name of the queue to be started was not received.

'E310 ACCESSING DOUT TO SET PROCESS ACTIVE INDICATOR '

Internal error during access to update status information.

'E315 RETRIEVED KEY FIELD IS TOO SHORT '

The queue name passed during startup does not have the correct length.

'E320 NOT SUPPORTED DRIVER TYPE '

The transfer program was started for a transfer data type, which it does not support.

'E325 ACCEPT ONLY RECEIVER CORRECTION RESPONSIBILITY '

The transfer program can only run if the target transaction program performs the error correction.

'E330 OUTPUT PROCESS IS ALREADY ACTIVE '

A transfer program is already active for this queue.

'E340 NO RECORD FOUND TO SEND TO THE TARGET SYSTEM '

The transfer program was started for the queue, but has not found any transfer data to be sent in the queue.

'E530 START BROWSE SPLD DATASET '

Internal error accessing the queue to update send data to be read from the SAP spool.

'E550 NO SPOOL CONTROL RECORD FOUND '

Internal error accessing the queue to update send data to be read from the SAP spool.

'E555 WRONG SPOOL FILE PASSWORD '

The SAP spool file, from which the transfer data was to be read, is password protected. The SAP spool password in the queue entry does not match the password of the referenced SAP spool file.

'E560 SPOOL RECORD WITH ZERO FIELD LENGTH '

Internal error accessing the queue to update send data to be read from the SAP spool.

'UNDEFINED ERROR CODE IN DRIVER TASK '

Internal error

In addition to the error text, an error code is output with the error message. As with the error message texts, there is a difference between the local error codes and the error codes sent by the partner transaction program. Below is a list of local error message codes of the SAP transfer program in a CICS environment. The error message codes represent the CICS condition codes, which can occur during error recognition by the SAP transfer program. The local error message codes are listed opposite the corresponding CICS condition codes.

Local error code	CICS condition code
CBID	CBIDERR
DSDI	DISABLED
DSID	DSIDERR
DUPK	DUPKEY
DUPR	DUPREC
ENDF	ENDFILE
ILLO	ILLOGIC
INVR	INVREQ
IO	IOERR
ISCI	ISCINVREQ
ITEM	ITEMERR
LENG	LENGERR

Error Messages of the SAP Transfer Program

NOST	NOSTG
NOSP	NOSPACE
NOAL	NOTALLOC
NOAU	NOTAUTH
NOTF	NOTFND
NOTO	NOTOPEN
QID	QIDERR
SESS	SESSBUSY
SIGN	SIGNAL
SYID	SYSIDERR
TERM	TERMERR
DSID	DISABLED
DUPK	DUPKEY
NOSP	NOSPACE
NOTA	NOTAUTH
NOTF	NOTFND
NOTO	NOTOPEN

Special Features on R/2 Hosts

Special features on various R/2 hosts are explained in the following chapters:

BS2000 R/2 Host: UTM-UTM Connection [Seite 196]

MVS/VSE R/2 Host: CICS and IMS [Seite 201]

BS2000 R/2 Host: UTM-UTM Connection

Purpose

No CPI-C interface is available in BS2000. Alternatively, you can use program-to-program communication between ABAP programs and UTM subprograms based on UTM-VTV. This means that two R/2 Systems under UTM are connected.

Implementation considerations

Communication can be initiated by both sides. As UTM does not support calls equivalent to the CPI-C calls *Initalize, Allocate, Accept* and *Deallocate*, these calls need not be used or must be simulated as follows:

CPI-C call in ABAP	UTM call
COMMUNICATION ALLOCATE	APRO
COMMUNICATION SEND	MPUT
COMMUNICATION RECEIVE	MGET

To create UTM-D subprograms, you will require the corresponding UTM guides.

The rules for distributed transaction processing must be adhered to.

The following examples are discussed:

Initiator: R/2 System [Seite 199]

Initiator: Non-SAP System [Seite 200]

Features

- UTM-D allows communication within the same application.

  Both the sending and the receiving program can be run for test purposes in the same SAP system. For the test, you do not need a second application (see the generation notes).

- Asynchronous CPI-C communication

  A special feature contained only in UTM implementation is the possibility of asynchronous communication. Unlike synchronous communication, which always involves sending a message (CMSEND) and then waiting for a reply (CMRECEIVE), asynchronous communication only involves sending.

  This offers a series of advantages:

  – When sending, the partner application need not be active.

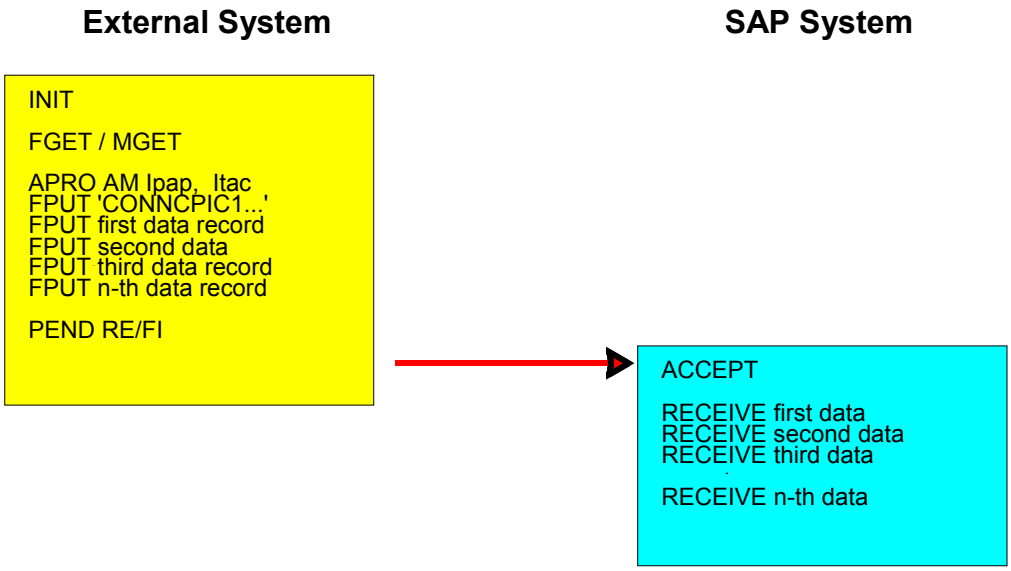
  – It is possible to send from asynchronous UTM transactions, i.e. from stations not operated.

  – Easier programming

  – No problems with UTM error handling

  Up to now, the asynchronous procedure has been used predominantly for sending messages to the SAP system. The procedure is based on a special feature of UTM-D,

that is asynchronous partial messages from the sender can be presented to the receiver as individual messages. Asynchronous communication from the external system to the SAP system is operated as follows:



You send a logon message (in which you specify the receiving report), and can then send as many data messages as required up to the maximum number of partial messages possible (around 32000 Bytes). The requirements here are simply large enough page pools in the KDCFILEs of sender and receiver.

Constraints

- No debugging mode in the ABAP program

  ABAP programs, which contain the COMMUNICATION statements, cannot run in debugging mode.

  Possible intermediate dialogs in this mode violate the rules for distributed transaction processing with UTM-D. Violation results in a PEND ER and task termination.

- No character string with FREE

  Free communication is restricted in that no message can begin with the string FREE because this is used for the DEALLOCATE simulation.

- Normally, the initiator (PLU) of communication must also end communication.

  As the statement DEALLOCATE is not supported in UTM, it must be simulated. From the point of view of the SAP system on the host, there are two synchronous processing scenarios:

  1. DEALLOCATE statement in the PLU
     (Primary Logical Unit)

     If the PLU performs a DEALLOCATE statement, which follows a RECEIVE, this must be made known to the SLU. A FREE message is created in the service routine *Deallocate* and sent to the SLU. At the same time, terminal output from the PLU is delayed until the response required by the UTM protocol is received from the SLU.

2. DEALLOCATE statement in SLU
   (Secondary Logical Unit)

   If, for example, an SLU encounters an error situation, in which it is preferable to continue communication, the SLU must end communication using DEALLOCATE.

   The SLU has two possible courses of action:

   - Send a FREE message to the PLU
     (possibly with an error message)
   - Perform a DEALLOCATE call

   If DEALLOCATE is called, the FREE message is generated automatically. You cannot send a message and then perform a DEALLOCATE call.

   If the SLU is not an SAP System, a process termination by PEND FI of the SLU is interpreted as DEALLOCATE by the SAP System.

A PLU can only close itself (PEND FI) after all its SLUs are closed. Otherwise, this would cause a UTM task termination with 87Z and KS01 (see bottom-up strategy in the UTM documentation).

Initiator: R/2 System

In the example below, the calling program is an ABAP program.

ABAP program	UTM subprogram
COMMUNICATION INIT ID convid DESTINATION sym_dest. COMMUNICATION ALLOCATE ID convid. COMMUNICATION SEND ID convid BUFFER sendarea LENGTH sendlen.	
	INIT MGET message from SAP MPUT message to SAP PEND RE
COMMUNICATION RECEIVE ID convid BUFFER rcvarea LENGTH reqlen RECEIVED rcvlen DATAINFO datai STATUSINFO stati. COMMUNICATION DEALLOCATE ID convid.	
	INIT MGET Deallocate simulation MPUT Deallocate acknowledgement PEND FI

Initiator: Non-SAP system

In the example below, the calling program is part of a non-SAP system.

UTM subprogram	ABAP program
INIT MGET Terminal message APRO SAP system MPUT to SAP system PEND RE/KP	
	COMMUNICATION ACCEPT ID convid. COMMUNICATION RECEIVE ID convid BUFFER rcvarea LENGTH reqlen RECEIVED rcvlen DATAINFO datai STATUSINFO stati. COMMUNICATION SEND ID convid BUFFER sendarea LENGTH sendlen.
INIT MGET message from SAP MPUT to SAP system (Deallocate simulation) PEND RE/KP	
	COMMUNICATION RECEIVE ID convid BUFFER rcvarea LENGTH reqlen RECEIVED rcvlen DATAINFO datai STATUSINFO stati.
INIT MGET Deallocate acknowledgement from SAP MPUT Terminal message PEND RE/FI	

MVS/VSE R/2 Host: CICS and IMS

Purpose

Make note of the following special features in the DC systens CICS and IMS when using an MVS/VSE R/2 host:

CICS Special Features [Seite 202]

IMS Special Features [Seite 203]

CICS Special Features

ABAP supports the *CPI-C Starter Set*. When using the LU6.2 program interface for CICS, this means:

- Mapped Conversation
- SYNCLEVEL 0 (NONE)

The table below contains a list of the CPI-C functions and the corresponding calls of the LU6.2 program interface (API) in CICS.

CPI-C calls and CICS calls

CPI-C in ABAP	CICS LU6.2 API
INIT	
ALLOCATE	EXEC CICS ALLOCATE + EXEC CICS CONNECT
ACCEPT	EXEC CICS RECEIVE
SEND	EXEC CICS SEND
RECEIVE	EXEC CICS RECEIVE
DEALLOCATE	EXEC CICS SEND LAST + EXEC CICS FREE

You must always analyze the internal CICS EIB fields to check the return codes (for example, EIBERRCD). If errors occur, you must check the entries in the SAP system log.

If you transfer large data volumes, you should use frequent RECEIVE calls to ensure that data transfer has physically taken place and the control of the SAP Basis system is returned.

IMS Special Features

The individual parameters required for LU6.2 communication are listed in the description of the IBM LU6.1 adapter for LU6.2 applications.

SAP is subject to all the restrictions of the LU6.1 adapter for LU6.2 applications.

For communication with an R/2 System in IMS environment, the following parameters are particularly important:

Active connection:

- The active establishment of a connection from the SAP system is only possible to the partner program IMSASYNC in asynchronous mode.

  Here, asynchronous means that a RECEIVE statement is not permitted, but the *conversation* must be acknowledged using CONFIRMED (Status = CM_CONFIRM_DEALLOC_RECEIVED).

- An IMSASYNC program should **always** be defined to receive and acknowledge data to be processed asynchronously from the *IMS Message Queue*.

Remotely attachable ABAP program:

- The SAP service transaction xxxX1SA is *conversational*.
- Several RECEIVE calls in sequence are not permitted. There must be at least one SEND call between two RECEIVE calls. The program status is displayed in the status field.
- The length of a transferred message must always be larger than zero.
- If several SEND statements are sent in succession, or very long messages are sent, segmentation will occur in the IMS receiver system.

  Only the first segment of a message is processed (up to 5.0C), so that data can be cut off.

  From R/2 Release 5.0D, the individual segments are concatenated and passed to the SAP application as a complete message.

- An external DEALLOCATE or a termination of the partner program are not passed on to the SAP system. For this reason, DEALLOCATE must always be called in the ABAP program in the IMS system.
- External security systems are not supported directly.

  Alternatively, you can call the command */SIGN*. Use *SEND* to send the *USERID/PWD* to IMS. Use *RECEIVE* to get the corresponding IMS message: *DFSxxx....*

Sample Programs

This section contains example programs for R/3 and the R/2 Releases 5.0 and 4.3/4.4, as well as the APC and APQ headers DSECT for assembler programs (R/2 version 4.3/4.4).

Sample Program for R/3 [Seite 205]

Sample Programs for R/2 Release 5.0 [Seite 208]

Sample Programs for R/2 Release 4.3/4.4

APC and APQ Headers DSECT for Assembler Programs [Seite 216]

Sample Program for R/3

```
PROGRAM RSQAPI10.
*---------------------------------------------------------------*
* This queue test program writes data into a queue.             *
*---------------------------------------------------------------*
INCLUDE RSEBCASC.     " ASCII/EBCDIC conversion table
INCLUDE RSQAPIDF.     " QAPI Defines

PARAMETERS:
            QUEUE    LIKE APQI-QID       DEFAULT 'Q123',
            TYPE     LIKE APQI-QATTRIB   DEFAULT Q_APPENDABLE,
            DESTSYS  LIKE APQI-DESTSYS   DEFAULT '         ',
            DATATYPE LIKE APQI-DATATYP   DEFAULT '    ',
            CLIENT   LIKE APQI-MANDANT   DEFAULT '   ',
            PROGRAM  LIKE APQI-PROGID    DEFAULT '         ',
            FORM     LIKE APQI-FORMID    DEFAULT '    ',
            DRIVER   LIKE APQI-STARTPGID DEFAULT 'RSQAPI20',
            START    LIKE APQI-STARTMODE DEFAULT Q_USERSTART,
            DATE     LIKE APQI-STARTDATE DEFAULT '         ',
            TIME     LIKE APQI-STARTTIME DEFAULT '      ',
            ASCTOEBC DEFAULT 'X',
            TESTLOOP TYPE I DEFAULT '5'.

DATA:
            COUNTER TYPE I,

            BUFFER  LIKE APQD-VARDATA,
            LENGTH  TYPE I,
            UNIT    TYPE I,
            POS     TYPE I,
            STATE,
            USERID LIKE APQI-USERID VALUE 'CPIC2',
            PASSWD LIKE APQI-PASSWD VALUE 'TEST'.

*BREAK-POINT.
*---------------------------------------------------------------*
* Open a Queue                                                  *
*---------------------------------------------------------------*

CALL FUNCTION 'QUEUE_OPEN'
              EXPORTING  NAME        = QUEUE    " Queue ID
                         TYPE        = TYPE     " Appendable/Unique
                         OPENMODE    = Q_WRITE  " Write Mode
*                                               needed if CPI-C
transfer is used
                         DESTINATION = DESTSYS  " TXCOM entries are
needed
*                                               if partner is an ABAP
program
                         DATATYPE    = DATATYPE
                         CLIENT      = CLIENT
```

Sample Program for R/3

```
                          USERID      = USERID
                          PASSWORD    = PASSWD
                          PROGRAM     = PROGRAM
                          FORM        = FORM


TXCOM entry
*             fields are needed if partner is a ABAP/4 program
                          DATATYPE    = DATATYPE
                          CLIENT      = CLIENT
                          USERID      = USERID
                          PASSWORD    = PASSWD
                          PROGRAM     = PROGRAM
                          FORM        = FORM
*                queue processing options
                          DRIVER      = DRIVER
                          START       = START
                          DATE        = DATE
                          TIME        = TIME
*             import automatic generated name, if input was space
              IMPORTING  NAME = QUEUE.
*---------------------------------------------------------------*
* Put Data into Queue                                           *
*---------------------------------------------------------------*
DO TESTLOOP TIMES.

* first msg of unit
  STATE  = Q_FIRST.
  BUFFER = 'QTEST00020LINE 1 of Queue Test'.
  LENGTH = STRLEN( BUFFER).
  PERFORM QUEUE_PUT USING QUEUE STATE LENGTH BUFFER.

* middle msg of unit
  STATE  = Q_MIDDLE.
  BUFFER = 'QTEST00020LINE 2 of Queue Test'.
  LENGTH = STRLEN( BUFFER).
  PERFORM QUEUE_PUT USING QUEUE STATE LENGTH BUFFER.

* last msg of unit
  STATE  = Q_LAST.
  BUFFER = 'QTEST00020LINE 3 of Queue Test'.
  LENGTH = STRLEN( BUFFER).
  PERFORM QUEUE_PUT USING QUEUE STATE LENGTH BUFFER.

ENDDO.

*---------------------------------------------------------------*
* Close Queue                                                   *
*---------------------------------------------------------------*
CALL FUNCTION 'QUEUE_CLOSE'
              EXPORTING NAME = QUEUE
                        OPENMODE = Q_WRITE.
COMMIT WORK.
```

```
*---------------------------------------------------------------------*
* FORM:  QPUT                                                         *
* -----------                                                         *
* Put a message into specified queue                                  *
*---------------------------------------------------------------------*
FORM QUEUE_PUT USING QUEUE STATE LENGTH BUFFER.

  WRITE: /(72) BUFFER.

  IF ASCTOEBC = 'X'.
     TRANSLATE BUFFER TO CODE PAGE '0100'.   "alternatively
  ENDIF.

  CALL FUNCTION 'QUEUE_PUT'
                EXPORTING NAME   = QUEUE
                          STATE  = STATE
                          LENGTH = LENGTH
                          BUFFER = BUFFER.

  IF ( STATE = Q_LAST OR STATE = Q_SINGLE).
     COMMIT WORK.
  ENDIF.
ENDFORM.
```

Sample Programs for R/2 Release 5.0

The ABAP sample programs contain functions and parameters which are dependent on the transfer data type.

- Data transfer in RODC format

  Program RSAPPQ10 [Seite 209]:

- Data transfer from the SAP spool system in CPIC format

  Program RSAPPQ20 [Seite 212]:

- Data transfer in CPIC format

  Program RSAPPQ30 [Seite 214]:

Program RSAPPQ10

```
************************************************************
*                                                          *
* Sample program for asynchronous communication via the DOUT  *
* file with transfer data in Remote ODC format             *
* (transfer format RODC)                                   *
************************************************************
PARAMETERS:
            QDEST(8)  TYPE C DEFAULT 'K44     ',
            QAPPL(8)  TYPE C DEFAULT 'X1SA    ',
            QUSER(12) TYPE C DEFAULT 'RODC-TEST   ',
            QPASS(8)  TYPE C DEFAULT 'TEST    ',
            QSTDA     TYPE D DEFAULT SY-DATUM,
            QSTTI     TYPE T DEFAULT SY-UZEIT,
            QSTART(1) TYPE C DEFAULT 'A',
            QANZHL(5) TYPE C DEFAULT '2'.
************************************************************
*    QDEST  : Connection name of target system             *
*    QAPPL  : Transaction program name in target system    *
*             (X1SA=SAP-System)                            *
*    QUSER  : Valid user account in target system          *
*             (QAPPL=X1SA)                                 *
*    QPASS  : User password in target system               *
*    QSTDA  : Driver start date                            *
*    QSTTI  : Driver start time                            *
*    QSTART : A=Automatic,                                 *
*             M=Manual start of driver program             *
*    QANZHL : No. of TS02 transaction entries in the queue *
************************************************************
TABLES    : QPARM.
************************************************************
*.............Set queue name.........................................*
QPARM-QDEST = QDEST.
QPARM-QAPPL = QAPPL.
QPARM-QDTYP = 'RODC'.
QPARM-QMAND = '000'.
*.............Set driver specific parameters.........................*
QPARM-QSTDA = QSTDA.
QPARM-QSTTI = QSTTI.
QPARM-QSTRT = QSTART.
QPARM-QCORR = 'R'.
*.............Set SAP specific data...........*
QPARM-QDUSR = QUSER.
QPARM-QDPAS = QPASS.
*
*.............Open the queue..................*
OPEN QUEUE QPARM.
*
*.............Write records in the queue.......*
PERFORM WRITE-QUEUE.
*
```

Program RSAPPQ10

```
*.............Close the queue..................*
CLOSE QUEUE QPARM.
*
*---------------------------------------------------------------*
*       FORM WRITE-QUEUE.                                       *
*---------------------------------------------------------------*
*       Insert records in the queue.                            *
*       Sample : Remote ODC data for the transaction TS02.      *
*---------------------------------------------------------------*
FORM WRITE-QUEUE.
*
DATA :
       TLNR(5)  TYPE C VALUE '00000',
       AREA(42) TYPE C.
*
FIELD-SYMBOLS:  <F>.
*
  DO QANZHL TIMES.
    ADD 1 TO TLNR.
*
*   Insert first dynpro
*
    QPARM-QFIRS = 'Y'.
    QPARM-QLAST = 'N'.
    QPARM-QDTRC = 'TS02'.
    QPARM-QDPGM = 'SAPPG02'.
    QPARM-QDDYN = '0041'.
    CLEAR AREA.
    AREA        = '220416               10805160108061601'.
    ASSIGN AREA(38) TO <F>.
    TRANSFER <F> TO QUEUE QPARM.
*
*   Insert second dynpro
*
    QPARM-QFIRS = 'N'.
    QPARM-QLAST = 'N'.
    QPARM-QDTRC = 'TS02'.
    QPARM-QDPGM = 'SAPPG02'.
    QPARM-QDDYN = '0060'.
    CLEAR AREA.
    AREA        = '221211           '.
    AREA+17(5)  = TLNR.
    ASSIGN AREA(22) TO <F>.
    TRANSFER <F> TO QUEUE QPARM.
*
*   Insert third dynpro
    QPARM-QFIRS = 'N'.
    QPARM-QLAST = 'Y'.
    QPARM-QDTRC = 'TS02'.
    QPARM-QDPGM = 'SAPPG02'.
    QPARM-QDDYN = '0062'.
    CLEAR AREA.
    AREA        = '180762123456789012'.
```

```
    ASSIGN AREA(18) TO <F>.
    TRANSFER <F> TO QUEUE QPARM.
  ENDDO.
*
ENDFORM.
```

Program RSAPPQ20

```
************************************************************
*                                                          *
* Sample program for asynchronous communication via the DOUT  *
* file with transfer data taken from the SAP spool file       *
* (transfer format SPLD)                                   *
************************************************************
*
PARAMETERS:
            QDEST(8)  TYPE C DEFAULT 'K43     ',
            QAPPL(8)  TYPE C DEFAULT 'X1SA    ',
            QUSER(12) TYPE C DEFAULT 'RODC-TEST   ',
            QPASS(8)  TYPE C DEFAULT 'TEST    ',
            QSTDA     TYPE D DEFAULT SY-DATUM,
            QSTTI     TYPE T DEFAULT SY-UZEIT,
            QSTART(1) DEFAULT 'A',
            QSPLNR(5) DEFAULT '0'.
*                                                                  *
************************************************************
*    QDEST  : Connection name of target system                 *
*    QAPPL  : Transaction program name in target system        *
*             (X1SA=SAP-System)                                *
*    QUSER  : Valid user account in target system              *
*             (QAPPL=X1SA)                                     *
*    QPASS  : User password in target system                   *
*    QSTDA  : Driver start date                                *
*    QSTTI  : Driver start time                                *
*    QSTART : A=Automatic,                                     *
*             M=Manual start of driver program                 *
*    QSPLNR : No. of the valid local spool file                *
************************************************************
*
TABLES    :
            QPARM.
*
DATA      :
            SPNR TYPE P,
            BEGIN OF SPOOL,
              SPMD LIKE APQD-SPMD VALUE '000',
              SPNR LIKE APQD-SPNR VALUE '0000',
              SPPW LIKE APQD-SPPW VALUE 'PASS',
            END OF SPOOL.
*
FIELD-SYMBOLS : <F>.
*
************************************************************
*
*.......Set queue name....                                  *
QPARM-QDEST = QDEST.
QPARM-QAPPL = QAPPL.
QPARM-QDTYP = 'SPLD'.
```

```
QPARM-QMAND = '000'.
QPARM-QABAP = 'RSAPPQ40'.
QPARM-QMODU = 'RECEIVE'.
*
*.............Set driver specific parameters.................*
QPARM-QSTDA = QSTDA.
QPARM-QSTTI = QSTTI.
QPARM-QSTRT = QSTART.
QPARM-QCORR = 'R'.
*
*.............Set SAP specific data...........................*
QPARM-QDUSR = QUSER.
QPARM-QDPAS = QPASS.
*
*.............Open the queue.....................             *
OPEN QUEUE QPARM.
*
*.............Write record in the queue.........             *
QPARM-QFIRS = 'Y'.
QPARM-QLAST = 'Y'.
SPOOL-SPNR = SPNR = QSPLNR.
ASSIGN SPOOL TO <F>.
TRANSFER <F> TO QUEUE QPARM.
*
*.............Close the queue...................             *
CLOSE QUEUE QPARM.
*
```

Program RSAPPQ30

```
*---------------------------------------------------------------------*
*                                                                     *
* Sample program for asynchronous communication                       *
* with user-defined transfer data                                     *
* (transfer format CPIC)                                              *
*                                                                     *
*---------------------------------------------------------------------*
PARAMETERS:
            QDEST(8)  TYPE C DEFAULT 'K43     ',
            QAPPL(8)  TYPE C DEFAULT 'X1SA    ',
            QUSER(12) TYPE C DEFAULT 'RODC-TEST   ',
            QPASS(8)  TYPE C DEFAULT 'TEST    ',
            QSTDA     TYPE D DEFAULT SY-DATUM,
            QSTTI     TYPE T DEFAULT SY-UZEIT,
            QSTART(1) TYPE C DEFAULT 'A'.
*---------------------------------------------------------------------*
*    QDEST  : Connection name of target system                        *
*    QAPPL  : Transaction program name in target system               *
*             (X1SA=SAP-System)                                       *
*    QUSER  : Valid user account in target system                     *
*             (QAPPL=X1SA)                                            *
*    QPASS  : User password in target system                          *
*    QSTDA  : Driver start date                                       *
*    QSTTI  : Driver start time                                       *
*    QSTART : A=Automatic,                                            *
*             M=Manual start of driver program                        *
*---------------------------------------------------------------------*
*
TABLES    :
            QPARM.
*
*---------------------------------------------------------------------*
*
*.............Set queue name.........................................*
QPARM-QDEST = QDEST.
QPARM-QAPPL = QAPPL.
QPARM-QDTYP = 'CPIC'.
QPARM-QMAND = '000'.
QPARM-QABAP = 'RSAPPQ40'.
QPARM-QMODU = 'RECEIVE'.
*
*.............Set driver specific parameters.......................*
QPARM-QSTDA = QSTDA.
QPARM-QSTTI = QSTTI.
QPARM-QSTRT = QSTART.
QPARM-QCORR = 'R'.
*
*.............Set SAP specific data................................*
QPARM-QDUSR = QUSER.
QPARM-QDPAS = QPASS.
```

```
*
*.............Open the queue.........................................*
OPEN QUEUE QPARM.
*
*.............Write records in the queue............................*
PERFORM WRITE-QUEUE.
*
*.............Close the queue.........................................*
CLOSE QUEUE QPARM.
*
*
*---------------------------------------------------------------*
*       FORM WRITE-QUEUE.                                       *
*---------------------------------------------------------------*
*       Insert records in the queue.                            *
*       Sample : Insert three records of type char.             *
*---------------------------------------------------------------*
FORM WRITE-QUEUE.
*
DATA :
       AREA(17) TYPE C.
*
FIELD-SYMBOLS:  <F>.
*
*    Insert first record
*
  QPARM-QFIRS = 'Y'.
  QPARM-QLAST = 'N'.
  CLEAR AREA.
  MOVE 'first record' TO AREA.
  ASSIGN AREA(12) TO <F>.
  TRANSFER <F> TO QUEUE QPARM.
*
*   Insert second record
*
  QPARM-QFIRS = 'N'.
  QPARM-QLAST = 'N'.
  CLEAR AREA.
  MOVE 'second record' TO AREA.
  ASSIGN AREA(13) TO <F>.
  TRANSFER <F> TO QUEUE QPARM.
*
*   Insert third record
*
  QPARM-QFIRS = 'N'.
  QPARM-QLAST = 'Y'.
  CLEAR AREA.
  MOVE 'third record' TO AREA.
  ASSIGN AREA(12) TO <F>.
  TRANSFER <F> TO QUEUE QPARM.
*
ENDFORM.
```

APC and APQ Headers DSECT for Assembler Programs

Definition

```
  APC Header as Assembler DSECT
  -----------------------------

*---------------------------------------------------------------*
*........APC HEADER.............................................*
*---------------------------------------------------------------*
APCDUMMY DSECT
APCREQID DS    CL4                 REQEST ID:
*                                     SAP-CONNECT:              CONN
*                                     SAP-FREE:                 FREE
*                                     SAP-APPC-COMMUNICATION:   APPC
APCTYPE  DS    CL4                 TYPE OF PROCESSING:
*                                     BATCH INPUT:              BTCI
*                                     PRESENTATION ON IWS:      DYNP
*                                     REMOTE DIALOG CALL:        RDIA
*                                     FREE PROTOCOL:         BLANK
APCMODNR DS    CL1                 MODE NUMBER
APCSTYPE DS    CL1                 START NEW TYPE (X)
APCERRCD DS    CL1                 ERROR-/ABEND-CODE
APCCHSET DS    CL1                 X'C5' = EBCDIC otherwise ASCII
APCVDATA EQU   *                   PARAMETERS
         SPACE 1
*........ERROR-MESSAGE (APCERRCD = E).................................*
         ORG   APCVDATA
APCEMSGN DS    CL5                 MESSAGE-NUMBER
APCEMSGT DS    CL80                MESSAGE-TEXT
APCEMSGL EQU   *-APCDUMMY          MESSAGE-LENGTH
         SPACE 1
*........REQUEST-ID CONN.............................................*
         ORG   APCVDATA
APCMANDT DS    CL3                 CLIENT
APCBNAME DS    CL12                BATCH-INPUT GROUPNAME (TYPE=BTCI)
*                                    OR USERNAME
APCPASSW DS    CL8                 PASSWORD
APCLANGU DS    CL1                 LANGUAGE
APCKORRV DS    CL1                 CORRECTION RESPONSIBILITY
(TYPE=BTCI)
*                                    R = RECEIVER
*                                    S = SENDER
APCCMSGL EQU   *-APCDUMMY          MESSAGE-LENGTH
         SPACE 1
*........REQUEST-ID CONN.............................................*
*........FREIES PROTOKOLL.............................................*
APCPGMNM DS    CL8                 ABAP PROGRAM NAME
APCMODNM DS    CL30                ABAP MODULE NAME


*........REQUEST-ID APPC.............................................*
```

```
*........BATCH INPUT PROCESSING (TYPE = BTCI).........................*
         ORG   APCVDATA             HOST INPUT.........................*
APCBSYNC DS    CL1                  SYNCPOINT INFORMATION
APCBSYNS EQU   C'S'                   START TRANSACTION
APCBSYNM EQU   C'M'                   BDC MESSAGE
APCBSTAT DS    CL1                  STATE OF PROCESSING

APCBSTAS EQU   C'S'                   SYNCHRONOUS VB
APCBTCOD DS    CL4                  TRANSACTION
APCBPGMN DS    CL8                  PROGRAMM NAME
APCBDYNR DS    CL4                  DYNPRO NUMBER
APCBSEPR DS    CL1                  SEPERATOR
APCBCURF DS    CL30                 CURSOR-POSITION ON FIELD
APCBMSGL EQU   *-APCDUMMY           BTCI-HEADER LENGTH
         DS    CL1
APCBDATA EQU   *                    START OF BDC DATA
         SPACE 1
         ORG   APCVDATA             RETURN INFORMATION.................*
APCRSTAT DS    CL1                  STATE
APCRSTAS EQU   C'S'                   START TRANSACTION
APCRSTAF EQU   C'F'                   TRANSACTION FINISHED
APCRSTAE EQU   C'E'                   TRANSACTION IN ERROR
APCRSTAN EQU   C'N'                   GET NEXT MESSAGE
APCRSTAA EQU   C'A'                   ABEND APC-PROCESSING

*
APCRCODE DS    CL4                  ABENDCODE
APCRPGMN DS    CL8                  PROGRAMM NAME
APCRDYNR DS    CL4                  DYNPRO NUMBER
APCRMSGN DS    CL5                  MESSAGE-NUMBER
APCRMSGT DS    CL80                 MESSAGE-TEXT
APCRMSGL EQU   *-APCDUMMY           MESSAGE-LENGTH
         SPACE 1
*........REQUEST-ID APPC.............................................*
*........DIALOG WITH WORKSTATION (TYPE = DYNP).......................*
         ORG   APCVDATA
APCDSTAT DS    CL1                  STATE OF PROCESSING
APCDSTAD EQU   C'D'                   SEND DYNPRO (INITIAL OUTPUT)
APCDSTAM EQU   C'M'                   SEND MESSAGE (DIALOGUE)
APCDTCOD DS    CL4                  TRANSAKTION / REPORT        RJE03605
APCDDATA EQU   *                    DATA (DYNPRO OR DIALOGUE MESSAGE)
         SPACE 1
*........REQUEST-ID APPC.............................................*
*........REMOTE DIALOGCALL (TYPE = RDIA).............................*
         ORG   APCVDATA
APCRPROG DS    CL8                  PROGRAMM NAME
APCRDYNP DS    CL4                  DYNPRO NUMBER
APCRDATA EQU   *                    PARAMETER
```

APQ-Header als Assembler DSECT

```
*-------------------------------------------------------------*
*--- I-RECORD FOR OPEN GROUP (MAPPE) -------------------------*
```

APC and APQ Headers DSECT for Assembler Programs

```
*-------------------------------------------------------------*
$SBG3    DS   0C
APQI$BGIN  DS    0CL1

*************************************************************
*     S E G M E N T - H E A D E R                           *
*************************************************************
APQILENG   DC    XL2'176'    MAXIMUM SEGMENT LENGTH
APQIRCRES  DC    XL2'0'
*************************************************************
*     K E Y                                                 *
*************************************************************
APQIRTYP   DC    CL1' '      RECORD TYPE ID FOR APPC DATA RECORDS
APQIQNAM   DS    0CL(61)
APQIDEST   DC    CL8' '      SAP TARGET SYSTEM NAME
APQIAPPL   DC    CL8' '      APPLIKATIONSNAME
APQIDTYP   DC    CL4' '      DATA TYPE OF TRANSFERRED DATA UNIT
APQIMAND   DC    CL3' '      CLIENT IN SAP TARGET SYSTEM
APQIPROG   DC    CL8' '      SAP PROGRAM IN TARGET SYSTEM
APQIMODP   DC    CL30' '
APQITRAN   DC    XL4'0'      APPC INTEGER
APQIRECO   DC    XL4'0'      APPC INTEGER
APQIFIXP   DS    0CL(44)
APQITREI   DC    CL8' '      APPC PROGRAM NAME
APQISTRT   DC    CL1' '      APPC STATUS
APQICORR   DC    CL1' '      APPC STATUS
APQICRDA   DC    CL8' '
APQICRTI   DC    CL6' '
APQIUSER   DC    CL12' '
APQIPASS   DC    CL8' '      APPC PASSWORD FOR BTCI DATA TRANSFER
APQIOUAC   DC    CL1' '      APPC STATUS
APQIOUSY   DC    CL8' '      APPC PROGRAM NAME
APQIOUAP   DC    CL8' '      APPC PROGRAM NAME
APQIOUID   DC    XL4'0'      APPC INTEGER
APQIOUTR   DC    XL4'0'      APPC INTEGER
APQIOURE   DC    XL4'0'      APPC INTEGER
APQIOUDA   DC    CL8' '
APQIOUTI   DC    CL6' '
APQIOUEN   DC    CL5' '      APPC MESSAGE NUMBER
APQIOUEM   DC    CL80' '
APQIINAC   DC    CL1' '      APPC STATUS
APQIINSY   DC    CL8' '      APPC PROGRAM NAME
APQIINAP   DC    CL8' '      APPC PROGRAM NAME
APQIINID   DC    XL4'0'      APPC INTEGER
APQIINTR   DC    XL4'0'      APPC INTEGER
APQIINRE   DC    XL4'0'      APPC INTEGER
APQIINDA   DC    CL8' '
APQIINTI   DC    CL6' '
APQIINEN   DC    CL5' '      APPC MESSAGE NUMBER
APQIINEM   DC    CL80' '
APQIEND  EQU   *
```

Conversion Tables EBCIDC from/to ASCII

The functions CMCNVI and CMCNVO, used to convert between EBCIDC format and ASCII format, work with predefined standard tables. If your application requires other tables, you can create and include your own conversion tables.

Creating Your Own Tables [Seite 220]

Sample File with Conversion Tables [Seite 221]

Creating Your Own Tables

Prerequisites

To do this, you must assign the name of a file, which contains the conversion table, to the shell variable CONVERT before starting the corresponding CPI-C program.

Procedure

When creating a conversion table, you must know the following:

- A comment must begin with the character *.
- Blank lines are allowed.
- The ASCII->EBCDIC conversion "a" is defined first, then the EBDIC->ASCII conversion "b".
- The function values are represented without hyphens or blanks as 2-character HEX numbers.
- Only the function values are entered in the file. The arguments are derived from the sequence of function values. The file has the following structure:

a(0)a(1)a(2).	a(255)
(0)b(1)b(2)	b(255)

There are no rules for line division.

Sample File with Conversion Tables

```
* @(#)convert     20.5  SAP   93/04/05
*
*  SAP AG Walldorf
*  Systems, Applications and Products in Data Processing
*
*  (C) Copyright SAP AG 1992
*
*********************************
* ASCII -> EBCDIC Conversion   *
*********************************
4040404040404040     * 000 - 007
4040404040404040     * 008 - 015
4040404040404040     * 016 - 023
4040404040404040     * 024 - 031
404F7F7B5B6C507D     * 032 - 039
4D5D5C4E6B604B61     * 040 - 047
F0F1F2F3F4F5F6F7     * 048 - 055
F8F97A5E4C7E6E6F     * 056 - 063
B5C1C2C3C4C5C6C7     * 064 - 071
C8C9D1D2D3D4D5D6     * 072 - 079
D7D8D9E2E3E4E5E6     * 080 - 087
E7E8E963ECFC5F6D     * 088 - 095
7981828384858687     * 096 - 103
8889919293949596     * 104 - 111
979899A2A3A4A5A6     * 112 - 119
A7A8A943BBDC5940     * 120 - 127
4040404040404040     * 128 - 135
4040404040404040     * 136 - 143
4040404040404040     * 144 - 151
4040404040404040     * 152 - 159
41AAB0B19FB2CC7C     * 160 - 167
BDB49A8ABA40AFBC     * 168 - 175
908FEAFABEA0B6B3     * 176 - 183
40DA9B8BB7B8B9AB     * 184 - 191
646562664A679E68     * 192 - 199
7471727378757677     * 200 - 207
AC69EDEEEBEFE0BF     * 208 - 215
80FDFEFB5AAD8EA1     * 216 - 223
44454246C0479C48     * 224 - 231
5451525358555657     * 232 - 239
8C49CDCECBCF6AE1     * 240 - 247
70DDDEDBD08DAEDF     * 248 - 255
*********************************
* EBCDIC -> ASCII Conversion   *
*********************************
2020202020202020     * 000 - 007
2020202020202020     * 008 - 015
2020202020202020     * 016 - 023
2020202020202020     * 024 - 031
2020202020202020     * 032 - 039
```

Sample File with Conversion Tables

```
2020202020202020     * 040 - 047
2020202020202020     * 048 - 055
2020202020202020     * 056 - 063
20A0E27BE0E1E3E5     * 064 - 071
E7F1C42E3C282B21     * 072 - 079
26E9EAEBE8EDEEEF     * 080 - 087
EC7EDC242A293B5E     * 088 - 095
2D2FC25BC0C1C3C5     * 096 - 103
C7D1F62C255F3E3F     * 104 - 111
F8C9CACBC8CDCECF     * 112 - 119
CC603A23A7273D22     * 120 - 127
D861626364656667     * 128 - 135
6869ABBBF0FDDEB1     * 136 - 143
B06A6B6C6D6E6F70     * 144 - 151
7172AABAE620C6A4     * 152 - 159
B5DF737475767778     * 160 - 167
797AA1BFD0DDFEAE     * 168 - 175
A2A3A5B7A940B6BC     * 176 - 183
BDBEAC7CAFA8B4D7     * 184 - 191
E441424344454647     * 192 - 199
484920F4A6F2F3F5     * 200 - 207
FC4A4B4C4D4E4F50     * 208 - 215
5152B9FB7DF9FAFF     * 216 - 223
D6F7535455565758     * 224 - 231
595AB2D45CD2D3D5     * 232 - 239
3031323334353637     * 240 - 247
3839B3DB5DD9DA20     * 248 - 255
```

If you set the shell variable CONVERT to the name *convert* (possibly the complete path if not in the current directory), this file is imported when CMCNVI or CMCNVO are first called and overwrites the standard conversion table.

You can use the SAP-specific functions SAP_CMLOADCONVTAB or SAP_CMMODCONVTAB to make additional modifications to the conversion table.