

SAP GUI

Technical Infrastructure



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Preface

The architecture of an SAP System consists of three levels (called three-tier model):

- Presentation Layer
- Application Layer
- Database Layer

The SAP GUI represents the presentation layer in the client-server architecture of the SAP System. It displays the application screens and the interaction of the users with the system. The SAP GUI is a graphical, window-based program that you control using a keyboard and mouse. To ensure reliable and secure delivery of your application to the end users, you have to provide an optimal supporting infrastructure.

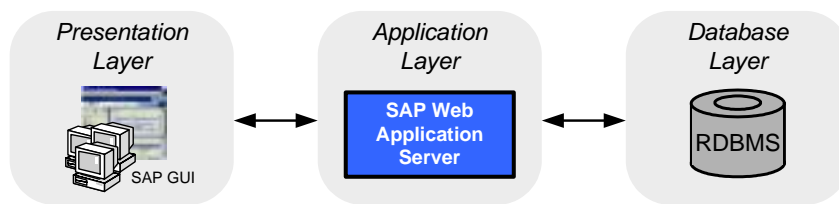


Figure 1
The SAP Three-Tier Model

The purpose of this guide is to:

- Give you an understanding of the different SAP GUI types, their specific properties and how they communicate with the mySAP system.
- Explain the performance requirements of the infrastructure.
- Describe trouble shooting options

Who Should Read This Document

Use this guide as a starting point for planning the technical infrastructure for your SAP GUI implementation. This guide is for anyone interested in the technical aspects of the SAP GUI IT infrastructure. This includes:

- System architects
- IT managers responsible for implementing and operating the SAP system
- System integration consultants

Icons

Icon	Meaning
	Caution
	Example

Status and Version History

Initial Version May 2002

All characteristics described in this document refer to SAP GUI 6.10 and above.

1 Overview

In this section, I will give you an overview on the different SAP GUI types and their properties. For detailed information, see <http://service.sap.com/ui>.

There are three different kinds of SAP GUI clients (see Figure 2 Overview on the Different SAP GUI Types).

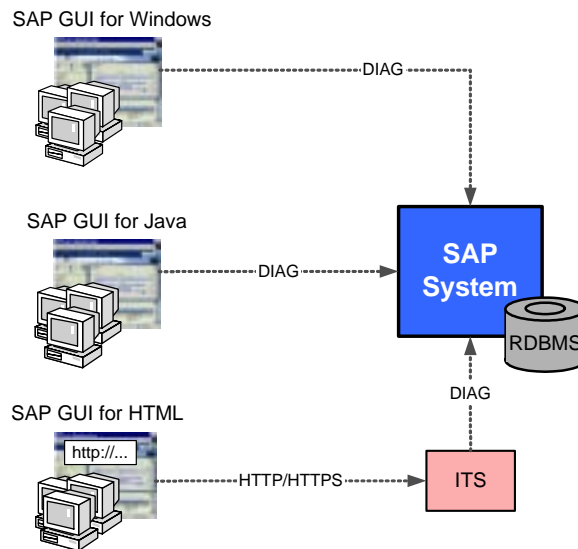


Figure 2
Overview on the Different SAP GUI Types

1.1 SAP GUI for Windows

The SAP GUI for Windows is the best-known front-end application for mySAP R/3. It is available for all 32-bit Microsoft Windows platforms.

The advantage of the SAP GUI for Windows is the singular range of functions.

1.2 SAP GUI for Java

The SAP GUI for Java looks similar to the SAP GUI for Windows. SAP GUI for Java runs on most known platforms and has nearly the same functionality as the SAP GUI for Windows.

For detailed platform information see <http://service.sap.com/sapgui/> >> *SAP GUI for the Java(TM) environment*.

1.3 SAP GUI for HTML

The SAP GUI for HTML uses a preinstalled Web-browser to show the application and its data.

A special client installation is not necessary but it remains an additional middleware component, the SAP Internet Transaction Server (ITS). ITS converts SAP R/3 screens into HTML format making it possible to access SAP systems with Web technology.

At the time of writing only Microsoft Internet Explorer 4.01 SP 2 (or higher) and Netscape Navigator 6.2 (or higher) are supported web browsers for the SAP GUI for HTML.

For more detailed information about the SAP ITS see <http://service.sap.com/sap-its>.

1.4 SAP GUI with Windows Terminal Server

You may also run SAP GUI on Windows Terminal Server (WTS). Every SAP GUI type is running on WTS. But apart from some exceptions it's only reasonable to use SAP GUI for Windows.

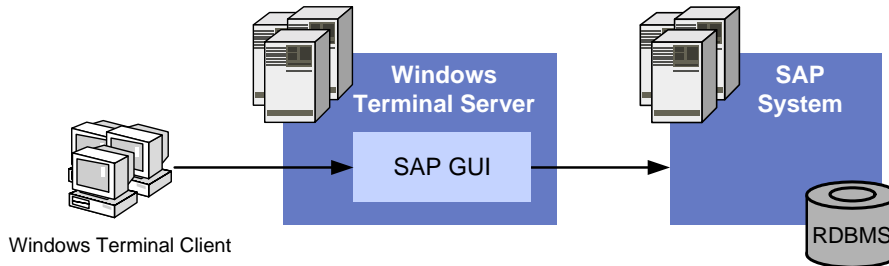


Figure 3
SAP GUI with Windows Terminal Services

Using SAP GUI on WTS, only input and output operations take place on the user workstation. This is useful if you want to use SAP GUI in a distributed scenario, where many users work on a WAN connection, or if you are using thin clients with WTS.

2 Technical Architecture

2.1 SAP GUI for Windows/Java

SAP GUI for Java has nearly identical features and behavior patterns as the SAP GUI for Windows. They also use the same source code for the network layer. For this reason these two GUI types are described in one section.

2.1.1 Connection

The SAP GUI for Windows/Java uses solely the TCP/IP protocol to connect to the SAP system. All connections are established from the front-end, and never from the SAP Server.

If you use the message server for load balancing, the SAP GUI will start making a TCP connection to the Message Server to determine the most suitable application server. Now, the SAP GUI establishes a TCP connection to the dispatcher on the application server.

All modes that are opened during a session use the same TCP connection.

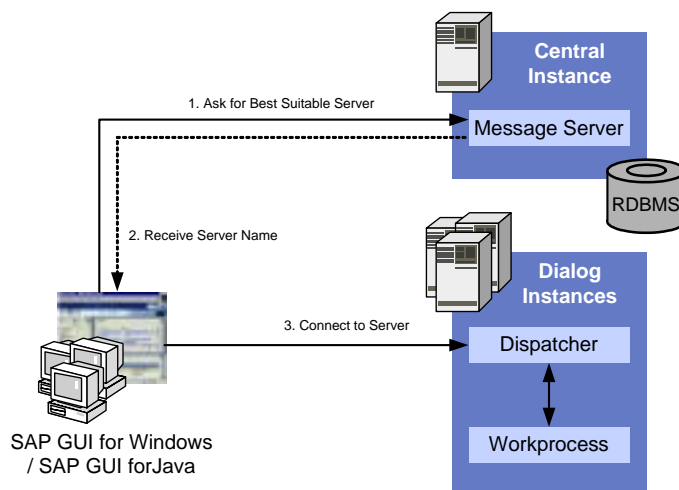


Figure 4
Connection Process of the SAP GUI for Windows/Java to an SAP System

2.1.2 SAProuter

The connection can also occur with one or several SAProuters; in this case, the TCP connection is only made to the SAProuter, which in turn connects to the next communication partner.

The SAProuter acts like a reverse proxy (without any caching mechanisms) and enables SAP GUI clients to connect to SAP systems in an unreachable network segment, for example behind a firewall.

You can use several SAProuters in a row.

Connecting the SAP system through an SAProuter, the client uses a so called "Route String" to address the used SAProuters and the target system. For details about this Route String see <http://service.sap.com/saprouter>.

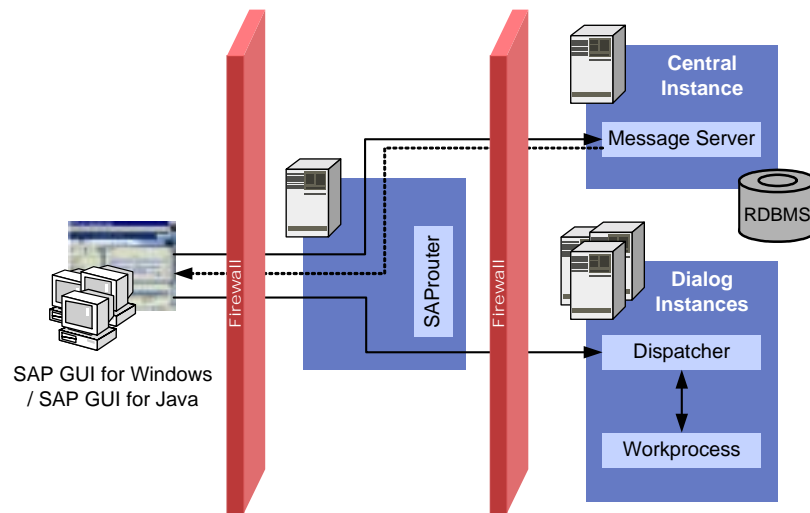


Figure 5
SAProuter scenario

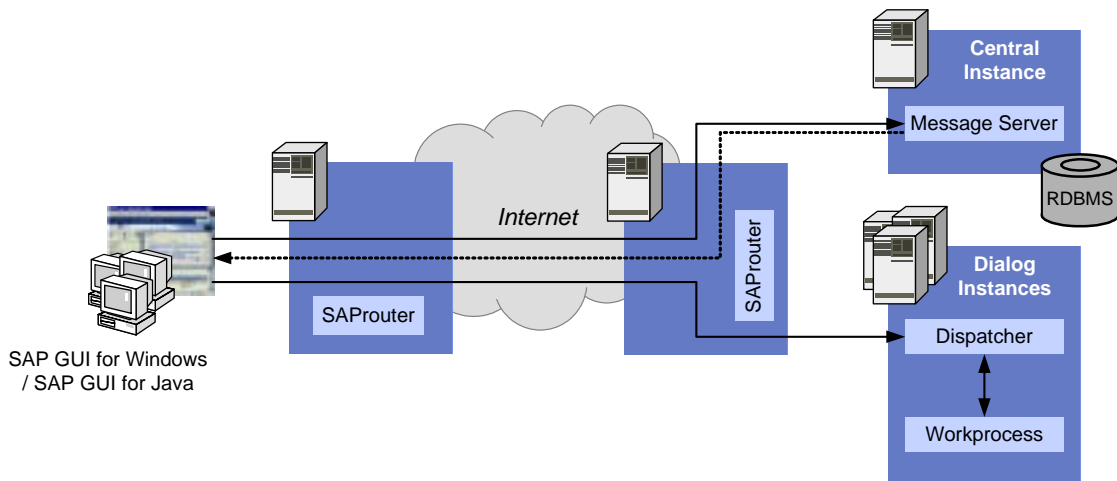


Figure 6
Using Several SAProuters in a Row

2.1.3 Time Out

The connection to the message server is subject to a timeout that by default takes 10 seconds.

If you have connection time outs, it will be helpful to temporarily increase this time out, especial if you use a Wide Area Network (WAN) connection.

You can configure the timeout directly in the SAPLogon options or using the environment variable TDW_TIMEOUT. This time out also affects the connection to the Dispatcher.

Default: 10 (seconds)

2.1.4 Keep Alive

If the user's SAP GUI session ends, the SAP System must release the resources that were used by this session. It is important that the system releases data records that have been processed by the session and are possibly locked.

If the SAP GUI process is terminated on the front-end the TCP connection will be ended and the system is automatically informed.

The situation is different if the front-end computer is turned off, fails, or the network connection is broken. Since the SAP System normally waits for queries from the SAP GUI and does not send data by itself to the front-end, it is not informed about this situation. The user session would remain in the system until the auto-logout is triggered or it is manually deleted.

To avoid this situation, the application server sends a network packet to the SAP GUI, if it has not sent any data for a period. The application server expects an answer from the SAP GUI within 40 seconds, otherwise the user session ends. This procedure is repeated periodically.

You can configure this wait period using the profile parameter *rdisp/keepalive*. A value of 0 deactivates the mechanism, which we only recommend in conjunction with a relative short auto-logout time.

Default: 1200 (seconds)

2.1.5 Network Address Translation (NAT) and Port-Mapping

Network Address Translation (NAT) modifies the IP addresses and if necessary the TCP port numbers in the network packets. This occurs transparently for the entire network protocol stack. NAT reduces official IP addresses when many computers communicate over the Internet, and it connects communication partners that cannot be reached directly due to address conflicts.

When using Network Address Translation with the SAP System, there are several limitations which arise from network addresses being transferred within the transaction data:

- ❑ If you use the SAP message server for load balancing, it sends the IP addresses and TCP services of the available SAP server back to the GUI. These IP addresses are then used to connect to the most suitable server. This procedure makes it necessary for the frontend computers to be able to reach the application server with its original IP address. Therefore, the addresses of SAP server hosts **must not** be modified.
- ❑ In certain cases, due to the network topology, the frontend computer may not be able to establish a direct TCP/IP connection to the SAP server without Network Address Translation. In this case, you can use an SAProuter to establish the connection. For more information, see section 2.1.2.
- ❑ Some network devices offer a port-mapping feature, i.e. they can forward an incoming connection on port A to another host on port B. Do not use this feature with any kind of SAP connections. In some constellations, this causes connection errors, which are sometimes hard to find.

2.1.6 Dynamic Host Configuration Protocol (DHCP)

The Dynamic Host Configuration Protocol (DHCP) automatically configures the network configuration of computers that are linked to a network. This is used primarily for administrating workstation computers in local networks and for dial-in connections. Using DHCP can lead to, that the same computer gets a different IP address after each restart or after each logon to the network.

You can generally operate SAP GUI with DHCP and changing IP addresses if there are no server services running on the client computer.

The SAP server buffers name and address resolution. This has consequences when operating clients with DHCP:

- ❑ The SAP System resolves IP addresses into names when you log on. This name resolution is buffered in the SAP Server. If another front-end logs on with the same IP address, the old name (now incorrect) is still stored in the system. Therefore, the incorrect name is entered in some log files. However, in the User Overview (Transaction SM04) the correct name is displayed, which is sent to the application server when logging on from the SAP GUI.
- ❑ For the SAP printing administration, it is not useful to specify a computer with a changing IP address as the print server. This also applies if your name resolution is able to map the host name correctly to the changing IP addresses (for example, with dynamic DNS). The reason is that the name resolution by the SAP server is performed only once and then buffered. New accesses to the same host names do not result in new name resolution, so that the print request could be sent to the wrong computer. Buffering name and address resolution in the SAP System cannot be deactivated.

2.1.7 Secure Network Communication (SNC)

SNC (Secure Network Communication) is an interface in the SAP architecture that lets you use external encryption products to secure SAP communication. SAP does not implement any encryption methods in its own software, instead it lets the user choose a third party encryption procedure and infrastructure. So, the security product can also use other security functions not offered directly by SAP, such as smart cards or biometrics. A variety of products has already been certified for use with SAP.

SNC secures data in the application layer. This guarantees a secure connection between SAP communication nodes (for example, between the SAPgui and the SAP application server), independently of the communication connection or transport medium used. This data security applies to SAP data traffic only.

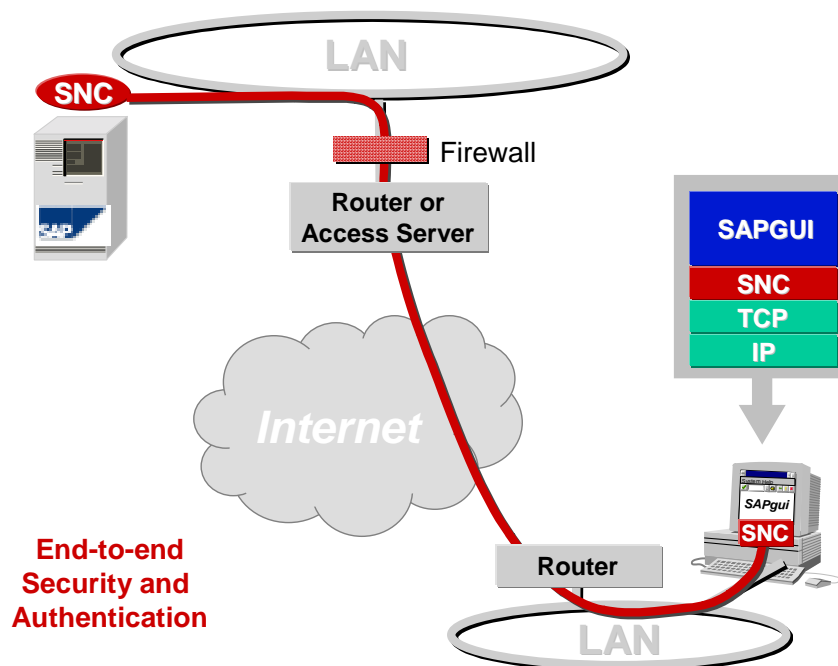


Figure 7
Standard SNC connection

You can use SNC for all types of external SAP communication:

- SAP GUI

- Printing (together with the SAPlpd printer server)
- Communication between SAP Systems
- Communication with external systems using RFC and CPI-C
- Internet Transaction Server

A user who logs on to the SAP GUI through an SNC connection is automatically authenticated in the SAP System. The user does not need any other logon information such as user name or password.

You can also use SNC between two SAProuters to set up a secure tunnel between networks, as in a Virtual Private Network (VPN). This tunnel secures your connections even if some of your components have an older SAP Release. SNC is supported for all external connections of the SAP System since Release 4.0A. You require the most up-to-date SAProuter version.

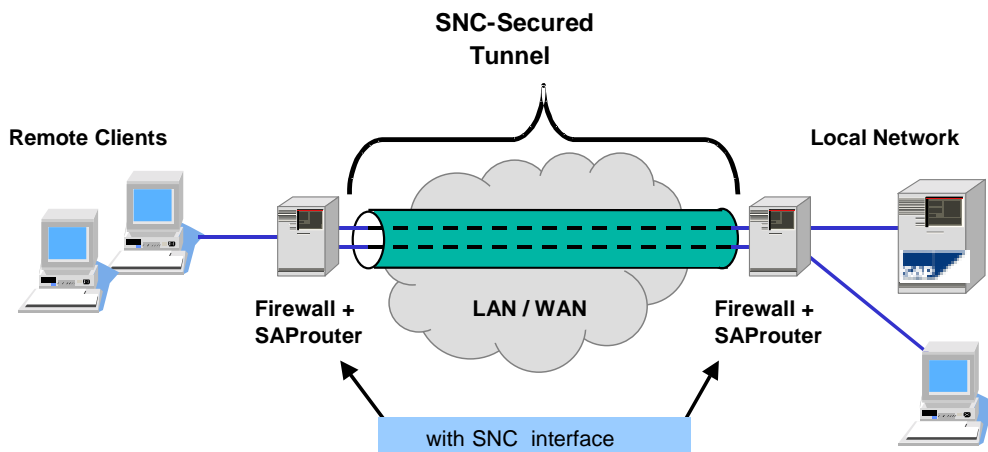


Figure 8
SNC-Secured Tunnel

For a detailed description of how to implement SNC, see the SAP Online Documentation.

2.2 SAP GUI for HTML

2.2.1 Connection

The SAP GUI for HTML uses the Internet Transaction Server (ITS) to connect to the SAP system. For the Web browser the ITS acts as web server, for the SAP system like a SAP client.

All connections are established from the front-end respectively from the ITS, but never from the SAP Server.

If you use the message server for load balancing, the ITS will start making a TCP connection to the Message Server to determine the most suitable application server. Now, the ITS establishes a TCP connection to the dispatcher on the application server.

For detailed information about the ITS, see the *SAP Internet Transaction Server - Technical Infrastructure* guide on <http://service.sap.com/ti>.

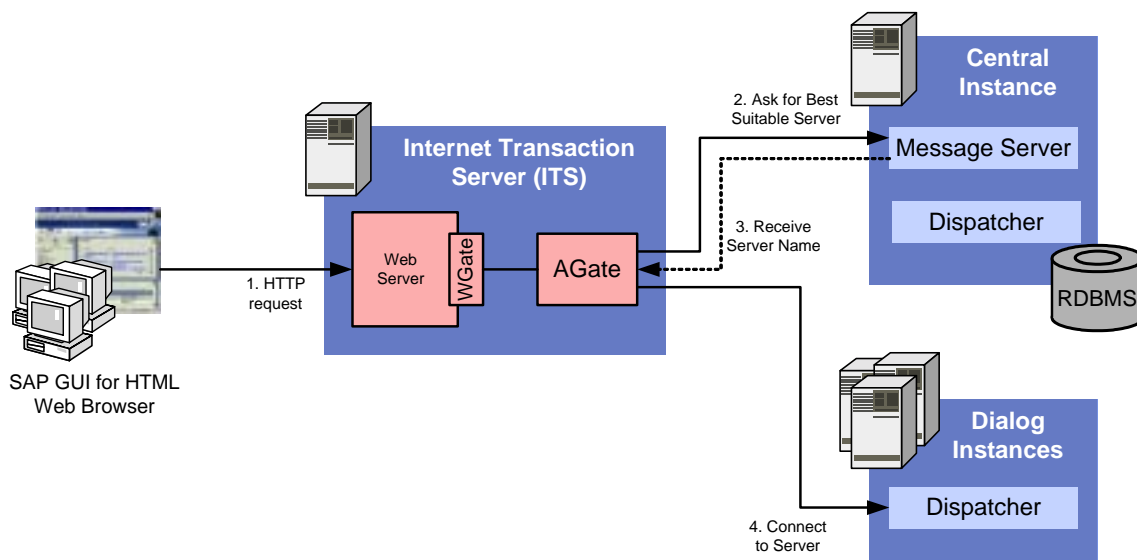


Figure 9
Connection Process of the SAP GUI for HTML to the SAP System

2.2.2 Encryption

To encrypt the data that is sent from the web browser to the ITS and vice versa you may use the web server integrated HTTPS mechanisms.

For further information about encryption between the ITS and the SAP system please refer to the *SAP Internet Transaction Server - Technical Infrastructure* guide on <http://service.sap.com/ti>.

2.2.3 NAT and Port-Mapping

Network Address Translation (NAT) modifies the IP addresses and if necessary the TCP port numbers in the network packets. This occurs transparently for the entire network protocol stack. NAT reduces official IP addresses when many computers communicate over the Internet, and it connects communication partners that cannot be reached directly due to address conflicts.

There are no known problems with using modified IP addresses between the Web browser and the ITS.

When using Network Address Translation between the ITS and the SAP System, there are several limitations which arise from network addresses being transferred within the transaction data:

- ❑ If you use the SAP message server for load-balancing, it sends the IP addresses and TCP services of the available SAP server back to the ITS. These IP addresses are then used to connect to the most suitable server. This procedure makes it necessary for the ITS host to be able to reach the application server with the IP address that they have in their local network. Therefore, the addresses of SAP server hosts to the ITS **must not** be modified.
- ❑ In certain cases, due to the network topology, the ITS host may not be able to establish a direct TCP/IP connection to the SAP server without Network Address Translation. In this case, you can use a SAProuter to establish the connection. For more information see section 2.1.2.
- ❑ Some network devices offer a port-mapping feature, i.e. they can forward an incoming connection on port A to another host on port B. Do not use this feature in connection with any kind of SAP connections. In some constellations, this causes connection errors, which are sometimes hard to find.

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The Dynamic Host Configuration Protocol (DHCP) automatically configures the network configuration of computers that are linked to a network. This is used primarily for administrating workstation computers in local networks and for dial-in connections. Using DHCP can lead to, that the same computer gets a different IP address after each restart or after each logon to the network.

You can generally operate SAP GUI for HTML clients with DHCP and changing IP addresses if there are no server services running on the client computer. Do not use DHCP on the ITS-host.

3 Printing

This section explains the different ways you can print with the R/3 System. In the R/3 System, a document is readied for printing using a special spool work process, which then passes the data to the spooler of the local computer. You can also access a print server using the network or you can print directly from the SAP GUI.

In reference to the subject of this paper, front-end printing is the most interesting part. But for the sake of completeness, we also explain the functionality of the other printing methods.

3.1 Local Printing

- SAP GUI for Windows
- SAP GUI for Java
- SAP GUI for HTML

When you print locally, the R/3 spool process sends the data to a printer that is set up on the operating system of the application server. The print request is then forwarded from the spool system of the operating system to the relevant printer. You can connect the printer locally to the computer or you can access it over the network.

Local printing is the fastest method to transmit data from the R/3 spool system to the printer because there is no network connection between the R/3 spool process and the printer spooler.

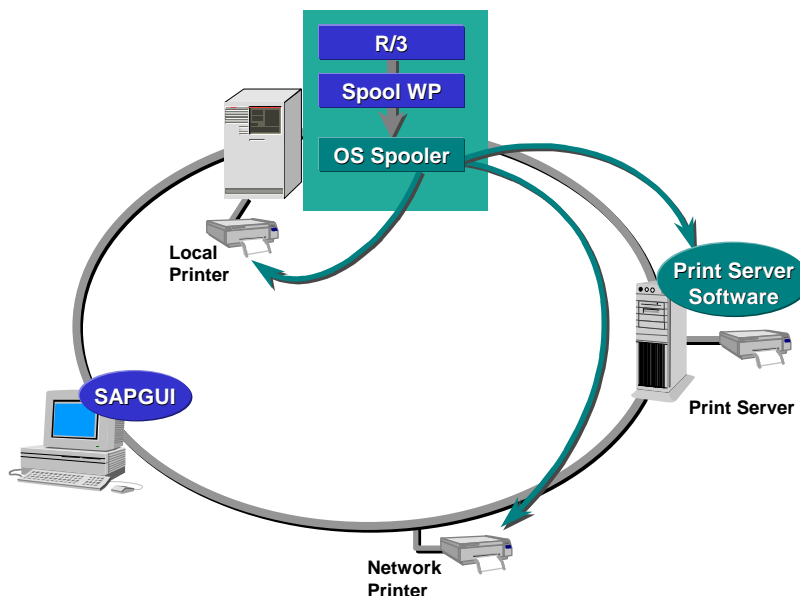


Figure 10
Local Printing

3.2 Remote Printing

- SAP GUI for Windows
- SAP GUI for Java

SAP GUI for HTML

The R/3 spool process can access any printing system in the network that can handle the lpr/lpd protocol (line printer requester/ line printer daemon). This protocol originates from BSD UNIX and is an industry standard for controlling printing. It is supported by many modern operating systems and by network-enabled printers.

The line printer requester (lpr) is a client and sends the print data to the server (lpd side). Using this protocol, various data formats, for example, PostScript or PCL can be transmitted.

Windows PCs do not usually have a line printer daemon (lpd). To be able to print using lpr/lpd, SAP developed its own lpd program for PCs called SAPIpd, which is installed with the SAP frontend. SAPIpd contains some extensions of the lpd protocol, for example, data compression, encryption using the SAP standard SNC (Secure Network Communication), and data transmission using the SAProuter.

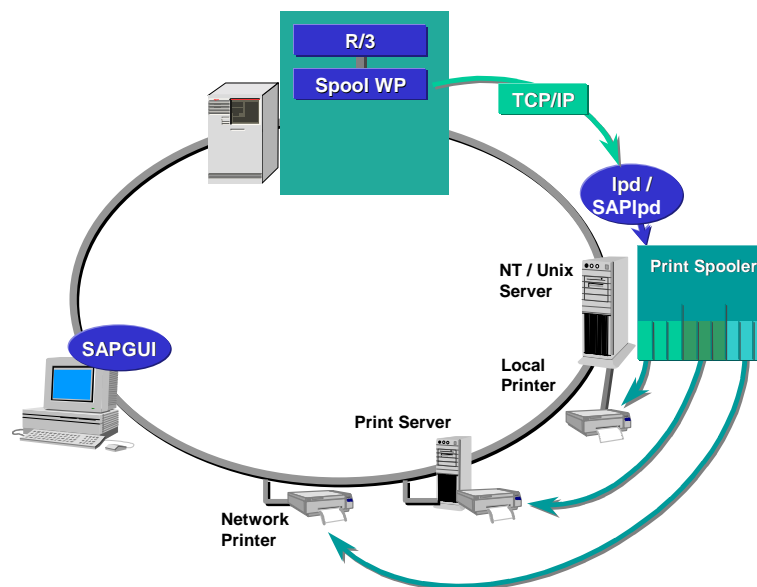


Figure 11
Remote Printing

3.3 Front-end Printing (SAP GUI for Windows/Java)

SAP GUI for Windows

SAP GUI for Java (on MS Windows only)

Another option when printing from the R/3 System is front-end printing, which lets you access printers that are not defined in the R/3 spool system.

The output data is transmitted directly over the SAP GUI to the front-end PC. To do this, the existing connection between the SAP GUI and the application server is used, so that an additional network connection is not required. The SAP GUI starts SAPIpd on the front-end PC and transmits the print data to it. SAPIpd then sends the data to the Windows standard printer or to another printer installed on the operating system.

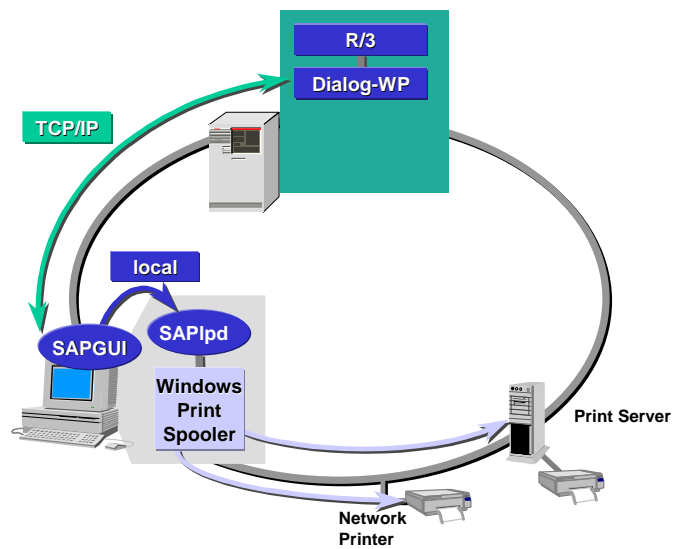


Figure 12
Front-end Printing with the SAP GUI for Windows/Java

3.4 Front-end Printing (SAP GUI for HTML)

SAP GUI for HTML

As in the SAP GUI for Windows/Java, front-end printing lets you access printers that are not defined in the R/3 spool system but configured on the front-end PC.

The SAP system converts the output data into the Acrobat format PDF and then transmits the file using HTTP over the existing connection to the web browser on the front-end PC. The browser then uses the Acrobat Reader plug-in to display and print the output data.

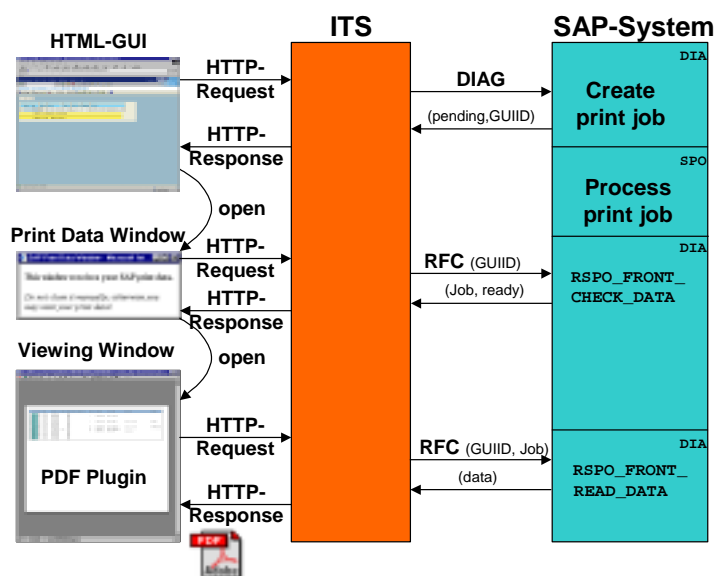


Figure 13

4 Network

4.1 TCP Ports

4.1.1 SAP GUI for Windows and SAP GUI for Java

The SAP GUI for Windows and SAP GUI for Java use the same target TCP Ports to connect to the SAP system.

Using a direct connection, the client needs several ports, depending on the number of instances and the respective system numbers (substituted with “nn”).

The used TCP ports are shown in white boxes. Below the graphic, you find an explanation of the respective inscriptions.

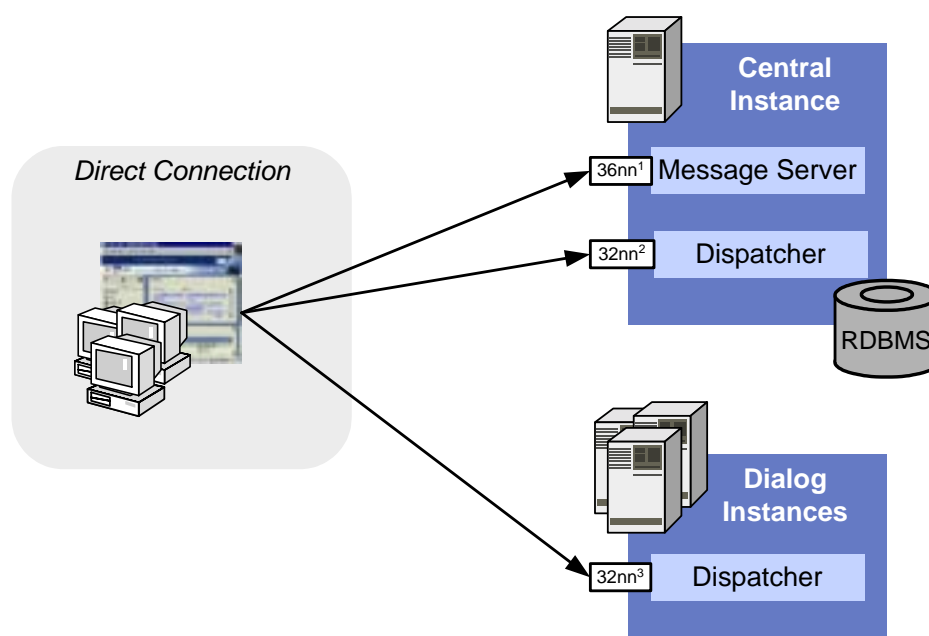


Figure 14
Direct Connection between SAP GUI and SAP system

*	SAP Port	TCP Port	
1	SAPMS<SID>	36<nn>	nn = instance number SID = system ID
2	SAPDP<nn>	32<nn>	nn = instance number
3	SAPDP<nn>	32<nn>	nn = instance number

In a SAProuter connection, the client uses only one port to connect to the SAProuter. The SAProuter then forwards the connection to the SAP system and port defined in the SAProuter string (see section 2.1.2).

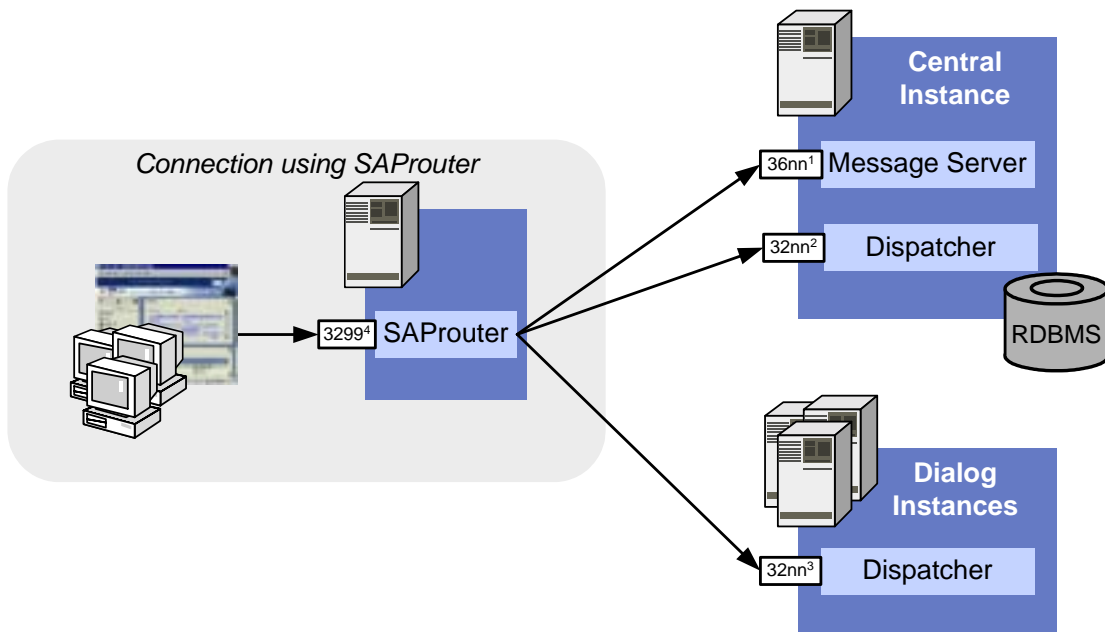


Figure 15
Connecting the SAP system using an SAProuter

*	SAP Port	TCP Port	
1	SAPMS<SID>	36<nn>	nn = instance number SID = system ID
2	SAPDP<nn>	32<nn>	nn = instance number
3	SAPDP<nn>	32<nn>	nn = instance number
4	SAProuter	3299	

4.1.2 SAP GUI for HTML

The SAP GUI for HTML uses only one port to connect to the Internet Transaction Server (ITS). This is usually the standard port for HTTP, port 80.

The ITS itself acts like a client and uses the same connections to the SAP system as a SAP GUI for windows. The Web Browser has no influence on which systems are connected and which ports are used in the backend.

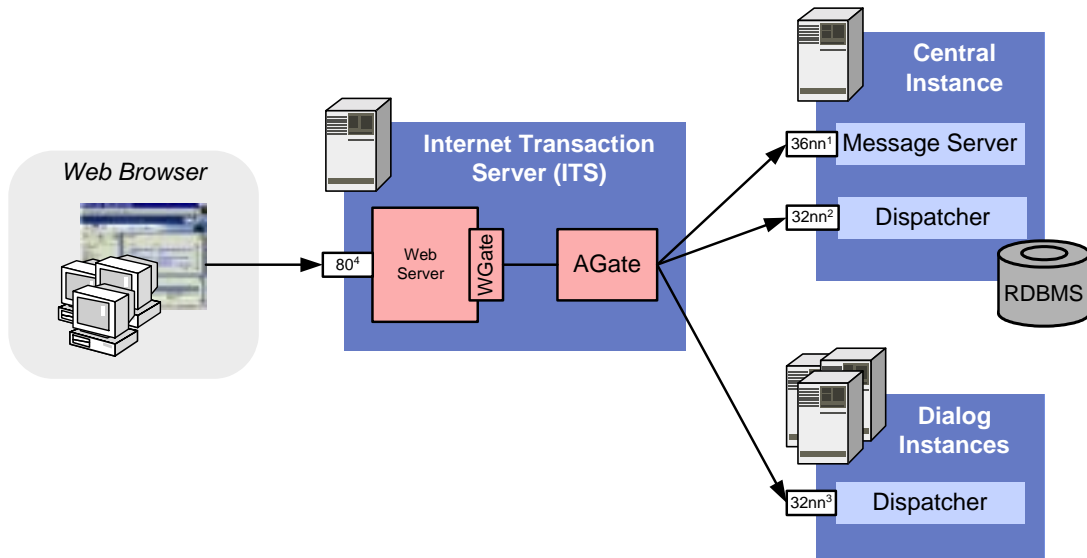


Figure 16
Connection through Internet Transaction Server (SAP GUI for HTML)

	SAP Port	TCP Port	
1	SAPMS<SID>	36<nn>	nn = instance number SID = system ID
2	SAPDP<nn>	32<nn>	nn = instance number
3	SAPDP<nn>	32<nn>	nn = instance number
4	-	80	Web server

4.2 Performance

For detailed information about SAP GUI performance and sizing issues, see the *Network Load for mySAP.com Solutions* document on <http://service.sap.com/sizing>.

5 Trouble Shooting

Communication between the front end and SAP systems takes place using the TCP/IP protocol. TCP/IP is a connection-oriented protocol that permits a certain amount of error tolerance. This prevents minor errors in the network affecting SAP applications.

If the TCP/IP stack identifies a problem in the communication that cannot be resolved, the existing connection is closed and an error message transmitted to the application.

This error message appears in the system traces of the SAP system and looks like

```
10054: WSAECONNRESET: Connection reset by peer
```

This message is usually generated if

- either the front end PC or the server host was switched off or the operating system was shut down even though connections were still present.
- the network connection was interrupted.
- several network segments of different types are between the front end and the SAP server, and several large transfer blocks (frames) are sent, the intervening routers may reject the frames without confirmation ("Black Hole" routers).

The following two sections will show you methods to find the reason for a network error.

5.1 Testing the Network with NIPING

Nipping is a powerful test program for the network interface (NI) layer. It provides connection and performance test with the same mechanisms that SAP GUI uses.

Please note that the SAP GUI for HTML does not use NI to connect to the ITS but HTTP/HTTPS. The ITS again uses NI to connect to the SAP system.

To test the network, you should use the *niping* tool to run a continuous test. It generate and evaluate a network trace simultaneously from the server and front end.

For further information on using *niping*, see SAP note 0500235.

5.2 Black Hole Routers

If you are operating a connection via a WAN network, the Maximum Transmission Unit (MTU) of a router or another unit within the connection link may differ from the MTU of the two end systems.

If the size of a frame sent exceeds the MTU of a router, the router fragments the frame into several smaller ones and forwards them to the next hop. If the flag "don't fragment" is set, the router does not split the frame but should send the ICMP message "destination unreachable" to the TCP/IP stack of the sending system as a reply. Most routers attach the relevant MTU for the next hop to this ICMP message. The host sends the frames again with the valid MTU or, if no MTU is received by the ICMP message, a lower one is sent as for the previous attempt.

The connection is interrupted if the router does not answer with an ICMP message and rejects the frame. These routers are called **Black Hole Routers**.

To check whether this problem is present, you should perform two tests with the *niping* (see chapter 5.1) tool using two different block sizes:

Start NIPING in server mode on the SAP server with the following command line from a command prompt:

```
niping -s -I t=0
```

Then start *niping* in client mode on the front end PC:

```
niping -c -H <R/3 hostname> -B 500 -L 1000
```

As a result of this command, 1000 packages of 500 bytes are sent and received again. This test must be successfully completed.

You must then repeat this test with a bigger buffer size:

```
niping -c -H <R/3 hostname> -B 5000 -L 1000
```

Following this command, 1000 packages of 5KB are sent to the *niping* server and received again. If this test causes an interruption, it looks like you have a Black Hole Router.

There are two ways to avoid this problem:

1. Release the PMTU Black Hole Detection with the Registry Editor.

As a result, the 'don't fragment' flag is no longer set. The router can fragment frames and frames within the LAN continue to be sent with the maximum MTU.

Windows NT, Windows 2000:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\TCPIP\Parameters
```

Via the Edit menu, add a key called `EnablePMTUBHDetect` with the data type `REG_DWORD` and set the value to "1".

Windows 95, Windows 98:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\VxD\MSTCP\
```

Add the key `PMTUBlackHoleDetect` and set the value to "1".

2. Use the Registry Editor to reduce the MTU size.

In this case, the size of the MTU corresponds to the smallest MTU of the network link. This value then also apply for communication within the LAN and may result in bad performance.

Windows NT:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\TCPIP\Parameters
```

Windows 2000:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\TCPIP\Parameters\Interfaces\ID for Adapter
```

Use the Edit menu to insert a key called `MTU` with the data type `REG_DWORD` and set the value for the MTU.

Windows 95, Windows 98:

```
Hkey_Local_Machine\System\CurrentControlSet\Services\Class\000n
```

Insert a key called `MaxMTU` and set the value for the MTU.

Make sure that the entry is in decimal form. Always select a value that is lower than the standard value. You can determine the size using the *niping* tool. The `MTU` respectively `MaxMTU` parameter is not present as default so you must enter it.

The changes in the Registry are activated after a restart.



Please note that incorrect changes in the registry can cause the operating system to crash.

Network	MTU(byte)
16 Mbit/Sec Token Ring	17914
4 Mbit/Sec Token Ring	4464
FDDI	4352
IEEE 802.3/802.2	1492
X.25	576

Table 1
Default MTU Values

Appendix

Glossary

DHCP	Dynamic Host Configuration Protocol The Dynamic Host Configuration Protocol (DHCP) automatically configures the network configuration, e.g. IP address, of computers that are linked to a network.
DNS	Domain Name Server A distributed client-server database system which links domain names with their numerical IP addresses.
GUI	Graphical User Interface A program interface that takes advantage of the computer's graphics capabilities to make the program easier to use.
HTML	Hypertext Markup Language The coding applied to text files that allows them to appear as formatted hypermedia documents in a Web browser.
HTTP	HyperText Transfer Protocol Application protocol, that contains a set of rules for exchanging files (text, graphic images, sound, video, and other multimedia files).
HTTPS	Secure HyperText Transfer Protocol Similar to HTTP , but encrypts and decrypts user page requests as well as the pages that are returned by the Web server using SSL .
ICMP	Internet Control Message Protocol Message control and error-reporting protocol.
ITS	Internet Transaction Server
LAN	Local Area Network A Local Area Network is a short-distance network. It provides low-cost, high-bandwidth networking capabilities within a small geographical area.
MTU	Maximum Transmission Unit Physical packet size, measured in bytes, that a network can transmit.
NAT	Network Address Translation Internet standard that enables a Local Area Network (LAN) to use one set of IP addresses for internal traffic and a second set of addresses for external traffic. Provides a type of firewall by hiding internal IP addresses and prevents conflicts with IP addresses used by other companies and organizations.
NI	Network Interface SAP specific proprietary network protocol.
PCL	Printer Control Language Developed by Hewlett Packard and used in many of their laser and ink-jet printers.
PDF	Portable Document Format

A file format developed by Adobe Systems. PDF captures formatting information from a variety of desktop publishing applications, making it possible to send formatted documents and have them appear on the recipient's monitor or printer as they were intended.

RFC	Remote Function Call Proprietary SAP communication interface.
SID	System ID The SID designates an SAP System using a short name composed of three characters.
SNC	Secure Network Communication Interface in the SAP architecture that lets you use external encryption products to secure SAP communication
SQL	Standard Query Language Widespread language for database queries.
SSL	Secure Sockets Layer Commonly-used protocol for managing the security of a message transmission on the Internet. SSL uses a program layer located between the Internet's Hypertext Transfer Protocol (HTTP) and Transport Control Protocol (TCP) layers
TCP/IP	Transport Control Protocol / Internet Protocol Suite of communications protocols used to connect hosts on the Internet.
VPN	Virtual Private Network A set of standards for forming secure connections over public networks, such as the Internet. Often used to remotely connect to corporate networks.
WAN	Wide Area Network WAN refers to a network that connects hosts over long distances, for example by telephone lines or satellite links.
WTS	Windows Terminal Server Product from Microsoft® which enables users to run programs on a central server. Only input and output operations take place on the user workstation. WTS is often used with thin client scenarios and by WAN users.

Related Documentation

SAP Network Integration Guide (<http://service.sap.com/network> or mail to network@sap.com)

SAP GUI Family (<http://service.sap.com/ui>)

Platform and Technology Information Center (<http://service.sap.com/platforms>)

R/3 Security Guide (<http://service.sap.com/security> → Guidelines and Audits)

Sizing (<http://service.sap.com/sizing>)

Microsoft® Windows Terminal Server (<http://www.microsoft.com>)