

Interfacing with

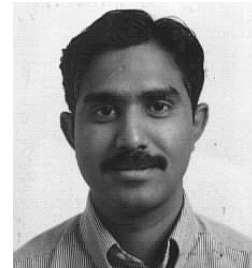
SAP R/3®

- A bird's eye view

White Paper

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About the Author



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1. Introduction

One of the primary challenges of SAP implementation process has been integrating SAP with the other applications. Be it the existing Legacy system, on which the customer has spent the money and time building complex business specific logics into it, or the buzzword of the new era 'web-enabling' applications, which opens up the eBusiness pathway to the whole world of customer and partners to interact directly with the ERP system.

Even after the current economic slowdown, Gartner¹ and Aberdeen Group² predict that the Enterprise Application Integration will be pursued as the key area in the forthcoming days.

SAP provides basic infrastructure needed to bridge this gap by providing various tools, techniques & technologies for the integration.

This document takes a closer look at these interfacing techniques, effective ways and scenarios to employ them, and their pros & cons.

At the end of the document you can also find links to various resources to get more details about each of these interfacing technologies.

Gartner¹: "Gartner Predicts 2002 – What's ahead for Business Applications"

Aberdeen Group²: "New Enterprise Information Integration Sector to fuel \$7.5 Billion market by 2003"

2. SAP Interfacing Techniques

SAP AG has been coming up with new tools and techniques to support emerging industry standard EAI technologies from time to time.

The following are the techniques currently supported by SAP (as in SAP Version 4.6c) for both batch and real-time interfacing.

- Batch Data Communication (BDC)
- Batch Input (BI) & Direct Input (DI) programs
- Remote Function Call (RFC)
- Electronic Data Interchange (EDI)
- Application Link Enabling (ALE)
- Business Application Programming Interface (BAPI)
- SAP Automation Tools
- SAP Connectors
- Internet Transaction Server (ITS)

Low-level communication techniques

- CPI-C Communication
- Platform specific development libraries for SNA & TCP/IP communication

and a number of third party EAI tools to integrate SAP and Non-SAP systems with R/3.

3. How they all fit together

The following diagram explains how these interfacing mechanisms work hand in hand with each other.

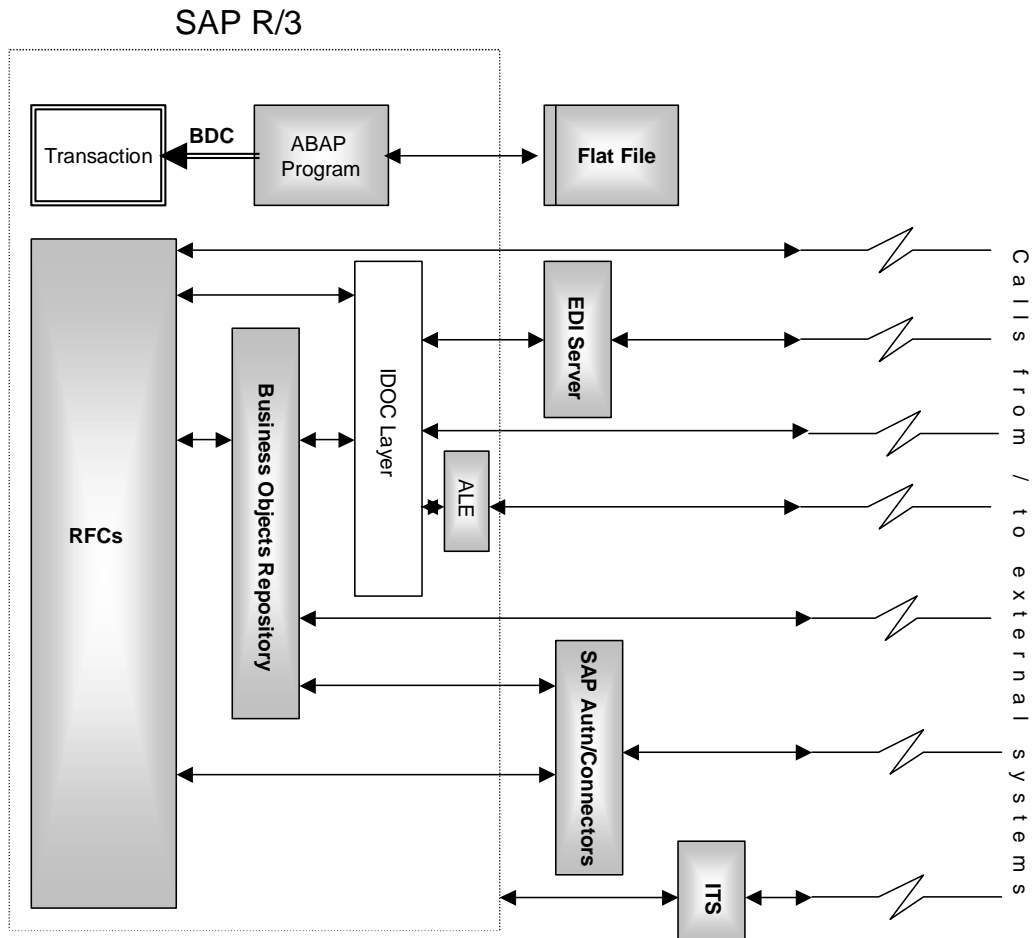


Figure 1: SAP Interface architecture

4. Batch Data Communication (BDC)

Batch Data Communication (BDC) is the oldest batch interfacing technique that SAP provided since the early versions of R/3. BDC is not a typical integration tool, in the sense that, it can be only be used for uploading data into R/3 and so it is not bi-directional.

BDC works on the principle of simulating user input for transactional screen, via an ABAP program. Typically the input comes in the form of a flat file. The ABAP program reads this file and formats the input data screen by screen into an internal table (BDCDATA). The transaction is then started using this internal table as the input and executed in the background. The following diagram explains this process.

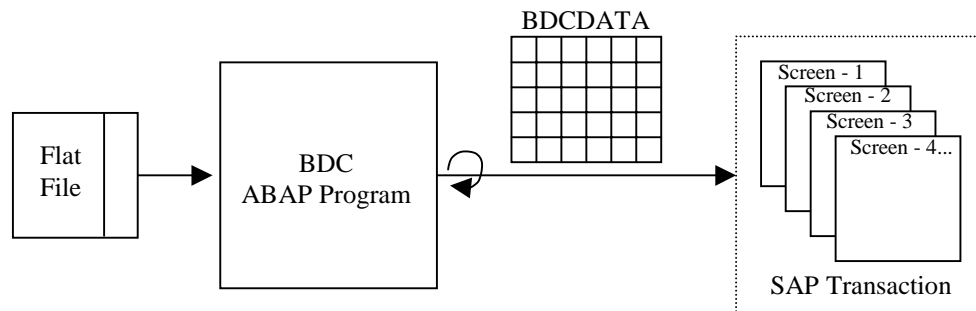


Figure 2 : A typical BDC Flow

Since the BDC technique invokes the standard SAP transaction, which the normal user would invoke interactively, all the input field validations, translations and flow are intact and behaves in accordance with the expected process flow (Please note that this does not hold good in a few cases, in which the Dialogue module checks whether the Transaction is being executed interactively or in the BDC Batch mode in order to control the screen flow. For example getting the confirmation from the end-user).

This flip side of it is performance hit. Since BDC has to go through all the Transactional screens and validations, most of the time is spent by the system in loading the DYNPRO (Dialog screens) as opposed to doing the actual business function.

There are two ways to run BDC programs.

- Using CALL TRANSACTION
- Using Batch Input Sessions

In 'Call Transaction', the transactions are triggered at the time of processing itself and so the ABAP program must do the error handling. It can also be used for real-time interfaces and custom error handling & logging features.

Whereas in Batch Input Sessions, the ABAP program creates a session with all the transactional data, and this session can be viewed, scheduled and processed (*using Transaction SM35*) at a later time. The latter technique has a built-in error processing mechanism too.

The BDC Transaction recorder (*Transaction SHDB*) helps in recording the user inputs and the screen flow of a transaction and can generate ABAP code to create BDC sessions. With this facility, the programmer no longer needs to dig through the attributes to note down the field names, program names and screen numbers to create a BDC program.

Though BDC is simple enough to develop, it is not very efficient when compared to other interfacing options like Batch Input (BI), Direct Input (DI), RFC, BAPI etc...

SAP has been introducing more and more BI / DI programs & BAPIs in the new releases, in order to provide better integration at the business object level and at a higher speed.

5. Batch Input (BI) & Direct Input (DI) programs

These are SAP supplied standard ABAP programs for loading master and transaction data into SAP. Both these types of programs take a flat file as the input and load the data into the R/3 system.

Batch Input (BI) programs still use the classical BDC approach but doesn't require an ABAP program to be written to format the BDCDATA. The user has to format the data using predefined structures and store it in a flat file. The BI program then reads this and invokes the transaction mentioned in the header record of the file.

Direct Input (DI) programs work exactly similar to BI programs. But the only difference is, instead of processing screens they validate fields and directly load the data into tables using standard function modules. For this reason, DI programs are much faster (RMDATIND - Material Master DI program works at least 5 times faster²) than the BDC counterpart and so ideally suited for loading large volume data.

DI programs are not available for all application areas. Only a limited number of DI programs have been supplied by SAP, which are listed below.

SAP supplied Direct Input Programs

Program	Description
RMDATIND	MM: Create Material master data
RFBIBL00	FI: Create Account documents
RVAFSS00	SD: Invoicing external transactions
RAALTD11	AM: Create Asset Account documents
RKEVEXT0	CO-PA: External data transfer to CO

The Direct Input sessions can be created, viewed, scheduled, processed and restarted using *Transaction BMV0* or using *Program RBMVSHOW*.

5 times faster² : Based on the benchmark performed by the author. Result may vary depending on factors like number of Transactions, Material Views, System load, Release, Database, Operating System, Hardware etc...

6. Remote Function Call (RFC)

Remote Function Call (RFC) in SAP R/3 is based on UNIX's Remote Procedure Call (RPC). RFC enables the *real-time* link between different R/3 instances and can connect SAP to Non-SAP systems.

With Remote Function Call, both inbound (RFCServer) and outbound (RFCClient) interfaces are possible. SAP also provides a toolkit called RFC API for non-SAP systems to interact with SAP's Function modules remotely.

The following diagram illustrates the RFC calls between SAP & non-SAP system programs.

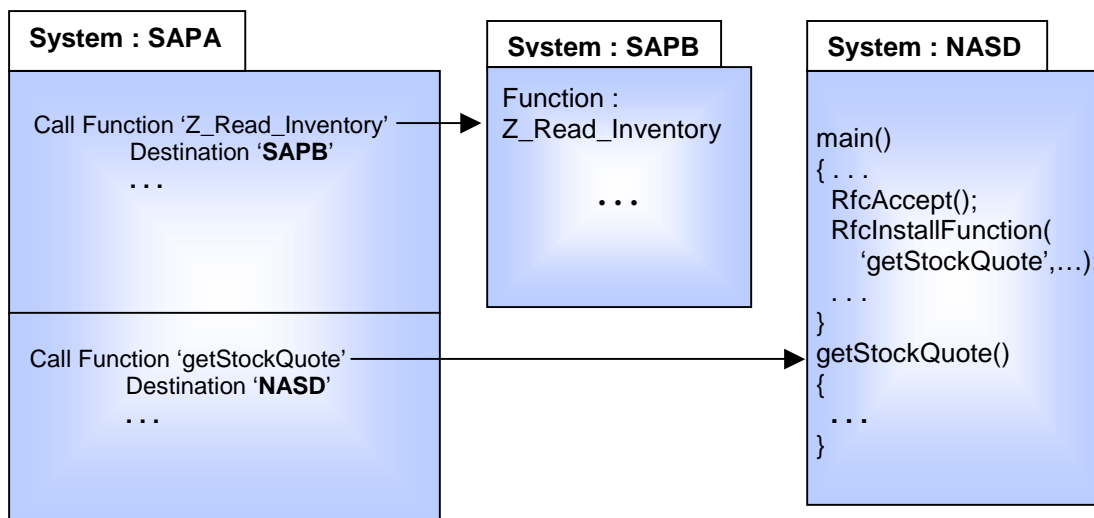


Figure 3 : RFC communication between systems

SAP maintains a central repository of interoperable system definitions called "Destinations" (*Transaction SM59*). The following types of connections are possible with RFC Destinations.

- Connection to R/3 system
- Connection to R/2 system
- External program connection via TCP/IP
- External program connection via SNA or APPC
- RFC via special ABAP/4 drivers

From release 3.0 onwards, SAP has introduced a new version of RFC called Transactional RFC (tRFC). tRFC makes sure that the function remote calls are *transactional* in nature, that is, safe, independent of the availability of the RFC server and being called only once. SAP provides support of both Synchronous and Asynchronous RFC calls.

RFC is a very powerful tool for interfacing with SAP system in real time. Most other interfacing techniques like ALE, EDI, BAPI etc... are inherently based on the RFC technology.

7. Electronic Data Interchange (EDI)

Electronic Data Interchange (EDI) is the industry standard format for exchanging Business data. SAP uses a neutral format called Intermediate Document (IDoc) for communicating EDI & ALE messages.

The IDoc interface contains data structures and processing logic for each of the business transaction. These are grouped as Message Types. The external EDI Server is responsible for receiving the EDI messages sent by the *trading partners*. These EDI messages are then mapped onto the IDoc structure fields and stored in the IDoc interface layer by SAP.

EDI/IDoc supports both inbound and outbound interfaces. The IDocs received through the EDI Server can be configured to automatically get processed, or can be stored in the IDoc interface layer for a future manual or scheduled processing.

The IDoc interface layer also has a powerful error handling, reporting, monitoring and re-processing mechanism built into it (*Transaction WEDI*). IDoc is also tightly integrated with the WorkFlow system of SAP for initiating other business tasks upon receiving/sending EDI messages.

The IDoc interface can be employed for non-SAP applications to load or extract data from SAP system. But typically, EDI / IDoc is engaged when SAP system is to be integrated with any of its business partners (Customers, Suppliers and other partners) for carrying out standard business transactions (like Create Sales orders, Sending Purchase orders to Suppliers, etc...).

8. Application Link Enabling (ALE)

Application Link Enabling (ALE) is a middleware tool, which is part of SAP's Business framework Architecture (BFA). ALE can effectively be used for loosely coupled *Asynchronous* communication between SAP systems and with non-SAP systems. ALE is based on the distributed processing architecture and hence integrates applications with the local database rather than centralized one.

ALE messages are based on the Intermediate Document (IDoc) format, similar to the EDI counterpart.

Though ALE can be used to interface with non-SAP systems, usually it is used to distribute Master & Transactional data between SAP R/3 instances.

The ALE distribution can be based on,

- Business APIs
- IDoc Message Types

Distribution based on IDoc Message types (example, MATMAS / MATCOR for Material Master data & ORDERS / ORDCHG for Customer master etc...) are typically used in 3.x SAP releases. The order of the day (since release 4.0A) and future is ALE distribution through BAPIs.

The main advantage of ALE is that it can work between different releases of R/3 systems. So, even after a release (version) upgrade, ALE links continue to work as is. Since ALE is based on the IDoc processing model, error handling becomes easy.

9. Business API (BAPI)

Business API (BAPI) is the most important component of SAP Business Framework. BAPI enables SAP and third party applications to interact and integrate with each other at the Business Object / Process level.

Till some time back, SAP was deep into its not-so-friendly interface and architecture, which it inherited from the IBM Mainframe based parent system. But now it has come up with truly platform independent business object interfaces using BAPIs. Business Objects and BAPIs provide an object-oriented view of SAP's business functionality (*Transaction BAPI*).

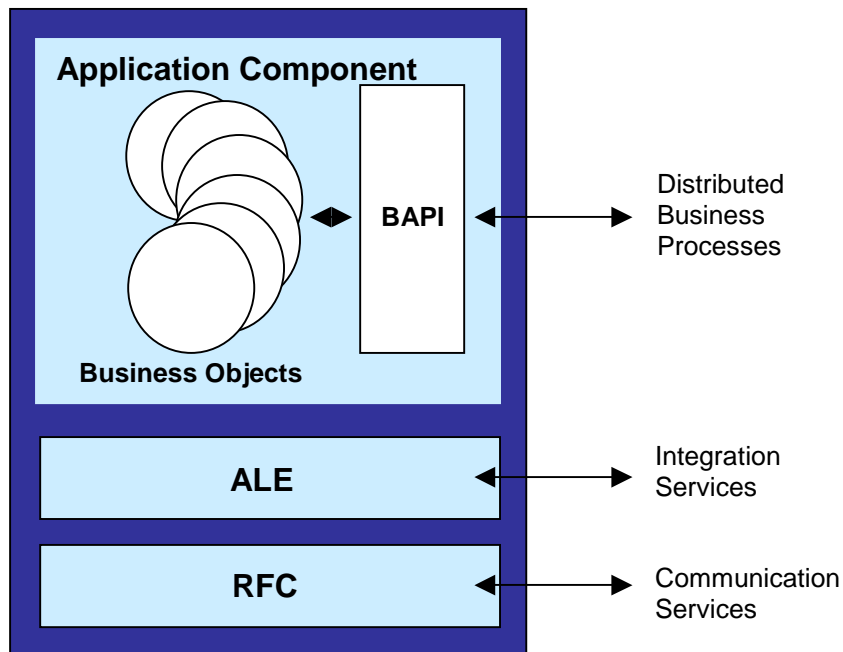


Figure 4 : BAPI and the SAP Business Framework

BAPIs are implemented using Remotely callable Function modules. These RFCs are assigned as a *callable method* of a Business Object in the Business Object Repository (BOR). All BAPIs are independent of the screen and hence can work in the background without user intervention.

BAPI supports both inbound and outbound processing. Since it follows object-oriented approach, SAP has positioned itself to support interfacing through BAPIs in the future.

10. SAP Automation Tools

SAP Automation Tools are set of tools, components and class libraries for developers to integrate non-SAP systems with SAP systems.

There are two tool sets available for SAP Automation.

- SAP GUI interfaces
- RFC & BAPI interfaces

SAP GUI interface toolset can be used for developing applications that can interact with SAP transactions interactively, so that the end-users can access SAP Screens directly from other applications (like showing SAP screen from a VisualBasic screen scraper program). These toolsets use the SAPGUI application server component to connect to SAP R/3.

Using the second set of tools, SAP lets you access RFCs and BAPIs directly from non-SAP systems. Using these tools you can

- Connect to R/3 from outside of the SAP GUI interface environment
- Access SAP business objects and Business APIs (BAPIs)
- Access R/3 RFC function modules
- Trigger R/3 transactions in batch mode from outside of R/3
- Provide an alternative GUI interface to R/3 applications and transactions (Screen scrapers)
- Send or receive inbound or outbound IDoc documents to or from R/3

The SAP Assistant toolset contains following components.

- C, C++, Java, VB APIs & Class files
- Active X controls
- COM / DCOM connectors & server
- Standalone EXE files, etc...

SAP Automation tools are very powerful developer toolkit, which is ideal for developing both inbound and outbound real-time interfaces to or from SAP R/3 system.

11. SAP Connectors

There are a number of connectors supplied by SAP for integrating R/3 with different applications and technologies.

- SAP Business Connectors
- SAP Java Connectors
- SAP .NET Connectors
- SAP DCOM Connectors

The Java, .NET and DCOM connectors are tool kits, which are functionally similar, to enable interoperability between SAP and other software. These toolkits typically come with middleware APIs to support RFC (synchronous, transactional & queued), BAPIs, and IDocs. These connectors are ideal for custom interface development for the in-house integration needs.

SAP Business Connectors is a step above the technology connectors. Business Connectors allow integration of local and application over the net, with open standards (like XML etc...). The BAPI and IDoc interfaces are made available to partners over the net using secured XML based services. In addition, Business Connectors enable to expose additional Web Services over the internet for the business partners to get information deeply buried into your ERP system.

12. Internet Transaction Server (ITS)

Internet Transaction Server (ITS) is the transaction processing system that connects the web HTTP server and the standard R/3 system. ITS is available since SAP release 3.1G. All the Internet Application Components (IAC) of SAP will be transacted through ITS.

Using ITS & IAC the standard R/3 transactions can be performed through the World Wide Web. Some of the business components that are pre-web-enabled by SAP are,

- HR Employee Self-Service (ESS)
- Components in SAP Retail Store
- SAP B2B Procurement

It is also possible to *web-enable* the custom transactions and other standard transactions using ITS, using the following tools and components supplied by SAP.

- SAP@Web Studio
- SAP GUI for HTML
- Web RFC
- Web Reporting
- Web Transactions

These components support generation of dynamic HTMLs, HTML^{Business}, JavaScript, Common Gateway Interface (CGI), Microsoft Information Server API (ISAPI), Netscape Server API (NSAPI) and can interact with Java, C++ or VB programs.

Though the current development environment is not yet a matured one, it will soon be so in the forthcoming releases of SAP.

13. CPI-C communication

Common Programming Interface – Communication (CPI-C) is a direct program-to-program communication protocol. Those who want to develop simple but proprietary protocol can use this technique. Remote Function Call (RFC) is a simplified version of CPI-C, so that the programmer need not worry about the communication protocols and rather can concentrate on communicating business information between programs.

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

CPI-C ABAP Statements

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

In short, CPI-C is the low-level stuff that hard-core protocol developers will be interested in. It is not meant for Business-Object-level or Application-level integration.

14. EAI Products for SAP R/3

There are a number of Enterprise Application Integration (EAI) products, which can integrate SAP R/3 with various other products and applications. These products claim to work at different levels of integration, viz., technology integration, application integration, business process integration, system integration etc...

Most of the products are generic integration tools that come with SAP specific adapters. Many of these also come with pre-built Business Object Templates for integrating SAP's standard business objects like Sales Orders, Invoices, Purchase Orders etc...

Some of the EAI products that are available in the market are :

- IBM's 'Websphere' (formerly known as Crossworlds)
- BEA's 'Weblogic Integration'
- Seebeyond's 'e*Gate'
- IT Architects 'Connect-IT'
- Tibco's 'Business Connect'
- Backsoft's 'btalk'
- Mercator's 'Integration Broker'

and

- SAP AG's own 'Business Connector' and 'mySAP Exchanges'

For more details about the products visit the links provided at the end of this document.

15. Related links

- SAP Home page
 - <http://www.sap.com>
- SAP Interface Home page
 - <http://ifr.sap.com>
- SAP Help portal – Online documentation containing details of all the components
 - <http://help.sap.com>
- Comprehensive list of all BAPI, RFC & IDoc message types available in R/3
 - <http://ifr.sap.com/catalog/query.asp>
- SAP Connectors
 - <http://service.sap.com/connectors> (at the SAP Service Marketplace)
- General whitepapers and brochures from SAP AG
 - <http://sap.com/solutions/technology/brochures.asp>
- EAI Products for SAP R/3
 - <http://www.sap.com/solutions/exchanges> : mySAP Exchanges
 - <http://www.crossworlds.com> : IBM Websphere / Crossworlds
 - <http://www.bea.com/products/weblogic/integration> : BEA Weblogic Integration
 - <http://seebeyond.com/products/egateOverviewProducts.asp> : Seebeyond 'e*Gate'
 - <http://www.it-architects.com/sapproducts.html> : IT Architects 'Connect-IT'
 - <http://www.tibco.com/products/ax/index.html> : Tibco Business Connect
 - <http://www.btalk.com> : Backsoft's 'btalk'
 - <http://www.tsisoft.com> : Mercator Integration Broker
- Other EAI - SAP related Journals and websites
 - <http://www.EAIJournal.com>
 - <http://eai.ittoolbox.com>
 - <http://www.intelligentEAI.com>
 - <http://eai.ebizq.net>
 - <http://www.itpapers.com>
 - <http://searchsap.techtarget.com>