OLE AND RFC
OPEN INTERFACES FOR DESKTOP INTEGRATION

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- ■ **Techniques for integrating PC programs**

- ■ **OLE for simple access to objects and functions**

- ■ **RFC for direct communication with R/3**

- ■ **Merging desktop software with enterprise solutions**

SAP®

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Openness

Strategies for Openness

The R/3 System is based on a multi-tier client/server architecture. An open system, it is designed for use under the operating systems of different vendors. As a rule, open systems use standard data exchange formats and standardized interfaces for interprogram communication. The R/3 System is open in various respects (see Fig. 1):

■ Open at the system level: it supports a large number of *standard user interfaces* (e.g. Windows, Macintosh, Motif, Presentation Manager). R/3 also runs on many *system platforms*, including various UNIX versions and Windows NT.

■ Transparency at the application level: *data models*, the *R/3 Analyzer*, and the *ABAP/4 Repository* enable users to view and understand the inner workings of R/3 applications. You can easily enhance and extend the applications to meet your specific requirements.

■ Message flow between companies: R/3 incorporates interfaces for *EDI* (Electronic Data Interchange). EDI automates exchange of data, e.g. orders, invoices, etc., between R/3 and the application systems used by business partners.

■ Message flow between individuals: R/3 uses *MAPI* (Messaging Application Program Interface). This lets you use any MAPI-capable mail client as a front-end for R/3.

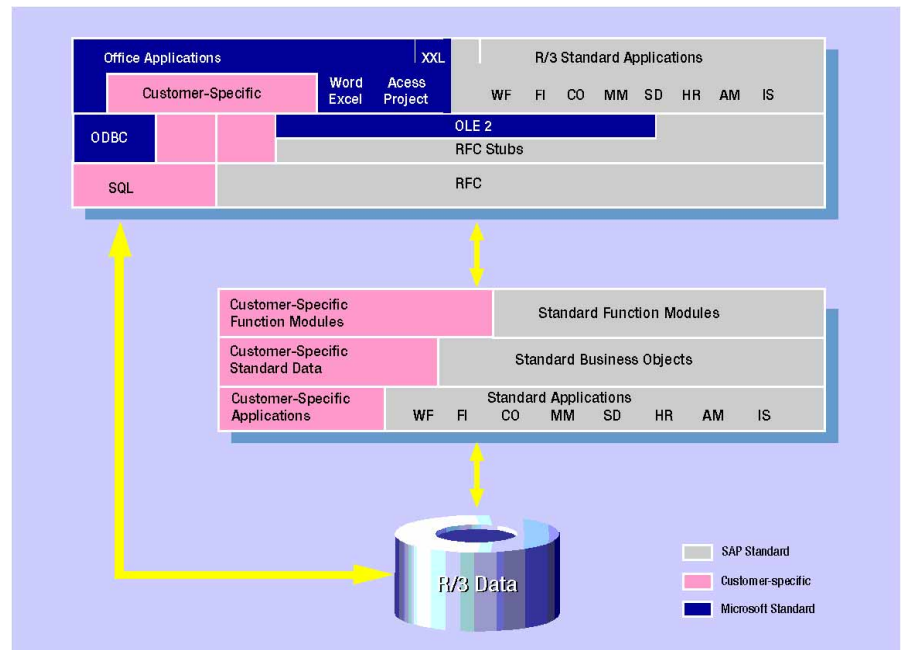■ Communication between distributed applications: for techni-

Figure 1: Integration of R/3 and desktop applications

cal and cost reasons, it is often smart to loosely couple application systems with one another. SAP has therefore integrated *ALE* (Application Link Enabling) into Release 3.0 of the R/3 System.

■ Transparency at the database level: R/3 relies upon relational database systems. But you are not restricted to the R/3 System's native query and retrieval tools. You are free to take advantage of tools supplied by the database vendor or third-party utilities for accessing R/3 data. You can also benefit from use of the *ODBC* (Open Database Connectivity) standard.

■ Open by virtue of a programming interface: R/3 lets other R/3 Systems and external programs invoke R/3 function mod-

ules. This is accomplished with *RFC* (Remote Function Call), the R/3 System's programming interface for external applications.

■ Open at the desktop level: R/3 utilizes the OLE (Object Linking and Embedding) standard. This grants access to the objects and functions of other OLE services that use OLE automation technology and, conversely, places SAP functions and objects at the disposal of OLE client programs.

ODBC, RFC and OLE

These are very important interfaces for accessing R/3 data and functions:

■ ODBC is an interface for accessing databases and data management systems. It is based on a
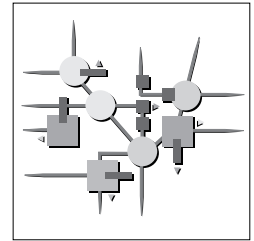
standard devised by the SQL Access Group.

- RFC is SAP's open programming interface. It lets your custom applications invoke SAP function modules and access ABAP/4 function libraries.

- OLE is a widely used standard that Microsoft developed to facilitate communication between applications.

Direct Access to R/3 Data Structures Using ODBC

ODBC is an industry standard you can harness to access the data of R/3 applications. Many modern data management systems support this standard. And desktop applications like Microsoft Access have interfaces for communicating with ODBC-capable systems.

Use of ODBC to access R/3 data makes sense when desktop applications need to spontaneously read certain data. However, users of ODBC should be aware of the fact that it bypasses the powerful logic of R/3's business processes along with all of their built-in authorization checks and control mechanisms. Consequently, when implementing business applications with a large number of dependencies it is a better idea to rely on function modules (taking advantage of RFC or OLE techniques).

For occasionally supplying a desktop application with individual data on an as-needed basis, ODBC is definitely the method of choice. In order to ensure that the data structures being accessed are correctly interpreted with regard to their structure and dependencies, it is advisable to use the SAP Enterprise Data Models. Use of the correspond-ing data model of the application in question will give you a deeper understanding of the business objects involved and processes associated.

RFC Technology

Remote Function Calls (RFCs) were originally developed to let SAP systems communicate with one another at the application level. Function modules are the typical units used for modularization at the ABAP/4 programming level. Remote functions differ only slightly from other function modules. To define one, all you need to do is set a flag in the ABAP/4 Development Workbench. When calling such a module, you must of course also stipulate the target system.

In order for desktop software to use RFCs to access function modules of an R/3 System, you need to write a program or macro in C or the application's native programming language (e.g. Visual Basic for Applications). From a technical standpoint, there are two ways to do this. The application can use functions of the RFC library that comes with R/3 or the ABAP/4 Development Workbench (e.g. RfcOpen(), RfcClose(), RfcCall(), RfcReceive(), etc.). Or it can employ a so-called stub created from a function module with the aid of the RFC Interface Generator (see Fig. 2). These functions permit exchange of single parameters or entire tables.

Remote Function Call technology is also available for R/2. To take advantage of it, you need the following system environment:

- SAP R/2 Version 5.0D or later

- SAP's R/2 Workstation Software: RFC and CPI-C development libraries for your platforms
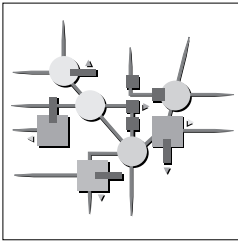
- Gateway (supplied with the libraries)

The RFC Interface Generator

The RFC Interface Generator helps developers of ABAP/4 function modules create libraries and DLLs for the desktop. The Generator is mainly used for automated generation of example programs to test function modules and demonstrate the RFC interface.

The RFC Interface Generator is part of the ABAP/4 Development Workbench, and is also used from within the ABAP/4 Development Workbench. When defining and modifying the interfaces of ABAP/4 function modules, it is possible to generate C code from within an existing module. The Generator creates files containing the extracted C code, the corresponding header files, and if wished even example programs for testing the modules, storing all of these in user-selectable paths on the front-end computer. The Generator is able to create sample programs in standard ANSI C or Visual Basic. You can then use any commercially available C compiler to translate the generated code into an executable program or, for Windows environments, a DLL.

Comparison of ODBC and RFC

What ODBC and RFC have in common is that they can both be used to access data of the R/3 System. Each of them has a different focus, however. Generally speaking, access via RFC is better when an application calls for business know-how or an understanding of certain business structures. By contrast, ODBC is the technique of choice for reading parts of tables on an as-

needed basis. RFC invokes functions at the R/3 application level, whereas ODBC directly accesses the database. The following rules of thumb have emerged for use of these techniques:

- If ODBC is only needed rarely in an application, you should try to dispense with it entirely. Then you only have to master a single technology (in this case, RFC), and the required maintenance work is greatly reduced when upgrading to a new release.

- RFC can be used to transfer large data volumes very efficiently by taking advantage of the TABLES interface. It is uncommon for ODBC access operations to be optimized for a particular database. By contrast, R/3 makes at least some use of database-specific functions and characteristics, and also employs so-called caching to buffer data. Consequently, RFC access operations do not diminish performance despite the additional application level involved (see Figure 1).

- ODBC is recommended when manipulating R/3 data with SQL operations that aren't supported by the ABAP/4 Development Workbench. Example: when "joining" an R/3 database table with non-SAP data.

- RFC is the only way to access objects that don't exist in the form of actual database tables, instead being generated on an as-needed basis from existing data by applying certain operations and rules. An example of this within the R/3 System is pricing in the SD Module.

Figure 2: Mode of action of the RFC Interface Generators
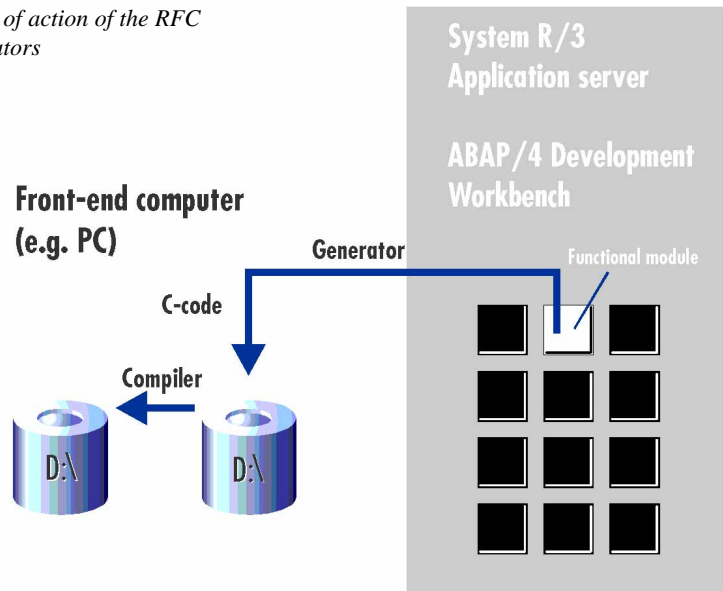
The Dilemma of Desktop Integration

Integration of individual applications using a programming interface like RFC also poses a dilemma: since no standard macro language exists for desktop applications, the link has to be reprogrammed from scratch for each integration. This is even the case when two PC applications use the same R/3 function module. Unfortunately, no standardization of PC macro languages is now in sight. But a solution exists: OLE.

OLE 2.0 is gaining importance for communication between desktop products. SAP has been following this development very attentively, striving to meet the requirements and expectations of the market by systematically enhancing its products along these lines:

- OLE permits use of standardized components.

- OLE is an excellent basis for interplay of applications.

- OLE permits easy access to the objects and functions of other applications.

- OLE is already widely used.

OLE in the R/3 System

OLE Automation

OLE 2.0 consists of several parts. For communication between applications, OLE Automation is particularly important. OLE Automation lets them access the components and functions of other applications. Components are designated as objects. An OLE Automation Server declares components and functions to other applications. Any OLE Automation Client can then use those components and functions.

R/3 Release 3.0 is able to assume the role of either OLE Automation Server or OLE Automation Client. This ability is actually somewhat
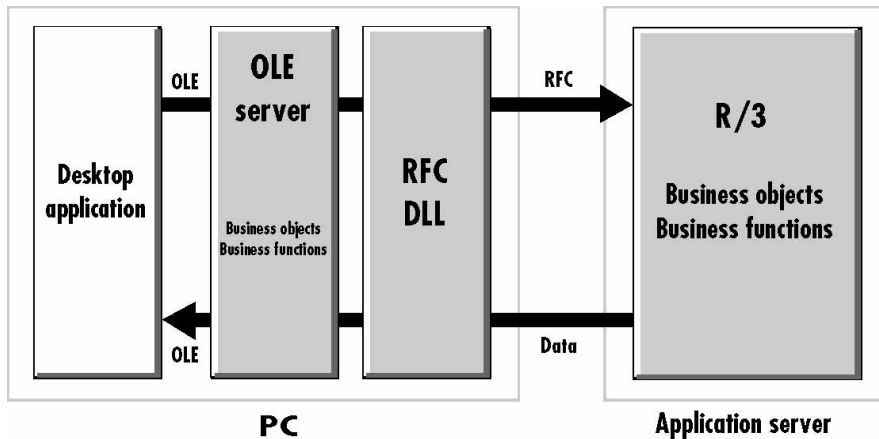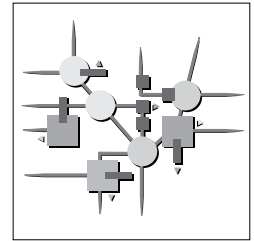
remarkable. Take Microsoft Word 6.0, for instance: it only presents itself as an OLE Server. It cannot take advantage of the functions of other servers, and is therefore not an OLE Automation Client itself.

R/3 as OLE Automation Server

SAP will be using OLE Automation to further simplify access to R/3 function modules (see Fig. 3). OLE Automation makes it easy and convenient to dynamically request function modules of the SAP System, pass the required parameters to them locally, and then issue a call to the SAP System. This OLE layer is based on SAP's RFC libraries. Because calls are made dynamically, the invoked function module doesn't need to be known until runtime. This approach lets ABAP/4 function modules be called by desktop applications using PC programming languages like Microsoft's Visual Basic, Borland's Delphi, and Powersoft's Powerbuilder.

R/3 as an OLE Automation Client

R/3 will also present itself as an OLE Automation Client (see Fig. 4). In other words, it will be easy to use the graphical user interface (SAP-GUI) of the R/3 System to access spreadsheets, texts created with word processing systems, and graphics, provided that the programs used to create them behave like OLE Servers. ABAP/4 contains special OLE commands for calling the objects and functions of desktop applications. Commands are included for calling components of the server program (identification), invoking functions of these components, reading and setting their attributes, and releasing the components.

Related Developments

Business APIs (BAPIs)

SAP has set itself the goal of developing libraries of appropriate functions for certain corporate routines. These function libraries will be grouped around special business objects and processes, which is why they are called *Business APIs (BAPIs)*. Each BAPI is modeled in R/3 using a set of ABAP/4 function modules. BAPIs are accessed from the outside using *OLE Automation*,

RFC technology, or *IDOCs* (Intermediate Documents). R/3 itself serves as the OLE Automation Server. BAPIs can be called by other applications, which are so-called OLE Clients. When using IDOCs, the external program sends a standardized intermediate document to R/3. Apart from special-purpose BAPIs, such as certified interfaces to external CAD products or EDI translators, there will also be a number of cross-application functions (e.g. for management of number ranges, units of measurement, etc.).

ALE: Application Link Enabling

ALE is a concept SAP has developed for loose coupling of application systems. In contrast to tight coupling, which uses a central database to ensure data consistency and business integration, in the case of loose coupling it is vital to closely control how messages are exchanged between applications, whether synchronously or asynchronously. An example of a synchronous message exchange is a cross-system credit limit check. In this context, standard intermediate documents (IDOCs) are used to exchange asynchronous messages (e.g. passing of SD billing documents to accounts receivable). Loose coupling of applications offers the following advantages:

■ Individual application systems become technically autonomous, e.g. independently of the release levels installed on other systems. They can temporarily operate on a stand-alone basis.
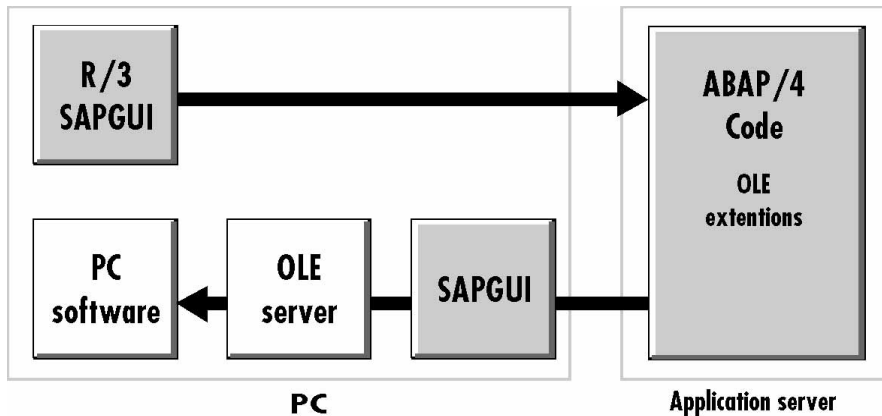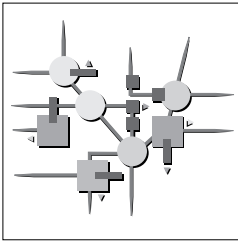
- SAP applications can easily communicate with third-party programs.

- Business processes can be integrated across multiple systems.

The underlying concept involves a three-layer architecture: applications generate ALE messages, distribution services provide functions for loose coupling of business applications (using BAPI techniques), and communication services exchange messages based on standards like X.400/X.500 or EDI.

Desktop Applications Integrated with R/3

Following examples show successful integrations of desktop applications with the R/3 System:

XXL List Viewer

The XXL List Viewer is a spreadsheet-based tool. It retrieves data from R/3 and displays it interactively. In contrast to straightforward file exchanges, it keeps the business meaning of the data intact. To accomplish this, structural information - such as keys, currency information, groupings, and hierarchies - is also transmitted. We have used specially programmed macros and OLE to customize Microsoft Excel so that users can access task-specific screens.

Unit Costing

Customers working with the R/3 modules for unit costing and project planning can employ Microsoft Excel to individually cost business objects such as orders, budgets, building materials, etc. You can either call up Excel from the appropriate business process, or else use it locally. The data is interactively compared with the data stored in the R/3 System in order to ensure consistency. You can use this procedure, for example, to retrieve cost center and pricing information from R/3. Excel itself is divided into a section able to communicate with R/3 and a section for normal calculations (see Figure 5).

Data Entry by Mobile Users for Consolidating Company Information

Companies' divisions and subsidiaries can take advantage of Microsoft Access to enter data of relevance for consolidation. Data stored in Access is later fed into the R/3 System, which consolidates the information for the company as a whole.

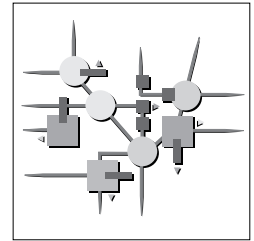## Administration of Travel Expenses for Mobile Users

You can also integrate Microsoft Access for management of travel expenses. In this case, travelers are enabled to enter data while on the road. They can then upload the entered Access data from their laptops to R/3 over phone lines. During transfer, R/3 uses RFC to check the data for consistency, comparing it with already stored travel and personal data. In this case it is important for the user interfaces of the components at both ends to be very similar to one another, as their users will very likely work with both.

Project Management for Mobile Users

We offer our R/3 customers an integrated project system with powerful functionality. Many customers also use Microsoft Project, mainly for on-site project planning. R/3 supports this by letting these project systems exchange data with one another.

Customizing R/3 with Microsoft Word

Online documentation simplifies adaptation of R/3 to the specific needs of each of our customers. We write this documentation using Microsoft Word for Windows. If you work with the ABAP/4 Develop-

ment Workbench, you can also use Word for Windows for this purpose. The created files are stored in the R/3 System to ensure central documentation management, which is a must when developing your own extensions and enhancements to standard R/3 applications. In the final step, the Microsoft Help Compiler generates the help files in the same way as the standard R/3 online documentation. Embedded hypertext references make this documentation very flexible and user-friendly.

Using Excel to Consolidate Business Data

R/3 supports preparation of balance sheets in Microsoft Excel. Consolidation is performed on the basis of R/3 System data. Your comptroller can display this data in Microsoft Excel, which provides flexible handling of main and secondary calculations. Excel can access individual R/3 objects (e.g. a subsidiary's data) or read entire R/3 tables. The spreadsheet values themselves can be moved back to R/3 when they are finished. This gives the comptroller instant access to up-to-date information from R/3, flexible support for preparing balance sheets, and the ability to channel the results of calculations back into the company's business processes.

Displaying Appointment Books

Central storage in the R/3 System lets coworkers view one another's schedules and appointments. This facility has a PC-based user interface programmed in Microsoft Visual Basic and modeled after that of Microsoft Schedule. It lets users enter data flexibly and access data stored by others.
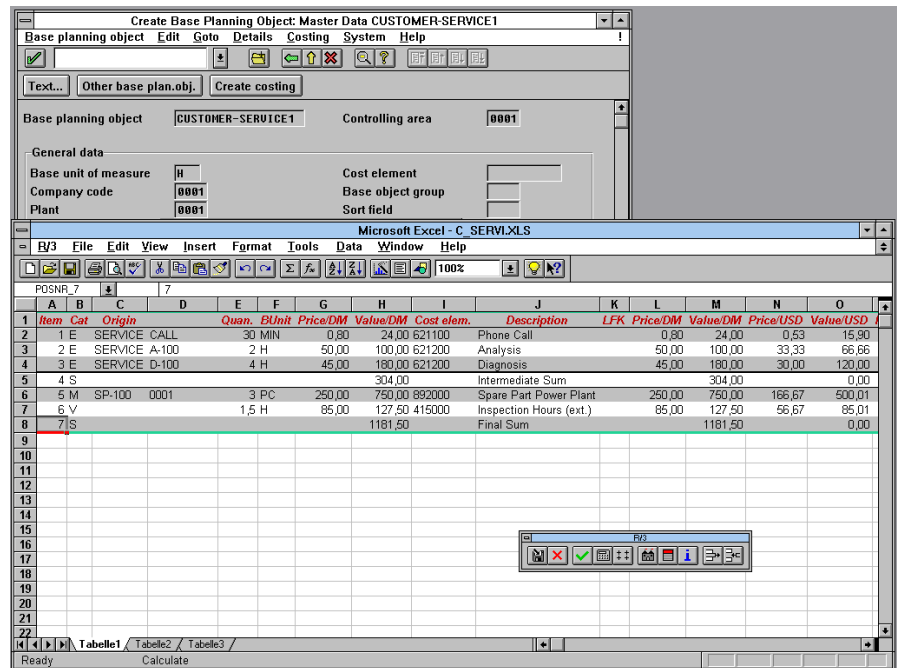

Figure 5: Integration of Microsoft Excel in Unit Costing

Other Applications

PC applications and standard desktop programs play an important role in other applications as well.

- In SAP-EIS, you can use Microsoft Word and XXL List Viewer to prepare reports from R/3 data.

- For effective management of events, you can take advantage of Microsoft Word to write invitations, RSVP notes, and the like.

- Your human resources department can use an integrated Windows program, a product from HQ Interaktive Mediensysteme called "Assessment Excellence", to test and evaluate job applicants. This software prepares tests based on job specifications and personal data; applicants take the tests on PCs. These tests use animation, simulations, and multimedia. Applicants' performance is evaluated not merely based on whether their answers are correct, but also on how they arrived at them. The results are then written back to R/3.

- You can also use Microsoft Word as a tool for processing job applications, for creating form letters, invitations, and many other kinds of documents.

- You can use any PC mail system that conforms to the MAPI standard - e.g. Microsoft Mail - as a front end for the R/3 e-mail system.

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