WOSA

(Windows™ Open Services Architecture)

Extensions for Financial Services

A Client-Server Architecture for
Financial Enterprise Computing under Microsoft® Windows

Application Programming Interface (API)
Service Provider Interface (SPI)

Programmer's Reference

Revision 2.00

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Developed by the members of the Banking Solutions Vendor Council

Revision History:

1.0	May 24, 1993	Initial release of API and SPI specification
1.11	February 3, 1995	Separation of specification into separate documents for API/SPI and service class definitions; with updates
2.00	November 11, 1996	Updated release encompassing self-service environment.

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1. Introduction

This is revision 2.0 of the API/SPI specification for the Windows Open Services Architecture, Extensions for Financial Services (WOSA/XFS). The other relevant specifications are the service class specifications. These specifications are part of the Software Development Kit (SDK), which supplies the components and tools to allow the implementation of compliant applications and services. These specifications are distributed to the financial services community for continuing review and comment, to allow them to provide input to the ongoing enhancement of WOSA/XFS.

Release 2.0 extends the scope of WOSA/XFS to include both the self service/ATM environment as well as the branch environment. The new specification now fully supports cameras, deposit units, identification cards, PIN pads, sensors and indicator units, text terminals, cash dispenser modules and a wide variety of printing mechanisms.

The members of the Banking Solutions Vendor Council encourage banks and other financial service companies world-wide, as well as other technology suppliers, to get updated information on the status of the project, and to submit comments, questions and requests for the specification and SDK. This may be done via one of the council members or via the Microsoft web site :

www.microsoft.com/industry/bank.

The Banking Solutions Vendor Council is accepting applications for affiliate membership; interested parties should contact one of the council members or send email to bsvc@microsoft.com.

1.1 Background

The Banking Solutions Vendor Council, an organization of leading vendors of information technology to the financial services industry, was formally announced at the American Bankers Association National Operations and Automation Conference (NOAC) in Denver on May 18, 1992. Revision 1.0 of this specification was released at NOAC in New Orleans on May 24, 1993.

The current charter members of the Banking Solutions Vendor Council are:

- Digital Equipment Corporation
- ICL Plc
- Microsoft Corporation
- NCR Corporation
- Nexus Software Incorporated
- Ing. C. Olivetti & C. S.p.A.
- Siemens Nixdorf Informationssysteme AG
- Retail Management Solutions
- Unisys Corporation

The Banking Solutions Vendor Council has held many multi-vendor development meetings, in addition to numerous additional hours invested in defining this specification for the WOSA Extensions for Financial Services.

1.2 Strategies

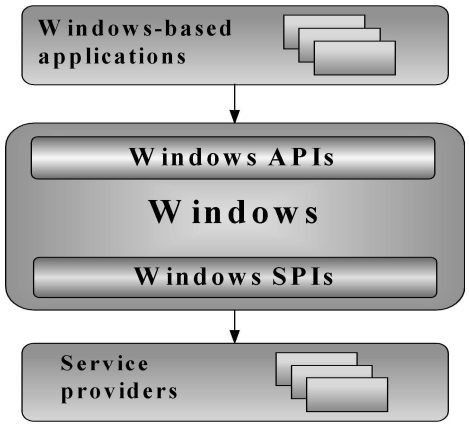
The following key strategies have been adopted by the Banking Solutions Vendor Council to implement the objectives defined above:

- Use the Microsoft® Windows™ operating systems family as the strategic platform for client-server computing.
- Adopt the Windows Open Service Architecture (WOSA) family of open interfaces and associated services for the integration of Windows and Windows-based applications into enterprise computing solutions.
- Utilize existing WOSA elements wherever possible, defining new elements, or extensions to existing elements, only when no suitable candidate(s) exist in the evolving WOSA family that meet the needs of financial services computing. In all cases, existing formal or de facto standards will be utilized to the maximum degree possible.
- Enhance WOSA with the Extensions for Financial Services to meet the special requirements of financial applications for access to services and devices.
- Maintain the highest possible level of compatibility of both the API and SPI specifications as the Extensions for Financial Services evolve to include new and enhanced capabilities.

WOSA comprises a family of stable, open-ended interfaces for enterprise computing environments that hides system complexities from users and application developers. WOSA allows the integration of Windows and Windows-based applications seamlessly with all the services and enterprise capabilities that application developers and users need. It includes such interfaces as:

- Open Database Connectivity (ODBC) for standard access to databases,
- Messaging Application Programming Interface (MAPI) for standard access to messaging services, and
- communications support, including Windows SNA, RPC, and Sockets.

Each of the elements of WOSA includes a set of Application Program Interfaces (APIs) and Service Provider Interfaces (SPIs), with associated supporting software. The architecture of WOSA is shown below:



WOSA: Windows Open Services Architecture

For additional information on WOSA, see the *WOSA Backgrounder* (Microsoft part number 098-34801).

The Extensions for Financial Services extend WOSA by defining a Windows-based client-server architecture for financial applications. The extensions (as with the other elements of WOSA) include a set of APIs and SPIs common to multiple financial applications.

The WOSA Extensions for Financial Services are planned to include specifications for access to financial peripherals (such as passbook/journal/receipt printers, magnetic card readers/writers, PIN pads, etc.), financial transaction messaging and management, as well as related services for financial networks such as network and systems management and security. All these capabilities are specified for access from the familiar, consistent Microsoft Windows user interface and programming environments. Whenever possible, the capabilities will be incorporated into the family of standard WOSA elements, and will utilize existing formal and de facto standards.

2. WOSA Extensions for Financial Services Overview

A key element of the Extensions for Financial Services is the definition of a set of APIs, a corresponding set of SPIs, and supporting services, providing access to financial services for Windows-based applications. The definition of the functionality of the services, of the architecture, and of the API and SPI sets, is outlined in this section, and described in detail in Sections 5 through 10.

The specification defines a standard set of interfaces such that, for example, an application that uses the API set to communicate with a particular service provider can work with a service provider of another conformant vendor, without any changes.

The specification is intended to be usable within all implementations and versions of the Windows operating systems, from Windows version 3.1, Windows for Workgroups version 3.1 and the initial versions of Windows NT, and onwards. It thus provides for both 16 and 32 bit operating environments (operating under the Win32s subsystem in 16 bit environments).

Although the WOSA Extensions for Financial Services define a general architecture for access to service providers from Windows-based applications, the initial focus of the Banking Solutions Vendor Council has been on providing access to peripheral devices that are unique to financial institutions. Since these devices are often complex, difficult to manage and proprietary, the development of a standardized interface to them from Windows-based applications and Windows operating systems can offer financial institutions and their solution providers immediate enhancements to productivity and flexibility.

2.1 Architecture

The architecture of the WOSA Extensions for Financial Services (WOSA/XFS) system is shown below.

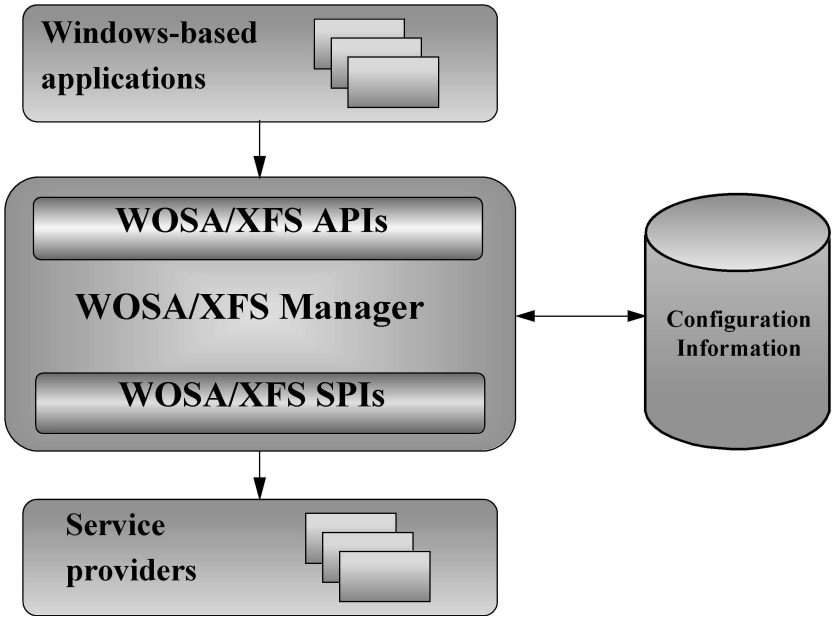


Figure 2.1 — WOSA Extensions for Financial Services Architecture

The applications communicate with service providers, via the WOSA Extensions for Financial Services Manager, using the API set. Most of these APIs can be invoked either "synchronously" (the Manager causes the application to wait until the API's function is completed) or "asynchronously" (the application regains control immediately, while the function is performed in parallel).

The common deliverable in all implementations of this WOSA Extensions for Financial Services specification is the WOSA Extensions for Financial Services Manager, which maps the specified API to the corresponding SPI, then routes this request to the appropriate service provider. The Manager uses the configuration information to route the API call (made to a "logical service" or a "logical device") to the proper service provider entry point (which is always local, even though the device or service that is the final target may be remote). Note that even though the API calls may be either synchronous or asynchronous, the SPI calls are always asynchronous.

The developers of financial services to be used via XFS and the manufacturers of financial peripherals will be responsible for the development and distribution of service providers for their services and devices. A setup routine for each device or service will also be necessary to define the appropriate configuration information. This information will allow an application to request capability and status information about the devices and services available at any point in time.

The primary functions of the service providers are to:

- Translate generic (e.g., forms-based) service requests to service-specific commands.
- Route the requests to either a local service or device, or to one on a remote system, effectively defining a peer-to-peer interface among service providers.
- Arbitrate access by multiple applications to a single service or device, providing exclusive access when requested.
- Manage the hardware interfaces to services or devices.
- Manage the asynchronous nature of the services and devices in an appropriate manner, always presenting this capability to the XFS Manager and the applications via Windows messages.

The system design supports solution of complex problems, often not addressed by current systems, by providing for maximum flexibility in all its capabilities:

- Multiple service providers, developed by multiple vendors, can coexist in a single system and in a network.
- The service class definition is based on the logical functionalities of the service, with no assumption being made as to the physical configuration. A physical device that includes multiple distinct physical capabilities (referred to as a "compound device" in this specification) is treated as several logical services; the service provider resolves any conflicts. Note also that a logical service may include multiple physical devices (for example, a cash dispenser consisting of a note dispenser and coin dispenser).
- Similarly, a physical device may be shared between two or more users (e.g., tellers), and the physical device synchronization is managed at the service provider level.
- The API definition and associated services provide time-out functionality to allow applications to avoid deadlock of the type that can occur if two applications try to get exclusive access to multiple services at the same time.
- The architecture is designed to provide a framework for future development of network and system monitoring, measurement, and management.

Note that Figure 2.1 is a high level view of the architecture and, in particular, it makes no distinction between service providers and the services they manage. This specification focuses on service providers rather than on services, because the way a service provider communicates with a service is a vendor-specific internal design issue that applications and the XFS Manager are unaware of. In fact, there are many different ways that service providers can make services available to applications. Hence, this specification refers primarily to the service providers, since these are the modules with which the XFS Manager communicates. There are occasional references to 'service' where this is appropriate.

Example

Figure 2.2 below shows a WOSA/XFS system supporting a set of financial peripherals. Note that in this framework the XFS Manager interfaces directly with a set of service providers that interface directly with the physical devices. Thus, the service providers are shown as implementing the service provider, service, and device driver functions, although these are more likely to be two or more separate layers. Many other configurations are possible.

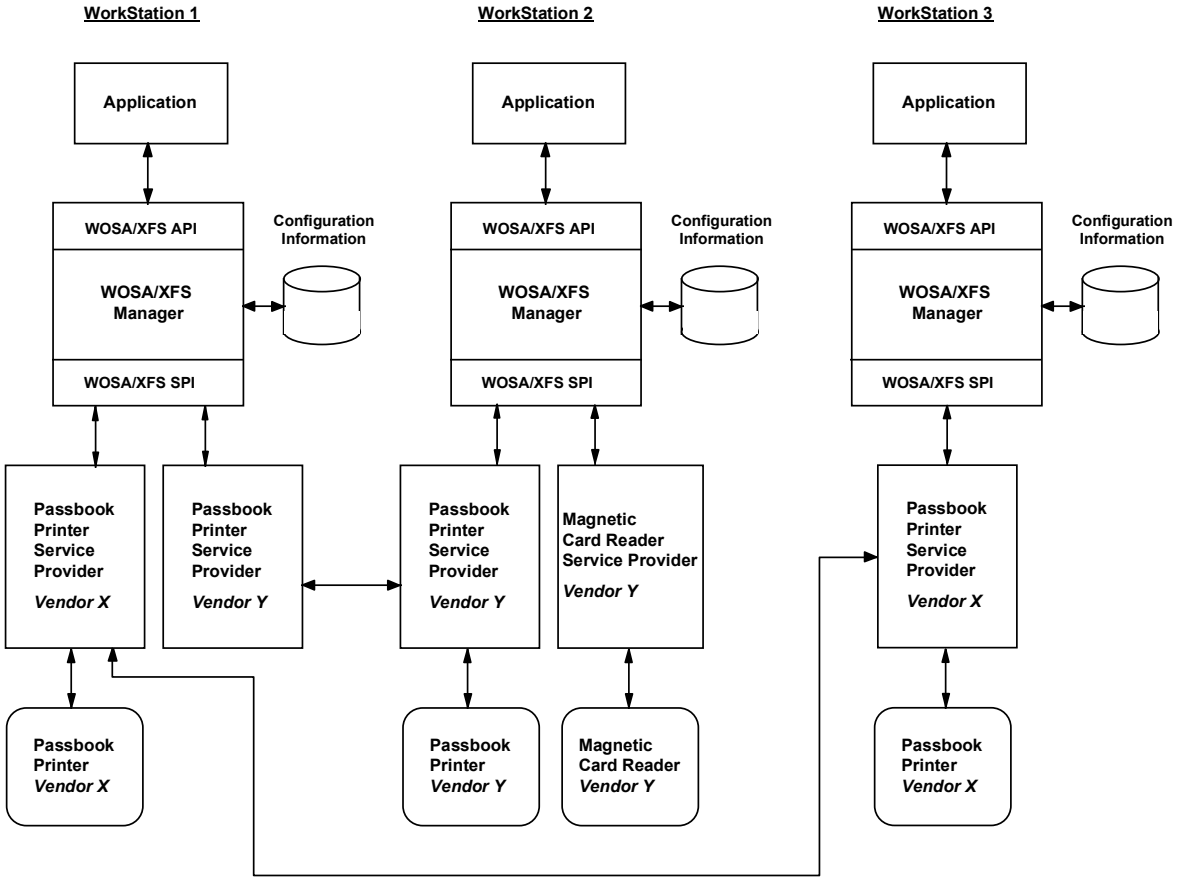


Figure 2.2 — A WOSA/XFS architecture example for a branch office banking system

It should also be noted that one vendor's service providers are not necessarily compatible with another vendor's, as shown in Figure 2.2. If one application has to access the same service class as implemented by different vendors, a service provider is installed for each vendor.

2.2 API and SPI Summary

Sections 5 through 7 of this document present the interfaces that allow a financial application to communicate in a standard fashion with financial services and devices. The functions are at a sufficiently high level to allow for seamless redirection to other parts of the underlying operating system. A printer, for example, might rely on a set of services provided by the operating system, but in order to handle the unique characteristics of a financial printer and application, the service provider would preprocess the command, then redirect the derived commands to the operating system's printing services. In other implementations, the printer might be supported entirely by WOSA/XFS service mechanisms, and not use the operating system printing services in any way.

The API is structured as sets of:

- **Basic functions**, such as **StartUp**/**CleanUp**, **Open**/**Close**, **Lock**/**Unlock**, and **Execute**, that are common to all the WOSA Extensions for Financial Services device/service classes,
- **Administration functions**, such as device initialization, reset, suspend or resume, used for managing devices and services, and
- **Specific commands**, used to request information about a service/device, and to initiate device/service-specific functions; these are sent to devices and services as parameters of the **GetInfo** and **Execute** basic functions. These service-specific commands are specified in a set of separate specifications, one for each service class.

To the maximum extent possible, the syntax of specific commands that are used with multiple device/service classes is kept consistent across all devices. A primary objective is to standardize function codes and structures for the widest possible variety of devices.

The SPI is kept as similar as possible to the API. Some commands are processed exclusively by the XFS Manager, and so are not in the SPI, and there are minor differences in the specific parameters passed at the two interface levels.

A typical scenario showing the usage of the APIs is shown below. This example illustrates the functions used to print a form.

- **StartUp** (connects the application to the XFS Manager, including version negotiation)
  - **Open** (establishes a session between the application and the service provider)
    - **Register** (specifies the messages that the application should receive from the service provider)
    - **Lock** (obtains exclusive access to the service by the application)
      - multiple **Execute** functions, passing one or more specific commands:
        - **Print_Form**
        - etc.
    - **Unlock** (releases exclusive access to the service by the application)
    - **Deregister** (specifies that the application should no longer receive messages from the service provider)
  - **Close** (ends the session between the application and the service provider)
- **CleanUp** (disconnects the application from the XFS Manager)

Note that within a session (defined by **Open** and **Close**), an application may at any time change the classes of messages it wishes to receive from the service provider (using **Register**), and may either **Lock** the service only for specified periods (typically for each transaction), or for the entire session. Also, note that several of the commands are optional, depending on how the device is being managed and shared (i.e., **Lock**/**Unlock**, **Register**/**Deregister**).

2.3 Device Classes

The classes of devices that belong to the second version of the WOSA Extensions for Financial Services are described in the separate Service Class Definition Document.

3. Architectural and Implementation Issues

The remainder of this document provides the technical specifications for the Windows Open Services Architecture (WOSA) Extensions for Financial Services (referred to hereafter as "WOSA/XFS" for brevity).

In this specification, the functions of the WOSA/XFS Application Programming Interface (API) and Service Provider Interface (SPI) are always described in terms of providing a standardized, portable interface for applications to gain access to service providers. This architecture allows service providers to deliver an open-ended set of capabilities to financial applications based on the Microsoft Windows operating systems, including access to peripheral devices unique to financial institutions. Since the first priority of the BSVC members for WOSA/XFS implementations will be to provide this peripheral device access capability, the examples used relate primarily to device control and physical input/output.

The key elements of the Extensions for Financial Services are the API definition and the corresponding SPI definition, used by the XFS Manager to communicate with the service providers, together with the set of supporting services provided by the XFS Manager. These elements are combined in a WOSA/XFS implementation, providing access to financial devices and services for Windows-based applications.

The specification defines a standard set of interfaces in order to provide multi-vendor interoperability: if an application uses the API to communicate successfully with a service provider, it should work with another conformant service provider of the same type, developed by another vendor, without any changes. Similarly, any service provider that conforms to the SPI definition can work with a range of conformant applications.

The specification is intended to be usable within all implementations and versions of the Windows operating systems, beginning with versions 3.1 of Windows, Windows for Workgroups, and Windows NT, and all future versions of these operating systems. In the 16 bit operating systems (Windows 3.x, Windows for Workgroups 3.x) the elements of an XFS subsystem (applications, XFS Manager, and service providers) will be 32 bit modules, implemented using the Win32s API. The specification thus provides for the development and deployment of 32 bit applications on both 16 and 32 bit operating systems, and the WOSA/XFS software development kit will include versions of the XFS Manager and associated programming aids that will allow development of applications and service providers for both environments.

For clarity, three prefixes are used in naming the function interfaces in WOSA/XFS:

Function type: Prefix	Functions called by	Functions provided by
• API functions: **WFS...** (**W**OSA **F**inancial **S**ervices)	• Applications	• XFS Manager (and typically passed through to **WFP** functions)
• SPI functions: **WFP...** (**W**OSA **F**inancial Services **P**roviders)	• XFS Manager	• Service providers
• Support/Configuration functions: **WFM**... (**W**OSA **F**inancial Services **M**anager)	• Service providers • Applications	• XFS Manager

3.1 The XFS Manager

The XFS Manager provides overall management of the WOSA/XFS subsystem. The XFS Manager is responsible for mapping the API (**WFS...**) functions to SPI (**WFP...**) functions, and calling the appropriate vendor-specific service providers. Note that the calls are ***always*** to a local service provider.

The XFS Manager determines which service provider to call using the logical name parameter of the WFSOpen or WFSAsyncOpen function. The logical name is the key providing access to the configuration information that defines the Service Class (e.g., printer, cash dispenser, etc.), the Service Type (e.g., receipt printer, journal printer, etc.) and the Service Provider (DLL file name), as well as additional information. The logical name must be unique at least within each workstation. See Sections 3.7 and 7 for discussions of configuration information access and management.

The XFS Manager also provides the Support Functions (**WFM...**) defined in Section 6 and the Configuration Functions (also **WFM...**) defined in Section 7.

Before an application is allowed to utilize any of the services managed by the WOSA/XFS subsystem, it must first identify itself to the subsystem. This is accomplished using the **WFSStartUp** function. An application is only required to perform this function once, regardless of the number of WOSA/XFS services it utilizes, so this function would typically be called during application initialization. Similarly, the complementary function, **WFSCleanUp**, is typically called during application shutdown. If an application exits or is shut down without issuing the **WFSCleanUp** function, the XFS Manager does the cleanup automatically, including the closing of any sessions with service providers the application has left open.

3.2 Service Providers

Each WOSA/XFS service, for ***each*** vendor, is accessed via a service-specific module called a service provider. For example, vendor A's journal printer is accessed via vendor A's journal printer service provider, and vendor B's receipt printer is accessed via vendor B's receipt printer service provider.

The following sections describe the functionality and packaging of service providers.

3.2.1 Service Provider Functionality

The primary functions of WOSA/XFS service providers, working in conjunction with their respective services and/or device drivers, are as follows. Note that ***how*** these functions are implemented is left to the service provider developer.

- Route the requests to the device or service, which may be on a remote workstation.
  Service providers may communicate with remote services in a variety of ways, such as NetBIOS, named pipes, RPC (Remote Procedure Calls), Windows Sockets, proprietary network programming interfaces, etc.

- Translate the generic requests to resource specific commands.
  Note that this involves translation not just to service-specific commands, but to the commands native to the resource being used. For example, the commands would not be translated to "Receipt Printer Service" commands, but to "Brand X, Model Y Receipt Printer" commands. For example, a driver may implement device-specific translation tables or processes itself, or utilize standard operating system device interfaces (such as the Windows GDI), if they exist for the particular peripheral.

- Arbitrate access to the resource by multiple applications.
  Note that when a physical device includes multiple peripherals (for example, a receipt and journal printer in a single unit), this may also include arbitration of the sub-devices.

- Manage the interface to the resource.
  When physical devices are being controlled, this includes managing the hardware interface to the device. For example, the service providers may use standard operating system device drivers, vendor-written proprietary device drivers, etc.

- Manage the asynchronous nature of the services in a consistent manner with respect to the applications.
  The asynchronous nature of the SPI must always be presented back to the XFS Manager and the applications in the form of Windows messages, as in other WOSA components such as the Windows Sockets or Windows SNA APIs.

- Error recovery.
  In some kinds of software failures, such as an application crash, the service provider loses connection with the application. In this situation, the service provider is responsible for an “orderly” shutdown of the session with that application. In particular, the service provider generates a system event (see Section 3.11) indicating that the connection was lost, and if any requests from the application were outstanding, it generates a system event for each completion that would normally have generated a completion message to the application.

3.2.2 Service Provider “Packaging”

WOSA/XFS service providers can be “packaged” into DLLs in a variety of ways:

- One service provider per DLL; for example, a vendor might produce a journal printer DLL, a receipt printer DLL, a cash dispenser DLL, etc.

- Multiple service providers per DLL; for example a vendor might produce a DLL which contains the service providers for all XFS-compliant printers.
- All service providers for a specific vendor in a single DLL.

3.3 Asynchronous, Synchronous and Immediate Functions

Windows and WOSA/XFS are built on an event-driven, asynchronous model. However, the WOSA/XFS design allows an application using its interfaces to behave in either an asynchronous or synchronous manner. Thus the API supports two versions of each of the appropriate functions (e.g., an application can request to lock a service using either the asynchronous **WFSAsyncLock** function or the synchronous **WFSLock** function).

Each WOSA/XFS API function operates in one of three synchronization modes: asynchronous, synchronous or immediate. These are described in the following sections.

Note that the SPI is purely an asynchronous interface, so all SPI functions are either asynchronous or immediate; there are no synchronous SPI functions.

See Sections 4 and 5 for a summary of the API and SPI functions and their synchronization modes.

3.3.1 Asynchronous Functions

Asynchronous mode is used for operations which may take an indeterminate amount of time to complete. Performing an operation in an asynchronous, as opposed to a synchronous, mode allows the application to operate in Windows' native event-driven, message-based manner. The processing of an asynchronous request (e.g., **WFSAsyncExecute)** is as follows:

- The application calls the XFS Manager.
- The XFS Manager generates a sequence number, the *RequestID*, assigns it to the request, and calls the service provider.
- The service provider schedules the request for deferred processing and immediately returns to the XFS Manager.
- The XFS Manager returns the *RequestID* to the application, with a status indicating that the request has been initiated and is being processed.
- At some point, the service provider processes the deferred request.
- On completion, the service provider posts a completion message to the window handle specified by the application in its original call. (For flexibility, an application using asynchronous functions can specify a different window for each request.) The message contains a pointer to a WFSRESULT data structure defining the results of the request, including the *RequestID*, the status code and the other relevant data.

3.3.2 Synchronous Functions

Synchronous mode is also used when an operation can take an indeterminate amount of time to complete, but the application wishes to handle the function in a sequential manner. The XFS Manager does not return control to the application until the operation has completed, thus synchronous functions are referred to as blocking. Each synchronous call made by an application is translated by the XFS Manager into its asynchronous SPI counterpart before being passed to the service provider.

If a blocking operation is not completed immediately in a Windows 3.x system, the XFS Manager executes a Windows message loop on behalf of the calling thread, thereby keeping the Windows system running. See Section 3.12 for a more detailed discussion of process, threads and message loops. In Windows NT, the calling application thread is blocked on request completion. A thread may have only ***one*** blocking WOSA/XFS call outstanding at any one time. See Section 3.12 for additional discussion of the management of synchronous functions, including replacement of the default message loop.

The processing of a synchronous request (e.g., **WFSExecute)** is as follows:

- The application calls the XFS Manager.
- The XFS Manager translates the request into an asynchronous SPI, generates a *RequestID* to track the request, provides its own window handle to receive the completion message, and calls the service provider DLL.

- The service provider schedules the request for deferred processing and immediately returns to the XFS Manager.
- The XFS Manager simulates synchronous processing as described above and in Section 3.12.
- At some point, the service provider processes the deferred request.
- On completion, the service provider posts a completion message to the window handle specified by the XFS Manager. The message contains a pointer to a WFSRESULT data structure defining the results of the request, including the *RequestID*, the status code and the other relevant data.
- The XFS Manager unpacks the information from the completion message into the appropriate parameters, and returns them to the application, unblocking the original application request.

3.3.3 Immediate Functions

These are API functions that are not either asynchronous or synchronous. Typically, immediate APIs are those which do not communicate with a service or a physical device (or use the network in any other way) and are thus guaranteed to complete immediately, whether successfully or not. They are handled in two ways:

- Processed entirely by the XFS Manager, which returns immediately to the application. Examples include **WFSStartUp**, and **WFSSetBlockingHook**.
- Passed by the XFS Manager to the service provider as an immediate SPI. The service provider processes the request and immediately returns to the XFS Manager, which returns immediately to the application. Examples include **WFSCancelAsyncRequest** and **WFMSetTraceLevel**.

3.4 Processing API Functions

When an application calls a WOSA/XFS API function one of the following processing scenarios takes place. Note that this classification is distinct from the API synchronization modes discussed above. See Section 5 for the mapping of API functions to SPI functions.

- The function is converted by the XFS Manager directly into the corresponding SPI function (e.g., **WFSAsyncRegister**).
- The XFS Manager performs some preprocessing and then converts the function into the corresponding SPI function (e.g., **WFSAsyncExecute**).
- The XFS Manager performs some preprocessing and then translates the API function to a different SPI function, which it passes to the service provider. Most of the synchronous API functions (e.g., **WFSLock**) are of this type, since they are translated to their asynchronous SPI equivalents.
- The XFS Manager performs some preprocessing and then translates the API function to multiple SPI functions, which it passes to the service provider (e.g., **WFSOpen**).
- The function is completely processed inside the XFS Manager (e.g., **WFSIsBlocking, WFSSetBlockingHook**).

Service providers (and sometimes applications) call the XFS Manager for the support functions defined in Section 6 and for the configuration functions defined in Section 7.

3.5 Opening a session

Once a connection between an application and the XFS Manager has successfully been negotiated (via **WFSStartUp**), the application establishes a virtual session with a service provider by issuing a **WFSOpen** (or **WFSAsyncOpen)** request. Opens are directed towards "logical services" as defined in the WOSA/XFS configuration. A service handle (*hService*) is assigned to the session, and is used in all the calls to the service in the lifetime of the session.

Note that applications may optionally choose to explicitly manage the concept of "application identity" when they need to use interdependent compound devices (see Section 3.8.2). This is achieved by using the **WFSCreateAppHandle** function to get an application handle (*hApp*), which is unique within the system. This function can be called multiple times to obtain multiple unique handles. An application handle parameter is then used in the **WFSOpen** function, directing the service provider to bind the specified application handle to the session being initiated. This allows a single application process (potentially multi-threaded) to act as multiple applications to the WOSA/XFS subsystem, to allow effective use of interdependent compound devices. An example of a case in which this could be useful is an application using the Multiple Document Interface (MDI); the application could associate an application handle with each MDI child window. See Section 3.8.2 for

additional discussion of the use of application handles with compound devices. Note that neither service nor application handles may be shared among two or more applications.

The actions performed by the XFS Manager on an open are as follows:
- Retrieves the configuration information defining the specified logical service, in order to determine the DLL name of the service provider. The logical service name is the key to the configuration information.
- Loads the DLL containing the requested service provider, if it is not already loaded.
- Performs pre-processing and translation as necessary, depending on whether the synchronous or asynchronous open API has been issued.
- Generates a unique service handle (*hService*) that identifies the session with the service provider that is being established, to be passed back to the application as a parameter.
- Calls the service provider's **WFPOpen** function, passing the parameters needed.

The service provider does the following:
- Performs version negotiation, using the parameters specifying the SPI version requested by the XFS Manager, and the service-specific interface version requested by the application.
- Retrieves the configuration information.
- Asynchronously establishes a session with the service specified in the configuration on the specified workstation, if necessary, relying on the transport facilities provided.
- Upon completion of the request, posts a completion message (WFS_OPEN_COMPLETE), which goes to the application for a **WFSAsyncOpen** call, and to the XFS Manager for a **WFSOpen** call.

Note that even if the service is locked by another application, the open function succeeds, as defined in Section 3.8, “Exclusive Service and Device Access.”

An application programmer has at least two obvious choices as to when to perform the **WFSOpen** (and the complementary **WFSClose**) of the services it utilizes:
- Open the services during application initialization, keep them open, and close them during application shutdown.
- Perform the open each time the service is required, utilize it, and immediately close it.

Each technique has its own advantages. For example, while the first example might provide better performance, the second might be easier to program. In any case, upon a successful completion of an open, the WOSA/XFS subsystem returns a service handle which must be used for all subsequent communication with the service.

Note that an application must perform an open for ***each*** logical service that it wishes to utilize, even if the services are of the same type. For example, if an application wishes to utilize two separate receipt printers, it must open two separate logical services.

Furthermore, an application may need to open multiple logical services, even when a set of devices are housed in a single device. For example, consider a compound printer which includes both a receipt and a journal printer. If the application requires access to both the receipt and journal printer functions, it must open both a receipt logical service and a journal logical service.

3.6 Closing a Session

When an application no longer requires the use of a particular service, it issues a **WFSClose** or **WFSAsyncClose** request. The WOSA/XFS subsystem then closes that session as follows:
- The XFS Manager calls the service provider's **WFPClose** function.
- The service provider schedules the request for deferred processing, and returns immediately to the XFS Manager. Note that at this point the service handle, *hService*, is no longer valid.
- At some point, the service provider processes the deferred close request, communicating with the service as necessary to accomplish the request.
- Requests that were issued by the application before the close are executed.
- If the calling application has the service locked under the same *hService*, the service provider unlocks it automatically (following the standard lock policy as defined in Section 3.8).
- The service cleans up its administrative information (removes **WFSRegister** entries etc.).

If the WOSA/XFS subsystem loses connection to an application, it closes the session as described above, and:

- An “application disconnect” event (SYSTEM_EVENT class) is generated.
- Since messages can no longer be posted to the application, any command completion and event notification messages from this service for the application are converted to “undeliverable message” events (SYSTEM_EVENT class).

Note that it is required that some application have registered for system events, or these events are effectively not reported.

3.7 Configuration Information

The XFS Manager uses its configuration information to define the relationships among the applications and the service providers. In particular, this information defines the mapping between the logical service interface presented at the API (via logical service name) and the appropriate service provider entry points.

The configuration information also includes specific information about logical services and service providers, some of which is common to all solution providers; it may also include information about physical services, if any are present on the system, and vendor-specific information. The location of the information is transparent to both applications and service providers; they always store and retrieve it using the configuration functions provided by the XFS Manager, as described in Section 7, for portability across Windows platforms.

It is the responsibility of solution providers, and the developers of each service provider, to implement the appropriate setup and management utilities, to create and manage the configuration information about the XFS subsystem configuration and its service providers, using the configuration functions.

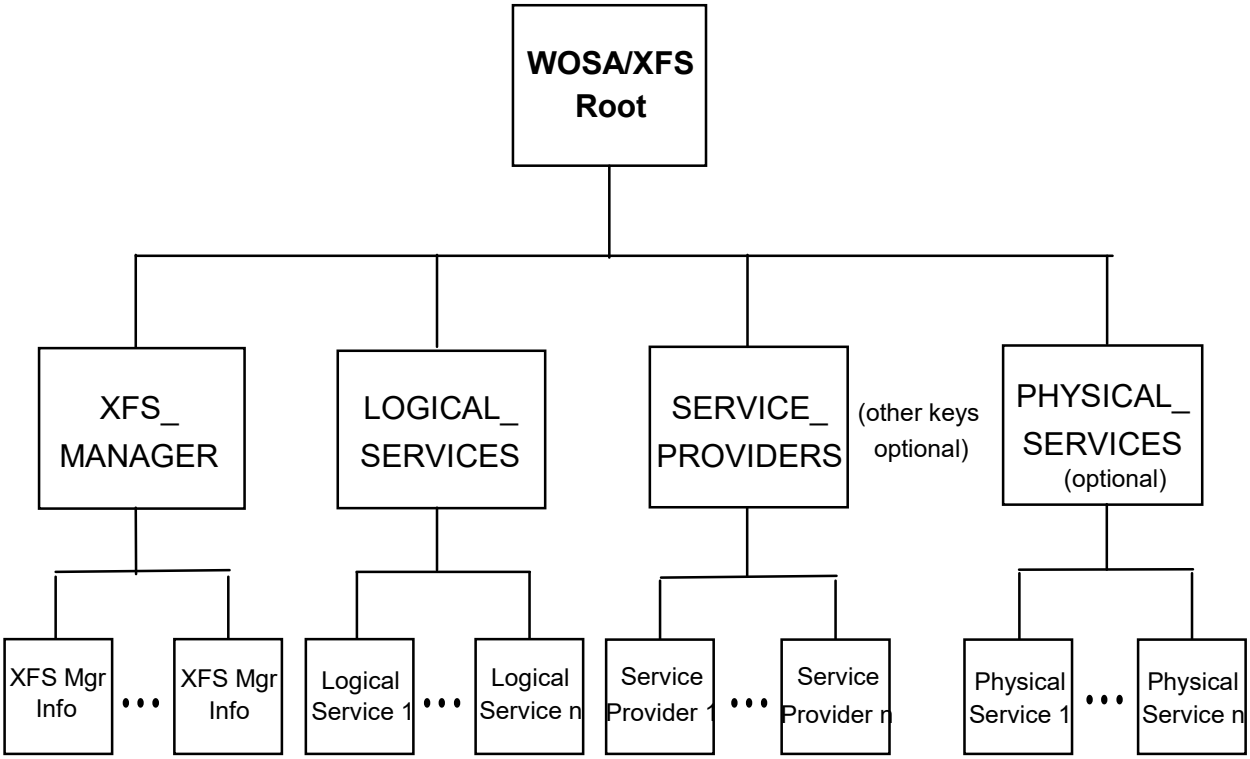
These functions are used by service providers and applications to write and retrieve the configuration information for a WOSA/XFS subsystem, which is stored in a hierarchical structure called the XFS configuration registry. The structure and the functions are based on the Win32 Registry architecture and API functions, and are implemented in Windows NT and future versions of Windows using the Registry and the associated functions. For Win32s-based implementations on Windows 3.1 and Windows for Workgroups, a subset of the functionality described here will be available; the SDK will define this subset.

Each node in the configuration registry is called a key, each having a name and (optionally) values. All values consist of a name and data pair, both null-terminated character strings. The structure is as follows:

(1) The top level is the root node for the WOSA/XFS subsystem. Its key name is WOSA/XFS_ROOT (it is a subkey of HKEY_CLASSES_ROOT in the Win32 Registry).
(2) The second level contains at least three keys: XFS_MANAGER, LOGICAL_SERVICES, and SERVICE_PROVIDERS. Other keys (e.g., PHYSICAL_SERVICES) may be defined and used as required.
(3) Below the XFS_MANAGER key there are values and/or keys for information that the XFS Manager creates and uses.
(4) Below the LOGICAL_SERVICES key there is a key for each logical service defined for the system on which the registry resides; the key names are the logical service names (the *lpszLogicalName* parameter of the **WFSOpen**, **WFSAsyncOpen** and **WFPOpen** functions). Since there is only one registry per workstation, this enforces the requirement that logical service names are unique within at least the workstation.
(5) Below the SERVICE_PROVIDERS key there is a key for each service provider defined for the system.

The configuration functions provide the capabilities to create, enumerate, open and delete keys, and to set, query and delete values within each key. Vendor-provided configuration utility programs set up the registry structure and its contents, using these functions. The third level contains the values and keys that define how the XFS subsystem, services and providers are configured. These are used by the XFS Manager, applications and service providers. Note that vendor-specific information may be added to any key in this structure, using optional values.

The figure below illustrates the structure of the configuration registry:



The XFS Manager key has the following optional values:

- TraceFile — the name of the file containing trace data. If this value is not set in the configuration, trace data is written to the default file path\name C:\XFSTRACE.LOG.
- ShareFilename — the name of the memory mapped file used by the memory management functions of the XFS Manager.
- ShareFilesize — the size of the memory mapped file used by the memory management functions of the XFS Manager.

Some additional values could be also defined in the WOSA/XFS SDK release notes. Please refer to the related document for more information.

Every logical service key has three mandatory values:

- class — the service class of the logical service; (see the Service Class Definition Document for the standard values)
- type — the service type of the logical service; the standard values for service type are defined in the WOSA/XFS software development kit SDK
- provider — the name of the service provider that provides the logical service (the key name of the corresponding service provider key)

A service provider key also has three mandatory values:

- dllname — the name of the file containing the service provider DLL
- vendor_name — the name of the supplier of this service provider

- version the version number of this service provider

An example of the content of the configuration information for an actual system is shown below. See Section 7 for the definitions of the configuration functions.

WOSA/XFS Registry Root	Second Level Keys	Third Level Keys (or values)	Values
WOSA/XFS_ROOT			
	XFS_MANAGER		
			TraceFile=<path-name>\<trace-file-name> ShareFilename=<path-name>\<share-file-name> ShareFilesize=<file size in bytes>
	LOGICAL_SERVICES		
		Passbook1	
			class=PTR type=PASSBOOK provider=Passbook_Receipt operator_station=1 input_paper_source=upper < other optional values >
		Receipt1	
			class=PTR type=RECEIPT provider=Passbook_Receipt < optional values >
		Journal1	
			class=PTR type=JOURNAL provider=Journal < optional values >
		ATSafe1	
			class=CDM type=ATSAFE provider=Cash_Dispenser < optional values >
		< other srvcs >	
	SERVICE_PROVIDERS		
		Cash_Dispenser	
			dllname=CASHDISP.DLL vendor_name=Big Bank , Inc. version=3.50 < optional values >
		Passbook_Receipt	
			dllname=RPPRNTR.DLL vendor_name=Code “R Us, Ltd. version=1.30 < optional values >
		Journal	
			dllname=JOURNAL.DLL vendor_name=Nobugs Systems version=2.01 < optional values >
		< other prvdrs >	
	< other keys >		

3.8 Exclusive Service and Device Access

This section describes how application access to services and devices is handled by WOSA/XFS subsystems, using the lock facility. It discusses the meaning of timers within the context of a lock request and issues that arise when multiple applications have issued lock requests. It also describes how requests that were submitted to the service provider prior to a lock request are managed. Furthermore, it describes how compound devices (physical devices that include two or more logical devices, such as a passbook printer that also includes a magnetic stripe reader) are handled.

Typically, an application requires ***exclusive*** access to a particular service when it is about to utilize it, particularly in combination with other services. For example, an application may need to use a PIN pad, magnetic stripe reader, receipt printer and journal printer to complete a transaction. The application must be guaranteed that it has access to ***all*** the devices before starting on the transaction, and that no other application will be able to use them until the transaction is complete and it has explicitly released them. This is accomplished by using the **WFSLock** (or **WFSAsyncLock**) function and the complementary **WFSUnlock** function.

An application should act in a cooperative manner when locking a service, by keeping it locked for the minimum time period that it requires exclusive access to the service. Typically, this means locking a set of services, performing a series of requests to the services to complete a transaction, and immediately unlocking the services.

Applications must use appropriate techniques to avoid deadlock when locking multiple services, typically by making use of the timeout parameter in the lock functions.

Also, note that there are cases in which exclusive access is not a requirement, so that it is not always required that an application lock a service before issuing execute operations to it.

The lock policy describes the rules that services use in managing lock requests. In the description of this policy, XFS requests are categorized into three types:

- **Non-deferred**: Requests that can be processed completely by a service as soon as they arrive (e.g., **WFPOpen**, **WFPRegister** and most **WFPGetInfo** calls.
- **Deferred**: Requests which may not be able to be processed completely as soon as they arrive, typically because they require hardware and/or operator interaction (e.g., **WFPExecute** and some **WFPGetInfo** calls).
- **Lock**: **WFPLock** calls.

The lock policy is described first for independent devices, i.e., logical services that correspond to devices whose operation is not interdependent with any other (even though they may be housed in the same physical enclosure). The following section describes the special requirements involved in managing compound interdependent devices.

3.8.1 Lock Policy for Independent Devices

The following describes how the categories of requests are handled, in each of the lock states of a service. Note that although the description refers to queues and other implied implementation characteristics, this is only for convenience; no particular implementation techniques are required.

Service state: UNLOCKED

- Non-deferred requests are processed on arrival.
- Deferred requests are placed in the deferred queue and processed FIFO.
- When a **WFPLock** request arrives:
  - The lock request is placed in the lock queue.
  - The service state changes to LOCK_PENDING.

Service state: LOCK_PENDING

- All requests in the deferred queue that arrived ***before*** the pending lock request are processed FIFO; after all are processed, the the lock queue is processed. Note that depending on the nature of the service/device, lock requests may be granted FIFO or in some other order, e.g., when an operator takes an action such as pressing a station button.
- When a lock request has been granted:
  - The service state changes to LOCKED.
  - Any other pending lock requests from the same "owner" are also granted. (The owner is the same if it comes from the same workstation and has the same application and service handles.)

Service state: LOCKED

- Arriving requests (except lock requests) are handled as follows:
  - Non-deferred requests are processed on arrival.
  - Deferred requests that are ***not*** **WFPExecute** requests are placed in the deferred queue.
  - **WFPExecute** requests from the owner of the lock are placed in the deferred queue.
  - **WFPExecute** requests that are not from the owner of the lock are rejected (with error code WFS_ERR_LOCKED).
  - **WFPUnlock** and **WFPClose** requests from the owner of the lock are placed in the deferred queue. (Note that a close request to a locked service is treated as an unlock followed by a close.)
  - **WFPUnlock** and **WFPClose** requests that are ***not*** from the owner of the lock are treated as non-deferred requests, i.e., processed on arrival.
- The deferred queue is processed FIFO.
- When a **WFPLock** request arrives:
  - If it is from the owner of the lock, it is granted.
  - If it is not from the owner of the lock, it is placed in the lock queue.
- When a **WFPUnlock** or **WFPClose** request is processed from the deferred queue, or the connection between the service and the owner of the lock is lost:
  - If the lock queue is not empty, the service state changes to **LOCK_PENDING**.
  - If the lock queue is empty, the service state changes to **UNLOCKED**.

Note that most requests include a timeout parameter which must be managed appropriately, i.e., when the specified time expires, the request is rejected with the error code WFS_ERR_TIMEOUT. The timeout parameter is particularly important with the **WFSLock** request, since it allows applications to set a maximum time to wait for a lock to be granted, to allow prevention of deadlock situations when requesting locks of multiple devices.

3.8.2 Compound Devices

Compound devices are very common in the financial services industry. For the purposes of this discussion, there are three types of compound devices:

- Two or more separate logical devices that share a physical housing (or perhaps some other attribute), but function completely independently of one another
- Two or more distinct logical devices that are functionally interdependent in some way, such as a journal printer and passbook printer that use the same print head mechanism
- Two or more logical devices that are simply different logical views of a single physical device, such as a single printer that is managed as two separate logical devices, a document printer and a passbook printer

The first of these types has no special significance from the XFS point of view. Each of the devices is managed as a separate logical and physical device, and the system configuration issues (e.g., making sure that devices that are packaged together are assigned to the same workstation) are left to application utilities outside the scope of this specification.

The latter two types are treated identically in an XFS system. When any one of a set of interdependent logical devices that forms a compound device is locked, all the other logical devices in that compound device are also ***implicitly*** locked on behalf of the requesting application. (The specific policy is described below.) If the ***same*** application (see the discussion of "application identity" below and in Section 3.5) explicitly requests a lock of another of these logical devices, the lock is granted. In order to allow the application to "know" that the devices

are part of a compound device, and therefore interdependent, the **WFSLock** function returns an array of service handles, defining the set of other devices within the compound device that are now explicitly locked by the application. This allows the application to manage its use of these devices accordingly. Normally, it must use them in a strictly sequential manner to avoid any possible conflicts, but if it has some special knowledge of how the devices are related, it may be able to multiplex requests in some ways.

Note that an application can also determine whether a device is compound by using the device capabilities query function of **WFSGetInfo**.

There are many different ways in which programmers can make use of multiple threads and/or processes in financial applications. Each WOSA/XFS service can be controlled from its own thread; all services can be controlled from a single thread, with other threads/processes used for other application functions; several identical threads can handle all open services as needed; etc. In some of these models, the "user" of a service could be considered to be the process as a whole; in other models, the "user" is a single thread. The WOSA/XFS design allows for both models by providing the programmer the capability to explicitly control the "identity" of an application. The programmer can make all the threads in a process appear to a service provider as one "application," identify each thread as a different "application," or create some hybrid of these approaches, allowing interdependent compound devices to be managed correctly no matter what application architecture is used.

In order to allow this flexibility in application architecture, the "identity" of an application can optionally be managed explicitly using the concept of application handles. An application handle (*hApp*) is created using the **WFSCreateAppHandle** function, and is guaranteed unique within the system. The **WFSOpen** function takes an optional application handle parameter which is bound to the service handle (*hService*) returned by the open function. This approach allows applications that use interdependent compound devices to be implemented with any combination of single or multiple processes and/or threads, by explicitly managing an appropriate set of application handles. If this facility is not used (indicated by the application using the value WFS_DEFAULT_HAPP for the *hApp* parameter in **WFSOpen**), the XFS subsystem automatically treats each process as having a single, unique application handle. See Section 3.5 for additional discussion of this topic.

The lock policy for interdependent compound devices uses the same rules as for independent devices, with some additional constraints. In order to synchronize access via multiple logical services to a single physical device, or to interdependent devices, the service manages a single lock queue and a single deferred queue for the set of related logical services. The additional constraints are:

Service state: LOCK_PENDING

- When a lock request has been granted to one of a set of related logical services:
  - All the other related services in the set change to a "reserved" state in which they are treated as being in the LOCKED state for requests not from the owner.
  - Any lock request from the owner for one of the reserved services is granted on arrival.
  - Lock requests that are not from the owner of the reserved devices are placed in the lock queue.

Service state: LOCKED

- Any lock request from the owner for one of the reserved services is granted on arrival.
- Lock requests that are not from the owner of the reserved devices are placed in the lock queue.
- Note that if a **WFPUnlock** or **WFPClose** request is processed for the service, and any other logical service that is related to this service is in the LOCKED state, then the service state is set to "reserved," ***not*** UNLOCKED.
- Note also, that if a **WFPUnlock** or **WFPClose** request is processed for the service, and the other logical services that are related to this service are in the "reserved" state, then all these services change to the UNLOCKED state.

3.9 Timeout

There are two fundamentally different time domains in a system, each having a different implication on the concept of timeout:

- "user time" = real time; timeout here says simply "this job is taking too long" as defined by the application and/or the user (indicated by a WFS_ERR_TIMEOUT error code)

- "service time" = the time taken by the service request ***within*** the service; typically, the physical device operation (indicated by WFS_ERR_DEV_NOT_READY or WFS_ERR_HARDWARE_ERROR error code)

In WOSA/XFS systems, the service manages the latter, ***without*** needing any input from the application, since it "knows" the charactistics of the device, and can generate a timeout event if the device takes too long, even if the application timeout value (if any) has not been exceeded. Therefore, the timeout value provided in the API is treated by the service provider as user/real time. If the time is exceeded, the service provider cancels the request and returns a timeout event to the application. An application can also specify that a request should wait until completion, no matter how long the request takes, by specifying the special value WFS_INDEFINITE_WAIT.

3.10 Function Status Return

When a WOSA/XFS API or SPI function call completes, it returns a value that either defines the completion status, or in the case of asynchronous functions, the status of the initial processing of the request. When an asynchronous function completes, the completion message includes the final status of the request. The return value of most functions is a "result handle," *hResult*, of type HRESULT. *hResult* values are defined to be WFS_SUCCESS (zero) for success; other values indicate the specific error that occurred, as defined in each function specification.
The XFS Manager and the service providers return status from a function call, in the form of an *hResult* result handle, in two manners:

- By returning an *hResult* value as the function return.
- By posting a completion message to the window specified in the request. The message contains a pointer to a structure that includes the *hResult*.

The mechanism depends on the category of function being processed, as follows:

- Immediate API
  The XFS Manager processes the request, and immediately returns a result handle. In some cases, the XFS Manager calls the service provider to process the request, then returns the result handle from the service provider to the application.
- Asynchronous API
  Since the processing is performed in a number of steps, as described earlier, return status is generated at a number of levels:
  - The service provider performs any validations which can be processed immediately.
  - If an error is detected, the service provider returns the *hResult* to the XFS Manager, which immediately returns it to the application.
  - Otherwise, the request is scheduled and an *hResult* of WFS_SUCCESS is immediately returned to the XFS Manager, which immediately returns it to the application. This informs the application that the request has been accepted and is being processed.
  - Upon completion of the deferred request, a completion message is posted to the application's window. This message points to the structure that includes the *hResult* indicating the completion status of the request.
- Synchronous API
  - Since a synchronous API call is translated by the XFS Manager to an asynchronous SPI, the service provider behaves the same as in asynchronous API processing. Specifically, the service provider performs any validations which can be processed immediately.
  - If an error is detected, the service provider returns the *hResult* to the XFS Manager, which immediately returns it to the application.
  - Otherwise, the request is scheduled and an *hResult* of WFS_SUCCESS is immediately returned to the XFS Manager, indicating that the request has been accepted and is being processed.
  - Upon completion of the deferred request, a completion message is posted to the XFS Manager window. The XFS Manager retrieves the *hResult* from the structure pointed to by the message and returns it to the application.

3.11 Notification Mechanisms — Registering for Events

The **WFSRegister** and **WFSDeregister** functions (and their asynchronous counterparts) are used to register and deregister the window procedures which are to receive Windows messages when particular unsolicited, asynchronous events occur, either during request processing or at other times. In other words, they are used to enable or disable the reception of event notifications. By providing notifications of this type to applications, the requirement to poll for status is removed, and a simple method for implementing "monitoring" applications is provided. Each **WFSRegister** call specifies a service handle (*hService*), one or more event classes, and an application window handle (*hWnd*) which is to receive all the messages of the specified class(es). The corresponding SPI functions, **WFPRegister** and **WFPDeregister**, implement the API functions.

There are four classes of events:
- SERVICE_EVENTS
- USER_EVENTS
- SYSTEM_EVENTS
- EXECUTE_EVENTS

For the first three of these event classes, if a class is being monitored and an event occurs in that class, a message is broadcast to every *hWnd* registered for that class, specifying the service identified by the *hService* handle. The events are generated when:
- the service status changes (SERVICE_EVENTS), e.g., a printer is suspended or is no longer available.
- the service needs an operation from the user to take place (USER_EVENTS), e.g., a device needs “abnormal” attention, such as adding paper or toner to a printer.
- a system event occurs (SYSTEM_EVENTS), e.g., a hardware error occurs, a version negotiation fails, the network is no longer available or there is no more disk space.

The EXECUTE_EVENTS class is different from the other three. These are events which occur as a normal part of processing an **WFSExecute** command. Examples include the need to interact with the user or operator to request an action such as inserting a passbook into a printer, “swiping” a mag stripe card, etc. A message generated by one of these events is sent ***only*** to the application that issued the **WFSExecute** that caused the event, even though other applications are registered for EXECUTE_EVENTS. Note that an application must explicitly register for these events; if it has not, and such an event occurs, the event is not deliverable and the **WFSExecute** completes normally.

The logic of **WFSRegister** is cumulative: for a given service the number of notification messages sent may be increased by specifying additional event classes. Since the XFS Manager does not keep track of what events the application is registered for and the logic of the register/deregister mechanism is cumulative, the service providers are responsible for implementing the logic of this process.

An application requests registration for more than one event class in a single call by using a logical ‘OR’:

```
hr = WFSRegister( hService,USER_EVENTS|SERVICE_EVENTS,hWnd );
```

Note that services always monitor their resources, regardless of whether any application has registered for event monitoring or not. Issuing **WFSRegister** simply causes a service to send notifications to the service provider, which, in turn, sends notifications to one or more applications.

To communicate to the XFS Manager that it no longer wishes to receive messages in one or more event classes, an application can cancel any previous registration using the **WFSDeregister** function. The logic of **WFSRegister** and **WFSDeregister** is symmetric: the application can deregister one or more classes of events monitored for each window, by properly specifying them in the parameter list. To deregister completely (e.g., every event class for every window), an application uses NULL event class and window handle values in the parameter list.

Although the **WFSDeregister** takes effect immediately, it is possible that messages may be waiting in the application's message queue. A robust application must therefore be prepared to receive event messages even after deregistration.

Note that an event notification message always passes the information describing the event to an application by pointing to a **WFSRESULT** data structure. After the application has used the data in the structure, it ***must*** free

the memory that the service provider allocated for the **WFSRESULT** data structure, using the **WFSFreeResult** function.

3.12 Application Processes, Threads and Blocking Functions

An application process contains one or more threads of execution. The WOSA/XFS interface is designed to work in both the single-threaded versions of the Windows operating systems (Windows 3.1 and Windows for Workgroups) and in the multi-threaded versions of Windows (Windows NT and future versions of Windows). All references to threads in this document refer to actual threads in multi-threaded Windows environments. In single-threaded environments, "thread" is synonymous with "process."

Within the XFS Manager, a blocking (synchronous) function is handled as follows: The XFS Manager initiates the operation, and then enters a loop in which it dispatches any Windows messages (thus yielding the processor to other applications as necessary) and checks for the completion of the operation. When the operation completes, or **WFSCancelBlockingCall** is invoked, the blocking operation completes with an appropriate result.

When a Windows message is received for a thread for which a blocking operation is in progress, the thread is not permitted to issue any WOSA/XFS calls during the processing of the message, other than the two specific functions provided to assist the programmer in this situation:

- **WFSIsBlocking** determines whether or not a blocking call is in progress.
- **WFSCancelBlockingCall** cancels a blocking call in progress.

Any other WOSA/XFS function called when a blocking call is in progress fails with the error WFS_ERR_OP_IN_PROGRESS. This restriction applies to requests for both blocking and non-blocking operations.

Although this mechanism is sufficient for simple applications, it cannot support those applications which require more complex message processing while blocked for a synchronous call, such as processing messages relating to MDI (multiple document interface) events, accelerator key translations, and modeless dialogs. For such applications, the WOSA/XFS API includes the function **WFSSetBlockingHook**, which allows the programmer to define a special routine which will be called instead of the default message dispatch routine described above. This function gives an application the ability to execute its own routine at blocking time in place of the default routine. It is ***not*** intended as a mechanism for performing general application functions while blocked; it is still true that the ***only*** WOSA/XFS functions that may be called from a blocking routine are **WFSIsBlocking** and **WFSCancelBlockingCall**. The asynchronous versions of the WOSA/XFS functions must be used to allow an application to continue processing while an operation is in progress.

This mechanism is provided to allow a Windows 3.x or Windows for Workgroups application to make blocking calls without blocking the rest of the system. Under Windows NT and future multi-threaded, preemptive versions of Windows, the default blocking action is to suspend the calling application's thread until the request completes. This is because the system is not blocked by a single application waiting for an operation to complete, and hence not calling **PeekMessage** or **GetMessage,** which are required in the non-preemptive systems in order to cause the application to yield control.

Therefore, if a single-threaded application is targeted at both single- and multi-threaded environments, and relies on this functionality, it should install a specific blocking hook by calling **WFSSetBlockingHook**, even if the default hook would suffice. This maximizes the portability of applications that depend on the blocking hook behavior. Programmers who are constrained to use blocking mode—for example, as part of an existing application which is being ported—should be aware of the semantics of blocking operations.

In the WOSA/XFS implementation in a single-threaded environment, the blocking function operates as follows. When an application requests a blocking WOSA/XFS API function, the XFS Manager initiates the requested function and then enters a loop which is equivalent to the following pseudocode:

```
for(;;) {
   /* flush messages for good user response */
   DefaultBlockingHook();
   /* check for WFSCancelBlockingCall() */
   if( operation_cancelled() )
      break;
   /* check to see if operation completed */
   if( operation_complete() )
      break;       /* normal completion */
}
```

The **DefaultBlockingHook** routine is equivalent to:

```
BOOL DefaultBlockingHook(void) {
   MSG msg;
   BOOL ret;
   /* Wait for the next message */
   ret = GetMessage(&msg, NULL, 0, 0);
   if( (int) ret != -1 ) {
      TranslateMessage(&msg);
      DispatchMessage(&msg);
   }
   /* FALSE if we got a WM_QUIT message */
   return( ret );
}
```

In a multi-threaded environment, the developer of a multi-threaded application must be aware that it is the responsibility of the application, not the XFS Manager, to synchronize access to a service by multiple threads. Failure to synchronize calls to a service leads to unpredictable results; for example, if two threads "simultaneously" issue **WFSExecute** requests to send data to the same service, there is no guarantee as to the order in which the data is sent. This is true in general; the application is responsible for coordinating access by multiple threads to any object (e.g., other forms of I/O, such as file I/O), using appropriate synchronization mechanisms. The XFS Manager can not, and will not, address these issues. The possible consequences of failing to observe these rules are beyond the scope of this specification.

In order to allow maximum flexibility in the design and implementation of applications, especially in multi-threaded environments, the concept of "application identity" can optionally be managed explicitly by the application developer using the concept of application handles. See Sections 3.5 and 3.8.2 for additional discussion of this concept.

3.13 Memory Management

WOSA/XFS specifies a protocol for dynamic allocation and release of memory. The general strategy is that the service providers allocate memory as they need it, and the applications specify when it can be released. This is implemented using a standard structure (WFSRESULT, defined in Section 8.1) that is always used to pass information to the applications from the services.

Most service provider function calls are asynchronous, and return their results via a completion message, which contains a pointer to a WFSRESULT structure, containing the function return status (hResult) and optional data. The service provider allocates the memory for this structure, using the memory management framework described below. The deallocation of the structure is done as follows:

- Asynchronous API functions
  The application receives the structure from the service provider via a completion message, and is responsible for deallocation.

- Synchronous **WFSExecute**, **WFSGetInfo** and **WFSLock** API functions
  The XFS Manager passes through the WFSRESULT structure to the application as a returned parameter, and the application is then responsible for deallocation, just as for asynchronous calls.

- All other synchronous API functions
  The XFS Manager unpacks the required information from the WFSRESULT structure into returned parameters to the application, deallocates the structure, and returns to the application.

Four functions are provided by the XFS Manager to implement this protocol: **WFMAllocateBuffer**, **WFMAllocateMore**, **WFMFreeBuffer**, and **WFSFreeResult**. Using these functions, two widely applicable allocation policies are supported:
- a linear allocation policy
- a linked allocation policy

Linear allocation can be used for any flat or contiguously allocated data structure. Such structures are returned in a single block of allocated memory by the **WFMAllocateBuffer** function.

Linked allocation can be used as an efficient way of managing complex data structures, permitting the service provider some flexibility while allowing the application to release the entire structure with a single call. In cases in which the service provider does not know a priori the size of the result data set, it makes an initial estimate, and uses **WFMAllocateBuffer**. If the service provider later determines that more space is required by the data, new memory is requested using the function **WFMAllocateMore**, and is automatically linked to the originally allocated block. The new memory block returned by **WFMAllocateMore** is, in general, not contiguous with the root block, and the user of this function should behave in all circumstances as if it is not.

The service provider is free to choose whatever allocation granularity is most convenient. This is completely transparent to the application or XFS Manager, which frees the entire WFSRESULT structure with a single **WFSFreeResult** call (the XFS Manager can also use this call as an indication that it can clean up any other objects associated with the request). Applications must be sure ***always*** to free a returned WFSRESULT structure. Note that a WFSRESULT structure may be returned even if the service provider has returned an error; if no WFSRESULT is returned, the pointer to the structure is NULL. A service provider may use also this facility for its "private" memory management requirements; it then uses the **WFMFreeBuffer** support function to free the allocated memory.

NOTE:
Applications and service providers ***must*** use the facilities provided by the XFS Manager for XFS-related memory allocation and deallocation, in order to avoid memory management conflicts among the applications, the XFS Manager and the service providers.

The following example illustrates how a service provider dynamically allocates a WFSRESULT buffer structure and an additional data buffer. Note that **WFMAllocateMore** automatically links these, allowing the application to free both structures with a single call.

```
WFSRESULT *  lpResultBuffer;

// service provider allocates a WFSResult buffer structure

result = WFMAllocateBuffer(sizeof(WFSRESULT), ulMemFlags, &lpResultBuffer);
•
•
•
// service provider allocates additional memory

hr = WFMAllocateMore(evenMoreMemory, lpResultBuffer, &lpResultBuffer->lpBuffer);
•
•
•
```

Once the application has retrieved all the information it needs from the WFSRESULT buffer and any associated structures, it must free the memory, which requires only a single call:

```
•
•
•
// application deallocates the structure when it is finished with it

hr = WFSFreeResult(lpResultBuffer);  // frees both the result buffer and
                                     // any additional buffers
```

NOTE:
When an application invokes an asynchronous or immediate (i.e., non-blocking) function which takes a pointer to a memory object as an argument, it is the responsibility of the service provider to ensure that it no longer needs access to the object before returning control to the application. This allows the application to release (deallocate) the memory object immediately upon the return from the call.

4. Application Programming Interface (API) Functions

The functions defined by the WOSA/XFS API are divided into:

- ***Basic functions*** that are common to all classes of financial services.
- ***Administration functions***, used for the special purpose of administering services.
- ***Service-specific commands*** that are peculiar to a single service class or a group of them and that are sent to services using basic functions (**WFSExecute**, **WFSAsyncExecute**, **WFSGetInfo**, **WFSAsyncGetInfo**).

The benefit of grouping functions that are common to all services is evident: programmers can immediately focus on those operations that are common through all services and thus can easily build a high level model of interaction with the service providers.

The basic functions are defined in this section, in alphabetical order, except that the asynchronous version of each command is described immediately following the synchronous version. For example, **WFSAsyncExecute** is placed immediately following **WFSExecute**. The table on the next page lists all the basic functions. This set of basic functions may be expanded in future releases of this specification, if new functions are determined to be useful for all service providers.

The administration functions have not yet been fully defined; they are outlined in Appendix A.2 - Planned Enhancements and Extensions.

The service-specific commands are defined in separate specifications–one for each service class.

The table below summarizes the WOSA/XFS API functions, and the sections in which they are defined.

Section	Function	Mode	Description
4.1	**WFSCancelAsyncRequest**	Immediate	Cancel an outstanding asynchronous request
4.2	**WFSCancelBlockingCall**	Immediate	Cancel an outstanding blocking operation
4.3	**WFSCleanUp**	Synchronous	Terminate a connection between an application and the XFS Manager
4.4	**WFSClose**	Synchronous	Close a session between an application and a service provider
4.5	**WFSAsyncClose**	Asynchronous	The asynchronous version of **WFSClose**
4.6	**WFSCreateAppHandle**	Immediate	Create a new application handle to be used in a subsequent **WFSOpen** call
4.7	**WFSDeregister**	Synchronous	Disable monitoring of a class of events by an application
4.8	**WFSAsyncDeregister**	Asynchronous	The asynchronous version of **WFSDeregister**
4.9	**WFSDestroyAppHandle**	Immediate	Destroy the specified application handle
4.10	**WFSExecute**	Synchronous	Send service-specific commands to a service provider
4.11	**WFSAsyncExecute**	Asynchronous	The asynchronous version of **WFSExecute**
4.12	**WFSFreeResult**	Immediate	Request the XFS Manager to free a result buffer
4.13	**WFSGetInfo**	Synchronous	Retrieve service-specific information from a service provider
4.14	**WFSAsyncGetInfo**	Asynchronous	The asynchronous version of **WFSGetInfo**
4.16	**WFSIsBlocking**	Immediate	Determine if a blocking call is in progress
4.17	**WFSLock**	Synchronous	Establish exclusive control by an application of a service
4.18	**WFSAsyncLock**	Asynchronous	The asynchronous version of **WFSLock**
4.19	**WFSOpen**	Synchronous	Open a session between an application and a service provider
4.20	**WFSAsyncOpen**	Asynchronous	The asynchronous version of **WFSOpen**
4.21	**WFSRegister**	Synchronous	Enable monitoring of a class of events by an application
4.22	**WFSAsyncRegister**	Asynchronous	The asynchronous version of **WFSRegister**
4.23	**WFSSetBlockingHook**	Immediate	Install an application-specific blocking routine
4.24	**WFSStartUp**	Immediate	Initiate a connection between an application and the XFS Manager
4.25	**WFSUnhookBlockingHook**	Immediate	Restore the default blocking routine
4.26	**WFSUnlock**	Synchronous	Release exclusive control by an application of a service
4.27	**WFSAsyncUnlock**	Asynchronous	The asynchronous version of **WFSUnlock**

4.1 WFSCancelAsyncRequest

HRESULT **WFSCancelAsyncRequest**(*hService, RequestID*)

Cancels the specified (or every) asynchronous request being performed on the specified service, before its (their) completion.

Parameters

HSERVICE *hService*
Handle to the service as returned by **WFSOpen** or **WFSAsyncOpen.**

REQUESTID *RequestID*
The request identifier for the request to be canceled, as returned by the original function call (NULL to cancel all).

Mode Immediate

Comments

If the *RequestID* parameter is set to NULL, the command will cancel ***all*** asynchronous requests that are in progress using the specified *hService*.

A previously initiated asynchronous request is canceled prior to completion by issuing the **WFSCancelAsyncRequest** function, specifying the request identifier returned by the asynchronous function. This function is immediate with respect to its calling application, but the cancellation process is inherently asynchronous. On completion, the specified request (or all requests) will have finished, with a completion message indicating a status of WFS_ERR_CANCELED, unless the cancel request was received by the service ***after*** the request had completed. Thus, **WFSCancelAsyncRequest** is not guaranteed to stop all asynchronous commands: normal completion messages may still be posted after the cancel. A robust application that uses asynchronous commands should be designed to accept these messages even after a cancel is issued.

The cancellation applies not only to the XFS Manager level, but also to the service provider level. The request is passed through the SPI, and the service provider normally then also cancels any physical I/O or other device operation in progress, in the appropriate manner for the device or service.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_REQ_ID
The *RequestID* parameter does not correspond to an outstanding request on the service.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See also **WFSAsyncExecute**

4.2 WFSCancelBlockingCall

HRESULT **WFSCancelBlockingCall**(dw*ThreadID*)

Cancels a blocking operation for the specified thread, if one is in progress.

Parameters **DWORD** *dwThreadID*
Identifies the thread for which the blocking operation is to be canceled; a NULL value indicates the calling thread.

Mode Immediate

Comments This function is used to cancel a blocking call (synchronous request) that is in progress. Since a thread may have only ***one*** blocking call in progress at any time, **WFSIsBlocking** and **WFSCancelBlockingCall** are the only WOSA/XFS functions allowed with respect to a thread when it has a blocking call in progress.

The application that issued the blocking call receives a WFS_ERR_CANCELED return code if the operation is successfully canceled.

The cancellation applies not only to the XFS Manager level, but also to the service provider level. The request is passed through the SPI, and the service provider normally then also cancels any physical I/O or other device operation in progress, in the appropriate manner for the device or service.

Note: the cancel request is accepted and is honored as soon as all Windows messages have been removed from the message queue (i.e. GetMessage returns no more messages). Refer to **WFSSetBlockingHook** for more information.

Error Codes If the function return is not WFS_SUCCESS, it is the following error condition:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_NO_BLOCKING_CALL
There is no outstanding blocking call for the specified thread.

WFS_ERR_NO_SUCH_THREAD
The specified thread does not exist.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

See also **WFSSetBlockingHook, WFSIsBlocking, WFSCancelAsyncRequest**

4.3 WFSCleanUp

HRESULT WFSCleanUp( )

Disconnects an application from the XFS Manager.

Parameters None

Mode Synchronous

Comments The **WFSCleanUp** call indicates disconnection of a WOSA/XFS application from the XFS Manager. This function, for example, frees resources allocated to the specific application. **WFSCleanUp** applies to all threads of a multi-threaded application. If **WFSClose** has not been issued for one or more service providers, then the XFS Manager will automatically issue the close(s). Once the **WFSCleanUp** has been performed, subsequent attempts to issue any WOSA/XFS function other than **WFSStartUp** will fail.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See also **WFSStartUp**

4.4 WFSClose

HRESULT WFSClose(*hService*)

Terminates a session (a series of service requests initiated with the **WFSOpen** or **WFSAsyncOpen** function) between the application and the specified service. The synchronous version of **WFSAsyncClose**.

Parameters **HSERVICE** *hService*
The service handle returned by **WFSOpen** or **WFSAsyncOpen**. Matches the close request to the open request, allowing an application to have multiple sessions open simultaneously with a single service provider.

Mode Synchronous

Comments **WFSClose** directs the service to free all resources associated with the series of requests made using the *hService* parameter since the **WFSOpen** that returned it. If there is a blocking call in progress the close fails. If the service is locked, the close automatically unlocks it. If no **WFSDeregister** has been issued, it is automatically performed.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelBlockingCall**.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See also **WFSAsyncClose, WFSOpen, WFSDeregister**

4.5 WFSAsyncClose

HRESULT **WFSAsyncClose**(*hService, hWnd, lpRequestID*)

Terminates a session (a series of service requests initiated with the **WFSOpen** or **WFSAsyncOpen** function) between the application and the specified service. The asynchronous version of **WFSClose**.

Parameters

HSERVICE *hService*
The service handle returned by **WFSOpen** or **WFSAsyncOpen.** Matches the close request to the open request, allowing an application to maintain several "open sessions" simultaneously.

HWND *hWnd*
The window handle which is to receive the completion message for this request.

LPREQUESTID *lpRequestID*
Pointer to the request identifier for this request (returned parameter).

Mode Asynchronous

Comments See **WFSClose**.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure which is pointed to by the completion message. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Messages WFS_CLOSE_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

The following error condition can be returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

See also **WFSOpen, WFSDeregister**

4.6 WFSCreateAppHandle

HRESULT WFSCreateAppHandle(*lphApp*)

Requests a new, unique application handle value.

Parameters **LPHAPP** *lphApp*
A pointer to the application handle to be created (returned parameter).

Mode Immediate

Comments This function is used by an application to request a unique (within a single system) application handle from the XFS Manager (to be used in subsequent **WFSOpen**/**WFSAsyncOpen** calls). Note that an application may call this function multiple times in order to create multiple "application identities" for itself with respect to the WOSA/XFS subsystem. See Sections 3.5 and 3.8.2 for additional discussion.

Error Codes If the function return is not WFS_SUCCESS, it is the following error condition.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

See also **WFSDestroyAppHandle, WFSOpen, WFSAsyncOpen**

4.7 WFSDeregister

HRESULT **WFSDeregister**(*hService, dwEventClass, hWndReg*)

Discontinues monitoring of the specified message class(es) (or ***all*** classes) from the specified *hService*, by the specified *hWndReg* (or ***all*** the calling application's *hWnd*'s). The synchronous version of **WFSAsyncDeregister**.

Parameters

HSERVICE *hService*
Service handle returned by **WFSOpen** or **WFSAsyncOpen**. If this value is NULL, and *dwEventClass* is SYSTEM_EVENTS, the XFS manager deregisters the application for those system events generated by the Manager itself.

DWORD *dwEventClass*
The class(es) of messages from which the application is deregistering. Specified as a bit mask that can be a logical OR of the values for multiple classes. A NULL value requests that ***all*** message classes be deregistered from the specified window for this *hService*.

HWND *hWndReg*
The window which has been previously registered to receive notification messages, and is now to be deregistered. A NULL value requests that ***all*** the application's windows be deregistered from the specified message class(es) for this *hService*.

Mode Synchronous

Comments The functions of a **WFSDeregister** request are performed automatically if a **WFSClose** is issued without a previous **WFSDeregister**.

See section 3.11 for a description of the classes of events that may be monitored.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_CANCELED
The request was canceled by **WFSCancelBlockingCall**.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_EVENT_CLASS
The *dwEventClass* parameter specifies one or more event classes not supported by the service.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWNDREG
The *hWndReg* parameter is not a valid window handle.

WFS_ERR_NOT_REGISTERED
The specified *hWndReg* window was not registered to receive messages for any event classes.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See also **WFSRegister, WFSClose**

4.8 WFSAsyncDeregister

HRESULT **WFSAsyncDeregister**(*hService, dwEventClass, hWndReg, hWnd, lpRequestID*)

Discontinues monitoring of the specified message class(es) (or ***all*** classes) from the specified *hService*, by the specified *hWndReg* (or ***all*** the calling application's hWnd's). The asynchronous version of **WFSDeregister**.

Parameters

HSERVICE *hService*
Service handle returned by **WFSOpen** or **WFSAsyncOpen**. If this value is NULL, and *dwEventClass* is SYSTEM_EVENTS, the XFS manager deregisters the application for those system events generated by the Manager itself.

DWORD *dwEventClass*
The class(es) of events from which the application is deregistering. Specified as a bit mask that can be a logical OR of the values for multiple classes. A NULL value requests that ***all*** event classes be deregistered from the specified window for this *hService*.

HWND *hWndReg*
The window which has been previously registered to receive notification messages, and is now to be deregistered. A NULL value requests that ***all*** the application's windows be deregistered from the specified message class(es) for this *hService*.

HWND *hWnd*
The window handle which is to receive the completion message for this request.

LPREQUESTID *lpRequestID*
Pointer to the request identifier for this request (returned parameter).

Mode Asynchronous

Comments See **WFSDeregister**.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure which is pointed to by the completion message. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Messages WFS_DEREGISTER_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_EVENT_CLASS
The *dwEventClass* parameter specifies one or more event classes not supported by the service.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_HWNDREG
The *hWndReg* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_REGISTERED
The specified *hWndReg* window was not registered to receive messages for any event classes.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

See also **WFSRegister, WFSClose**

4.9 WFSDestroyAppHandle

HRESULT WFSDestroyAppHandle(*hApp*)

Makes the specified application handle invalid.

Parameters **HAPP** *hApp*
The application handle to be made invalid.

Mode Immediate

Comments This function is used by an application to indicate to the XFS Manager that it will no longer use the specified application handle (from a previous **WFSCreateAppHandle** call). See **WFSCreateAppHandle** and Sections 3.5 and 3.8.2 for additional discussion.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_INVALID_APP_HANDLE
The specified application handle is not valid, i.e., was not created by a preceding create call.

See also **WFSCreateAppHandle**

4.10 WFSExecute

HRESULT **WFSExecute** (*hService, dwCommand, lpCmdData, dwTimeOut, lppResult*)

Sends a service-specific command to a service provider. The synchronous version of **WFSAsyncExecute**.

Parameters

HSERVICE *hService*
Handle to the service as returned by **WFSOpen** or **WFSAsyncOpen**.

DWORD *dwCommand*
Command to be executed by the service provider.

LPVOID *lpCmdData*
Pointer to a command data structure to be passed to the service provider.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

LPWFSRESULT * *lppResult*
Pointer to the pointer to the result data structure used to return the results of the execution. The service provider allocates the memory for this structure.

Mode

Synchronous

Comments

This function is used to execute service-specific commands. Each class of service includes a unique set of commands for the given type of device or service; they are defined in the service-specific command specifications. Each service provider developer is responsible for recognizing the complete set of commands for a given class, even if the service provider doesn't support them all. Each command, for each service class, defines a command data structure and/or a result data structure. See the separate specifications for each service class for more discussion of these issues, and the definitions of the service-specific commands and associated data structures.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure returned by this function. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelBlockingCall**.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_COMMAND
The *dwCommand* issued is not supported by this service class.

WFS_ERR_INVALID_DATA
The data structure passed as input parameter contains invalid data.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_LOCKED
The service is locked under a different *hService*.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_TIMEOUT
The timeout interval expired.

WFS_ERR_UNSUPP_COMMAND
The *dwCommand* issued, although valid for this service class, is not supported by this service provider or device.

See Also **WFSAsyncExecute**

4.11 WFSAsyncExecute

HRESULT **WFSAsyncExecute**(*hService, dwCommand, lpCmdData, dwTimeOut, hWnd, lpRequestID*)

Sends a service-specific command to a service provider. The asynchronous version of **WFSExecute**.

Parameters

HSERVICE *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen.**

DWORD *dwCommand*
Command to be executed by the service provider.

LPVOID *lpCmdData*
Pointer to the data structure to be passed to the service provider.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

HWND *hWnd*
The window handle which is to receive the completion message for this request.

LPREQUESTID *lpRequestID*
Pointer to the request identifier for this request (returned parameter).

Mode Asynchronous

Comments See **WFSExecute**.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure which is pointed to by the completion message. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Messages
WFS_EXECUTE_COMPLETE
WFS_EXECUTE_EVENT

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_COMMAND
The *dwCommand* issued is not supported by this service class.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_UNSUPP_COMMAND
The *dwCommand* issued, although valid for this service class, is not supported by this service provider or device.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_DATA
The data structure passed as input parameter contains invalid data.

WFS_ERR_LOCKED
The service is locked under a different *hService*.

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_TIMEOUT
The timeout interval expired.

WFS_ERR_UNSUPP_COMMAND
The *dwCommand* issued, although valid for this service class, is not supported by this service provider or device.

See Also **WFSCancelAsyncRequest, WFSExecute**

4.12 WFSFreeResult

HRESULT WFSFreeResult (*lpResult*)

Notifies the XFS Manager that a memory buffer (or linked list of buffers) that was dynamically allocated by a service provider is to be freed.

Parameters **LPWFSRESULT** *lpResult*
Pointer to a WFSRESULT data structure.

Mode Immediate

Comments The WOSA/XFS service providers may allocate memory to send data to an application. This function is used by the application to deallocate the memory, and the application must call it when it no longer needs access to the memory. When the applications calls **WFSFreeResult**, all memory allocated by the service provider for this result is deallocated. See Section 3.13.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_RESULT
The *lpResult* parameter is not a pointer to an allocated WFSRESULT structure.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

See Also **WFSExecute**, **WFSAsyncExecute**, **WFSGetInfo**, **WFSAsyncGetInfo**

4.13 WFSGetInfo

HRESULT **WFSGetInfo**(*hService, dwCategory, lpQueryDetails, dwTimeOut, lppResult*)

Retrieves information from the specified service provider. The synchronous version of **WFSAsyncGetInfo**.

Parameters

HSERVICE *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen.**

DWORD *dwCategory*
Specifies the category of the query (e.g., for a printer, WFS_INF_PTR_STATUS to request status or WFS_INF_PTR_CAPABILITIES to request capabilities). The available categories depend on the service class, the service provider and the service. The information requested can be either static or dynamic, e.g., basic service capabilities (static) or current service status (dynamic).

LPVOID *lpQueryDetails*
Pointer to the data structure to be passed to the service provider, containing further details to make the query more precise, e.g., a form name. (Many queries have no input parameters, in which case this pointer is NULL.)

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

LPWFSRESULT ***** *lppResult*
Pointer to the pointer to the data structure to be filled with the result of the execution. The service provider allocates the memory for the structure.

Mode Synchronous

Comments

The XFS Manager passes the request to the service provider, and since the information may be stored remotely, the function cannot be immediate. Note that many requests ***can*** be satisfied by the service provider and will therefore complete immediately.

The definitions of the *dwCategory* and *lpQueryDetails* parameters are provided in the service-specific command sections of this specification. Note that these information retrieval functions are separate from the other service-specific commands, since those commands can be executed only via **WFSExecute** or **WFSAsyncExecute**, which require that the service be either locked by the application issuing the command, or unlocked. The **GetInfo** functions, however, can be used even when a service is locked by another application.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure which is returned by this function. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelBlockingCall**.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_CATEGORY
The *dwCategory* issued is not supported by this service class.

WFS_ERR_INVALID_DATA
The data structure passed as input parameter contains invalid data.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_TIMEOUT
The timeout interval expired.

WFS_ERR_UNSUPP_CATEGORY
The *dwCategory* issued, although valid for this service class, is not supported by this service provider.

See Also **WFSAsyncGetInfo**

4.14 WFSAsyncGetInfo

HRESULT **WFSAsyncGetInfo**(*hService, dwCategory, lpQueryDetails, dwTimeOut, hWnd, lpRequestID*)

Retrieves information from the specified service provider. The asynchronous version of **WFSGetInfo**.

Parameters

HSERVICE *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen.**

DWORD *dwCategory*
See **WFSGetInfo**.

LPVOID *lpQueryDetails*
See **WFSGetInfo**.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

HWND *hWnd*
The window handle which is to receive the completion message for this request.

LPREQUESTID *lpRequestID*
The request identifier for this request (returned parameter).

Mode Asynchronous

Comments See **WFSGetInfo**. The only difference in the asynchronous version of the function is that the results (query details) returned to the application (in the WFSRESULT data structure) are pointed to by the WFS_GETINFO_COMPLETE message sent to the specified *hWnd*.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure which is pointed to by the completion message. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Messages WFS_GETINFO_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_CATEGORY
The *dwCategory* issued is not supported by this service class.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_UNSUPP_CATEGORY
The *dwCategory* issued, although valid for this service class, is not supported by this service provider.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_DATA
The data structure passed as input parameter contains invalid data..

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_TIMEOUT
The timeout interval expired.

See also **WFSGetInfo, WFSCancelAsyncRequest**

4.15 WFSIsBlocking

BOOL WFSIsBlocking( )

Determines whether a thread has a blocking operation in progress.

Parameters None

Return Value The return value is TRUE if a blocking operation is in progress and FALSE otherwise.

Mode Immediate

Comments Although a call issued on a synchronous (blocking) function appears to an application as though it blocks, the XFS Manager in fact relinquishes control of the processor to allow other Windows processes to run. Thus it is possible for an application that issues a blocking call to be re-entered, depending on the messages it receives. Since the XFS Manager prohibits more than one outstanding blocking call per thread, an application's message processing routines need a way to determine whether they have been re-entered while the application is waiting for an outstanding blocking call to complete. The **WFSIsBlocking** function provides this function, allowing an application to detect whether a blocking operation is already in progress, before it issues another WOSA/XFS request.

Note that if another WOSA/XFS call ***is*** issued in this situation, the XFS Manager returns with a WFS_ERR_OP_IN_PROGRESS error code. See Section 3.12 for additional discussion.

See also **WFSCancelBlockingCall**

4.16 WFSLock

HRESULT **WFSLock**(*hService, dwTimeOut , lppResult*)

Establishes exclusive control by the calling application over the specified service. The synchronous version of **WFSAsyncLock**.

Parameters

HSERVICE *hService*
Service provider handle as returned by **WFSOpen** or **WFSAsyncOpen.**

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

LPWFSRESULT * *lppResult*
Pointer to the pointer to a WFSRESULT data structure (see Comments). The service provider allocates the memory for this structure.

Mode Synchronous

Comments

A service provider can support a "shared" session, in which multiple applications' data are mixed in the service's I/O stream. More typically, a session is exclusive at any point in time; all I/O is for a single application. To define an exclusive use of the service provider, a lock function (synchronous or asynchronous) must be used. See Section 3.8 for more discussion of the lock concepts and policy.

The time to complete will depend on whether there is another application that has acquired exclusive access to the service. Note that trying to lock several services at the same time can lead to a deadlock. The timeout capability is provided in the API to allow applications to prevent this.

lppResult is a pointer to a pointer to a WFSRESULT data structure containing a null-terminated array of service handles (*hService* values), specifying any ***other*** services that are already locked by the application (i.e., under the same *hApp*) , ***only if*** those services are part of a compound device that includes the service being locked, ***and*** are interdependent with it. The returned pointer is NULL if there are no such "associated" services locked. See Section 3.8.2 for more discussion of this subject.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure, if there is one. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelBlockingCall**.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_TIMEOUT
The timeout interval expired.

See also **WFSAsyncLock, WFSUnlock, WFSCancelBlockingCall**

4.17 WFSAsyncLock

HRESULT **WFSAsyncLock**(*hService, dwTimeOut, hWnd, lpRequestID*)

Establishes exclusive control by the calling application over the specified service. The asynchronous version of **WFSLock.**

Parameters

HSERVICE *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen**.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

HWND *hWnd*
The window handle which is to receive the completion message for this request.

LPREQUESTID *lpRequestID*
Pointer to the request identifier for this request (returned parameter).

Mode Asynchronous

Comments

See **WFSLock** and Section 3.8.2. In particular, note that if other services are locked as a result of this call (i.e., because the service specified is part of a compound device), the handles of these services are returned in the WFSRESULT data structure pointed to by the completion message.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Messages WFS_LOCK_COMPLETE

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_TIMEOUT
The timeout interval expired.

See also **WFSLock, WFSUnlock, WFSCancelAsyncRequest**

4.18 WFSOpen

HRESULT **WFSOpen**(*lpszLogicalName, hApp, lpszAppID, dwTraceLevel, dwTimeOut, dwSrvcVersionsRequired, lpSrvcVersion, lpSPIVersion, lphService*)

Initiates a session (a series of service requests terminated with the **WFSClose** function) between the application and the specified service. The synchronous version of **WFSAsyncOpen.**

Parameters

LPSTR *lpszLogicalName*
Points to a null-terminated string containing the pre-defined logical name of a service. It is a high level name such as "SYSJOURNAL1," "PASSBOOKPTR3" or "CASHDISP02," that is used by the XFS Manager and the service provider solely as a key to obtain the specific configuration information they need.

HAPP *hApp*
The application handle to be associated with the session being opened. If this parameter is equal to WFS_DEFAULT_HAPP, the session is associated with the calling process as a whole (i.e., the calling process, not some subset of its threads, is the owner of the session and its *hService*). See **WFSCreateAppHandle** and Sections 3.5 and 3.8.2 for details.

LPSTR *lpszAppID*
Points to a null-terminated string containing the application ID; the pointer may be NULL if the ID is not used. This ID may be used by services in a variety of ways; e.g., it is included in the SYSTEM_EVENT message for undeliverable events, to aid in finding system problems

DWORD *dwTraceLevel*
See **WFMSetTraceLevel**. NULL turns off all tracing.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

DWORD *dwSrvcVersionsRequired*
Specifies the range of versions of the service-specific interface that the application can support. (See Comments.) The low-order word indicates the highest version of the interface the application can support; the high-order word indicates the lowest version of the interface the application can support. In each word, the low-order byte specifies the major version number and the high-order byte specifies the minor version number (i.e., the numbers before and after the decimal).
Note: in order to allow intermediate minor revisions (e.g., between 1.10 and 1.20), the minor version number should always be expressed as two decimal digits, i.e., 1.10, 1.11, 1.20, etc.

LPWFSVERSION *lpSrvcVersion*
Pointer to the data structure that is to receive version support information and other details about the service-specific interface implementation (returned parameter).

LPWFSVERSION *lpSPIVersion*
Pointer to the data structure that is to receive version support information and (optionally) other details about the SPI implementation of the service provider being opened (returned parameter). This pointer may be NULL if the application is not interested in receiving this information. See **WFPOpen**.

LPHSERVICE *lphService*
Pointer to the service handle that the XFS Manager assigns to the service on a successful open; the application uses this handle for communication with the service provider for the remainder of the session (returned parameter). If a process opens the same service twice, the XFS Manager generates and returns different *hService* values.

Mode Synchronous

Comments This function is used by an application to initiate a session with a service; the session is terminated by **WFSClose.** After **WFSStartUp**, an application must use this function (or the

asynchronous version) to access a service. The request is made in terms of a logical service name (*lpLogicalName*) which is mapped by the XFS Manager to a service provider. The XFS Manager loads the service provider, if necessary, and returns a logical service handle to the application which is used during the session to refer to the service.

In order to support future WOSA/XFS implementations with maximum flexibility, two version negotiations take place in **WFSOpen** processing. An application specifies in the *dwSrvcVersionsRequired* parameter the range of versions of the service-specific interface (as defined in the separate XFS specifications for specific classes of devices, such as banking printers and cash dispensers) that it can support. If the range of versions specified by the application overlaps the range of versions that the service provider's implementation can support, the call succeeds. Otherwise the call fails. (The other negotiation that takes place during the open process is between the XFS Manager and the service provider regarding the SPI level. See **WFPOpen** for details.)

Information describing the actual service provider implementation is returned in the WFSVERSION data structure (defined in Section 8.2). In particular, it returns the version the service provider expects the application to use (the highest common version), as well as the lowest and highest versions it is capable of. If the call fails, WFSVERSION is still returned, to help with analysis of the failure.

The version numbers refer to the complete interface specification: the service-specific **WFSExecute** and **WFSGetInfo** commands, parameters, data structures, error codes, and messages. If there are any changes to these, the version number should be changed.

This version negotiation allows a WOSA/XFS application and a service provider to operate successfully if there is any overlap in their versions. The following chart gives examples of how **WFSOpen** works in conjunction with different application and service provider versions:

Application version(s)	Service Provider version(s)	Return status from **WFSOpen**	Result
1.00	1.00	WFS_SUCCESS	use 1.00
1.00 - 2.10	1.00	WFS_SUCCESS	use 1.00
1.11	1.00 - 2.00	WFS_SUCCESS	use 1.11
2.11 - 3.00	1.00 - 2.20	WFS_SUCCESS	use 2.20
1.00	2.20 - 3.00	WFS_ERR_SRVC_VERS_TOO_LOW	fails
1.11 - 3.00	1.00	WFS_ERR_SRVC_VERS_TOO_HIGH	fails

Note that a version negotiation error also generates a system event (see Section 9.7).

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelBlockingCall**.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_APP_HANDLE
The specified application handle is not valid, i.e., was not created by a preceding create call.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_INVALID_SERVPROV
The file containing the service provider is invalid or corrupted.

WFS_ERR_INVALID_TRACELEVEL
The *dwTraceLevel* parameter does not correspond to a valid trace level or set of levels.

WFS_ERR_NO_SERVPROV
The file containing the service provider does not exist.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_SERVICE_NOT_FOUND
The logical name is not a valid service provider name.

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_SPI_VER_TOO_HIGH
The range of versions of WOSA/XFS SPI support requested by the XFS Manager is higher than any supported by the service provider for the logical service being opened.

WFS_ERR_SPI_VER_TOO_LOW
The range of versions of WOSA/XFS SPI support requested by the a XFS Manager is lower than any supported by the service provider for the logical service being opened.

WFS_ERR_SRVC_VER_TOO_HIGH
The range of versions of the service-specific interface support requested by the application (in the *dwSrvcVersionsRequired* parameter of this call) is higher than any supported by the service provider for the logical service being opened.

WFS_ERR_SRVC_VER_TOO_LOW
The range of versions of the service-specific interface support requested by the application (in the *dwSrvcVersionsRequired* parameter of this call) is lower than any supported by the service provider for the logical service being opened.

WFS_ERR_TIMEOUT
The timeout interval expired.

WFS_ERR_VERSION_ERROR_IN_SRVC
Within the service, a version mismatch of two modules occurred.

See also **WFSAsyncOpen, WFSClose, WFSCreateAppHandle**

4.19 WFSAsyncOpen

HRESULT **WFSAsyncOpen**(*lpszLogicalName, hApp, lpszAppID, dwTraceLevel, dwTimeOut, lphService, hWnd, dwSrvcVersionsRequired, lpSrvcVersion, lpSPIVersion, lpRequestID*)

Initiates a session (a series of service requests terminated with the **WFSClose** or **WFSAsyncClose** function) between the application and the specified service. The asynchronous version of **WFSOpen.**

Parameters

LPSTR *lpszLogicalName*
See **WFSOpen**.

HAPP *hApp*
The application handle to be associated with the session being opened.
See **WFSOpen**, **WFSCreateAppHandle** and Sections 3.5 and 3.8.2 for details.

LPSTR *lpszAppID*
Points to a null-terminated string containing the application ID. See **WFSOpen.**

DWORD *dwTraceLevel*
See **WFMSetTraceLevel**. NULL turns off all tracing.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

LPHSERVICE *lphService*
Pointer to the service handle (returned parameter).

HWND *hWnd*
The window handle which is to receive the completion message for this request.

DWORD *dwSrvcVersionsRequired*
See **WFSOpen.**

LPWFSVERSION *lpSrvcVersion*
See **WFSOpen** (returned parameter).

LPWFSVERSION *lpSPIVersion*
See **WFSOpen** (returned parameter).

LPREQUESTID *lpRequestID*
Pointer to the request identifier for this request (returned parameter).

Mode Asynchronous

Comments See **WFSOpen**.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure which is pointed to by the completion message. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Messages WFS_OPEN_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_APP_HANDLE
The specified application handle is not valid, i.e., was not created by a preceding create call.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_INVALID_SERVPROV
The file containing the service provider is invalid or corrupted.

WFS_ERR_INVALID_TRACELEVEL
The *dwTraceLevel* parameter does not correspond to a valid trace level or set of levels.

WFS_ERR_NO_SERVPROV
The file containing the service provider does not exist.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_SERVICE_NOT_FOUND
The logical name is not a valid service provider name.

WFS_ERR_SPI_VER_TOO_HIGH
The range of versions of WOSA/XFS SPI support requested by the XFS Manager is higher than any supported by the service provider for the logical service being opened.

WFS_ERR_SPI_VER_TOO_LOW
The range of versions of WOSA/XFS SPI support requested by the a XFS Manager is lower than any supported by the service provider for the logical service being opened.

WFS_ERR_SRVC_VER_TOO_HIGH
The range of versions of the service-specific interface support requested by the application (in the *dwSrvcVersionsRequired* parameter of this call) is higher than any supported by the service provider for the logical service being opened.

WFS_ERR_SRVC_VER_TOO_LOW
The range of versions of the service-specific interface support requested by the application (in the *dwSrvcVersionsRequired* parameter of this call) is lower than any supported by the service provider for the logical service being opened.

WFS_ERR_VERSION_ERROR_IN_SRVC
Within the service, a version mismatch of two modules occurred.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready timed out.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_TIMEOUT
The timeout interval expired.

WFS_ERR_VERSION_ERROR_IN_SRVC
Within the service, a version mismatch of two modules occurred.

See also **WFSOpen, WFSClose, WFSCreateAppHandle, WFSCancelAsyncRequest, WFMSetTraceLevel**

4.20 WFSRegister

HRESULT **WFSRegister**(*hService, dwEventClass, hWndReg*)

Enables event monitoring for the specified service by the specified window; all messages of the specified class(es) are sent to the window specified in the *hWndReg* parameter. The synchronous version of **WFSAsyncRegister**.

Parameters

HSERVICE *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen**. If this value is NULL, and *dwEventClass* is SYSTEM_EVENTS, the XFS manager registers the application for those system events generated by the Manager itself.

DWORD *dwEventClass*
The class(es) of events for which the application is registering. Specified as a set of bit masks that are logically ORed together into this parameter.

HWND *hWndReg*
The window handle which is to be registered to receive the specified messages.

Mode Synchronous

Comments Issuing a **WFSRegister** for a service enables event monitoring on that service. **WFSRegister** calls can be cumulative for the same window. For example, to receive notification for both system and user events, the application can call **WFSRegister** with both SYSTEM_EVENTS and USER_EVENTS, as follows:

```
hr = WFSRegister(hPassbook1, SYSTEM_EVENTS |  USER_EVENTS, hWndReg1);
```

or call them in two phases:

```
hr = WFSRegister( hPassbook1, SYSTEM_EVENTS, hWndReg1);
. . . . . .
. . . . . .
hr = WFSRegister( hPassbook1, USER_EVENTS, hWndReg1);
```

To cancel notifications use **WFSDeregister**.

Note that the service provider always monitors the service, regardless of whether an application has registered for event monitoring. Issuing **WFSRegister** simply causes the service provider to post messages to the application in addition to handling the messages itself. See the discussion in Section 3.11.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelBlockingCall**.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_EVENT_CLASS
The *dwEventClass* parameter specifies one or more event classes not supported by the service.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWNDREG
The *hWndReg* parameter is not a valid window handle.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See also **WFSAsyncRegister, WFSDeregister, WFSAsyncDeregister**

4.21 WFSAsyncRegister

HRESULT **WFSAsyncRegister**(*hService, dwEventClass, hWndReg, hWnd, lpRequestID*)

Enables event monitoring for the specified service by the specified window; all messages of the specified class(es) are sent to the window specified in the *hWndReg* parameter. The asynchronous version of **WFSRegister**.

Parameters

HSERVICE *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen.** If this value is NULL, and *dwEventClass* is SYSTEM_EVENTS, the XFS manager registers the application for those system events generated by the Manager itself.

DWORD *dwEventClass*
See **WFSRegister**.

HWND *hWndReg*
The window handle which is to be registered to receive the specified messages.

HWND *hWnd*
The window handle which is to receive the completion message for this request.

LPREQUESTID *lpRequestID*
Pointer to the request identifier for this request (returned parameter).

Mode Asynchronous

Comments See **WFSRegister**.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure pointed to by the completion message. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Messages WFS_REGISTER_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_EVENT_CLASS
The *dwEventClass* parameter specifies one or more event classes not supported by the service.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_HWNDREG
The *hWndReg* parameter is not a valid window handle.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

The following error conditions can be returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

See also **WFSRegister, WFSDeregister, WFSAsyncDeregister**

4.22 WFSSetBlockingHook

HRESULT **WFSSetBlockingHook**(*lpBlockFunc, lppPrevFunc*)

Establishes an application-specific blocking routine.

Parameters

XFSBLOCKINGHOOK *lpBlockFunc*
Pointer to the procedure instance address of the blocking routine to be installed.

LPXFSBLOCKINGHOOK *lppPrevFunc*
Returned pointer to a pointer to the procedure instance of the ***previously*** installed blocking routine.

Mode Immediate

Comments When this function is successfully issued by an application, it returns a pointer to the previously installed blocking routine. The application may save this pointer so that it can be restored if desired. If such "nesting" is not required, the application can discard this value and simply use the **WFSUnhookBlockingHook** function to restore the default routine at any time.

See Section 3.12 for a complete discussion.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

See also **WFSUnhookBlockingHook, WFSCancelBlockingCall, WFSIsBlocking**

4.23 WFSStartUp

HRESULT **WFSStartUp**(*dwVersionsRequired, lpWFSVersion*)

Establishes a connection between an application and the XFS Manager.

Parameters

DWORD *dwVersionsRequired*

Specifies the range of versions of the XFS Manager that the application can support. The low-order word indicates the highest version of the XFS Manager the application can support; the high-order word indicates the lowest version of the XFS Manager the application can support. In each word, the low-order byte specifies the major version number and the high-order byte specifies the minor version number (i.e., the numbers before and after the decimal).

Note: in order to allow intermediate minor revisions (e.g., between 1.10 and 1.20), the minor version number should always be expressed as two decimal digits, i.e., 1.10, 1.11, 1.20, etc.

LPWFSVERSION *lpWFSVersion*

Pointer to the data structure that is to receive version support information and other details about the current WOSA/XFS implementation (returned parameter).

Mode Immediate

Comments

This function is used by an application to register itself with the XFS Manager and specify the version(s) of the WOSA/XFS API specification it can use, and returns information on the specific WOSA/XFS implementation. It ***must*** be the first WOSA/XFS API function called by an application. An application may only issue further WOSA/XFS functions after a successful **WFSStartUp** has completed.

In order to support future WOSA/XFS implementations with maximum flexibility, a version negotiation process takes place in **WFSStartUp**. An application specifies in the *dwVersionsRequired* parameter the range of versions of the WOSA/XFS API specification which it can support. If the range of versions specified by the application overlaps the range of versions that the current implementation of XFS Manager can support, the call succeeds. Otherwise the call fails.

Information describing the actual WOSA/XFS implementation is returned by the XFS Manager in the WFSVERSION data structure (defined in Section 8.2). In particular, it returns the version it expects the application to use (the highest common version), as well as the lowest and highest versions it is capable of. If the call fails, WFSVERSION is still returned, to help with analysis of the failure.

The version numbers refer to the API specification, specifically functions, parameters, data structures, error codes, and messages. If there are any changes to these, the version number should be changed.

This version negotiation allows a WOSA/XFS application and the XFS Manager to operate successfully if there is any overlap in their versions. The following chart gives examples of how **WFSStartUp** works in conjunction with different application and XFS Manager versions:

Application versions	XFS Manager versions	Return status from **WFSStartUp**	Result
1.00	1.00	WFS_SUCCESS	use 1.00
1.00 - 2.10	1.00	WFS_SUCCESS	use 1.00
1.11	1.00 - 2.00	WFS_SUCCESS	use 1.11
2.11 - 3.00	1.00 - 2.20	WFS_SUCCESS	use 2.20
1.00	2.20 - 3.00	WFS_ERR_API_VERS_TOO_LOW	fails
1.11 - 3.00	1.00	WFS_ERR_API_VERS_TOO_HIGH	fails

Note that a version negotiation error also generates a system event (see Section 9.7).

After making its last WOSA/XFS call, an application ***must*** call **WFSCleanUp** to allow the XFS Manager to release any resources allocated for the application.

Error Codes The return value indicates whether the application was registered successfully (i.e., the XFS Manager can support requests from the application). If the function was successful, the returned value is WFS_SUCCESS; if not, it is one of the following error conditions:

WFS_ERR_ALREADY_STARTED
A **WFSStartUp** has already been issued by the application, without an intervening **WFSCleanUp**.

WFS_ERR_API_VER_TOO_HIGH
The range of versions of WOSA/XFS API support requested by the application is higher than any supported by this particular WOSA/XFS implementation.

WFS_ERR_API_VER_TOO_LOW
The range of versions of WOSA/XFS API support requested by the application is lower than any supported by this particular WOSA/XFS implementation.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

See also **WFSCleanUp**

4.24 WFSUnhookBlockingHook

HRESULT WFSUnhookBlockingHook( )

Removes any previous blocking hook that had been installed and reinstalls the default blocking mechanism.

Parameters None.

Mode Immediate

Comments The function will always install the ***default*** routine, not the ***previous*** routine. If an application wishes to nest blocking hook routines—i.e., to establish a temporary blocking call and then revert to the previous mechanism—it must save and restore the value returned by the **WFSSetBlockingHook** function. See Section 3.12.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See also **WFSSetBlockingHook**

4.25 WFSUnlock

HRESULT WFSUnlock(*hService*)

Releases a service that has been locked by a previous **WFSLock** or **WFSAsyncLock** function. The synchronous version of **WFSAsyncUnlock**.

Parameters **HSERVICE** *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen.**

Mode Synchronous

Comments See Section 3.8.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_CANCELED
The request was canceled by **WFSCancelBlockingCall**.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_NOT_LOCKED
The application requesting a service be unlocked had not previously performed a successful **WFSLock** or **WFSAsyncLock**.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See also **WFSAsyncUnlock, WFSLock, WFSAsyncLock**

4.26 WFSAsyncUnlock

HRESULT **WFSAsyncUnlock**(*hService, hWnd, lpRequestID*)

Releases a service that has been locked by a previous **WFSLock** or **WFSAsyncLock** function. The asynchronous version of **WFSUnlock**.

Parameters

HSERVICE *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen.**

HWND *hWnd*
The window handle which is to receive the completion message for this request.

LPREQUESTID *lpRequestID*
Pointer to the request identifier for this request (returned parameter).

Mode Aynchronous

Comments See **WFSUnlock** and Section 3.8.

The application ***must*** call **WFSFreeResult** to deallocate the WFSRESULT data structure which is pointed to by the completion message. Note that a WFSRESULT structure may be returned even if the function completes with an error; see Section 3.13.

Messages WFS_UNLOCK_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure:

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_NOT_LOCKED
The application requesting a service be unlocked had not previously performed a successful **WFSLock** or **WFSAsyncLock**.

See also **WFSUnlock, WFSLock, WFSAsyncLock**

5. Service Provider Interface (SPI) Functions

The service provider functions are described in the following sections, in alphabetical order. The table below shows the SPI functions, the sections in which they are defined, their modes, and the API functions they implement.

Section	WOSA/XFS SPI	Mode	WOSA/XFS API	Mode
5.1	**WFPCancelAsyncRequest**	Immediate	**WFSCancelAsyncRequest**	Immediate
5.1	**WFPCancelAsyncRequest**	Immediate	**WFSCancelBlockingCall**	Immediate
	(none)	-	**WFSCleanUp**	Synchronous
5.2	**WFPClose**	Asynchronous	**WFSClose**	Synchronous
5.2	**WFPClose**	Asynchronous	**WFSAsyncClose**	Asynchronous
	(none)	-	**WFSCreateAppHandle**	Immediate
5.3	**WFPDeregister**	Asynchronous	**WFSDeregister**	Synchronous
5.3	**WFPDeregister**	Asynchronous	**WFSAsyncDeregister**	Asynchronous
	(none)	-	**WFSDestroyAppHandle**	Immediate
5.4	**WFPExecute**	Asynchronous	**WFSExecute**	Synchronous
5.4	**WFPExecute**	Asynchronous	**WFSAsyncExecute**	Asynchronous
	(none)	-	**WFSFreeResult**	Immediate
5.5	**WFPGetInfo**	Asynchronous	**WFSGetInfo**	Synchronous
5.5	**WFPGetInfo**	Asynchronous	**WFSAsyncGetInfo**	Asynchronous
	(none)	-	**WFSIsBlocking**	Immediate
5.6	**WFPLock**	Asynchronous	**WFSLock**	Synchronous
5.6	**WFPLock**	Asynchronous	**WFSAsyncLock**	Asynchronous
5.7	**WFPOpen**	Asynchronous	**WFSOpen**	Synchronous
5.7	**WFPOpen**	Asynchronous	**WFSAsyncOpen**	Asynchronous
5.8	**WFPRegister**	Asynchronous	**WFSRegister**	Synchronous
5.8	**WFPRegister**	Asynchronous	**WFSAsyncRegister**	Asynchronous
	(none)	-	**WFSSetBlockingHook**	Immediate
5.9	**WFPSetTraceLevel**	Immediate	(none)	-
	(none)	-	**WFSStartUp**	Immediate
	(none)	-	**WFSUnhookBlockingHook**	Immediate
5.10	**WFPUnloadService**			
5.11	**WFPUnlock**	Asynchronous	**WFSUnlock**	Synchronous.
5.11	**WFPUnlock**	Asynchronous	**WFSAsyncUnlock**	Asynchronous

Note that in this section device drivers and devices are mentioned frequently, instead of service providers and services. This is due primarily to the fact that access to financial peripheral devices is the first category of financial services being addressed by the BSVC. However, note that in the future other financial services will be part of the WOSA Extensions to Financial Services, and will also use these interfaces, with additions as necessary. See Appendix A for more on this subject.

5.1 WFPCancelAsyncRequest

HRESULT **WFPCancelAsyncRequest**(*hService, RequestID*)

Cancels the specified (or every) asynchronous request being performed on the specified service provider, before its (their) completion.

Parameters

HSERVICE *hService*
Handle to the service provider.

REQUESTID *RequestID*
The request identifier (NULL to cancel all requests for the specified *hService*).

Mode

Immediate. Although the cancellation process itself is asynchronous, the completion message(s) are associated with the original request, not the cancel request (even if they indicate a WFS_ERR_CANCELED status).

Comments

If the *RequestID* parameter is set to NULL, the command will cancel ***all*** asynchronous requests on the specified service that are in progress on behalf of the calling application.

A previously initiated asynchronous request is canceled prior to completion by issuing the **WFSCancelAsyncRequest** function, specifying the request identifier returned by the asynchronous function. This function is immediate with respect to its calling application, but the cancellation process is inherently asynchronous. On completion, the specified request (or all the requests) will have finished, with a completion message indicating a status of WFS_ERR_CANCELED, unless the cancel request was made after the request had completed.

The cancellation applies to the service provider level. The request is passed through the SPI, and the service provider normally then also cancels any physical I/O or other device operation in progress, in the appropriate manner for the device or service.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_REQ_ID
The *RequestID* parameter does not correspond to an outstanding request on the service.

5.2 WFPClose

HRESULT **WFPClose**(*hService, hWnd, ReqID*)

Terminates a session (a series of service requests initiated with the **WFPOpen** SPI function) between the XFS Manager and the specified service provider.

Parameters

HSERVICE *hService*
Handle to the service provider.

HWND *hWnd*
The window handle which is to receive the completion message for this request.

REQUESTID *ReqID*
Request identification number.

Mode Asynchronous

Comments **WFPClose** directs the service to free all resources associated with the series of requests made using the *hService* parameter. If the service is locked by the application, the close automatically unlocks it. If no **WFPDeregister** has been issued, it is automatically performed.

See **WFPOpen** and Section 3.6 for further discussion.

Messages WFS_CLOSE_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated. The service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

5.3 WFPDeregister

HRESULT **WFPDeregister**(*hService, dwEventClass, hWndReg, hWnd, ReqID*)

Discontinues monitoring of the specified message class(es) from the specified service provider, by the specified *hWndReg* (or all *hWnd*'s).

Parameters

HSERVICE *hService*
Handle to the service provider

DWORD *dwEventClass*
The class(es) of messages from which the application is deregistering. Specified as a set of bit masks that can be logically ORed together. A NULL value requests that ***all*** message classes be deregistered from the specified window for this service provider.

HWND *hWndReg*
The window to which notification messages are posted. A NULL value requests that ***all*** the application's windows be deregistered from the specified message class(es) for this *hService*.

HWND *hWnd*
The window handle which is to receive the completion message for this request.

REQUESTID *ReqID*
Request identification number.

Mode Asynchronous

Comments

WFPDeregister does not stop asynchronous command completion messages from being posted; a robust application should be designed to accept these messages even after a deregister is issued.

A **WFPDeregister** os performed automatically if a **WFPClose** is issued without a previous **WFPDeregister**.

To deregister ***all*** messages for ***all*** *hWnd*s, the call supplies NULL values for both the *dwEventClass* and *hWnd* parameters.

See the **WFPRegister** function for a description of the types of events that may be monitored.

Messages WFS_DEREGISTER_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_EVENT_CLASS
The *dwEventClass* parameter specifies one or more event classes not supported by the service.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_HWNDREG
The *hWndReg* parameter is not a valid window handle.

WFS_ERR_NOT_REGISTERED
The specified *hWndReg* window was not registered to receive messages for any event classes.

The following error condition is returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

5.4 WFPExecute

HRESULT **WFPExecute**(*hService, dwCommand, lpCmdData, dwTimeOut, hWnd, ReqID*)

Sends asynchronous service class specific commands to a service provider.

Parameters

HSERVICE *hService*
Handle to the service provider.

DWORD *dwCommand*
Command to be executed.

LPVOID *lpCmdData*
Pointer to the data structure to be passed.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

HWND *hWnd*
The window handle which is to receive the completion message for this request.

REQUESTID *ReqID*
Request identification number.

Mode Asynchronous

Comments See **WFSExecute**.

Messages WFS_EXECUTE_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_COMMAND
The *dwCommand* issued is not supported by this service class.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_UNSUPP_COMMAND
The *dwCommand* issued, although valid for this service class, is not supported by this service provider.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_INVALID_DATA
The data structure passed as input parameter contains invalid data..

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_LOCKED
The service is locked under a different *hService*.

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_TIMEOUT
The timeout interval expired.

5.5 WFPGetInfo

HRESULT **WFPGetInfo**(*hService, dwCategory, lpQueryDetails, dwTimeOut, hWnd, ReqID*)

Retrieves various kinds of information from the specified service provider.

Parameters

HSERVICE *hService*
Handle to the service provider.

DWORD *dwCategory*
Specifies the category of the query (e.g., for a printer, WFS_INF_PTR_STATUS to request status or WFS_INF_PTR_CAPABILITIES to request capabilities). The available categories depend on the service class, the service provider and the service. The information requested can be either static or dynamic, e.g., basic service capabilities (static) or current service status (dynamic).

LPVOID *lpQueryDetails*
Pointer to the data structure to be passed to the service provider, containing further details to make the query more precise, e.g., a form name. (Many queries have no input parameters, in which case this pointer is NULL.)

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

HWND *hWnd*
The window handle which is to receive the completion message for this request.

REQUESTID *ReqID*
Request identification number.

Mode Asynchronous

Comments The XFS Manager retrieves the information requested from the service provider itself, and, since the information can be stored remotely, the function cannot be guaranteed to complete immediately. Note that, typically, requests for generic and class specific categories ***can*** complete immediately. See **WFSGetInfo** for additional discussion.

The specifications for the information structures for each service class can be found in the specifications for the service-specific commmands.

Messages WFS_GETINFO_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_CATEGORY
The *dwCategory* issued is not supported by this service class.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_UNSUPP_CATEGORY
The *dwCategory* issued, although valid for this service class, is not supported by this service provider.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_DATA
The data structure passed as input parameter contains invalid data..

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_TIMEOUT
The timeout interval expired.

5.6 WFPLock

HRESULT **WFPLock**(*hService, dwTimeOut, hWnd, ReqID*)

Establishes exclusive control by the calling application over the specified service.

Parameters

HSERVICE *hService*
Handle to the service provider.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

HWND *hWnd*
The window handle which is to receive the completion message for this request.

REQUESTID *ReqID*
Request identification number.

Mode Asynchronous

Comments See **WFSLock**.

Messages WFS_LOCK_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_TIMEOUT
The timeout interval expired.

5.7 WFPOpen

HRESULT **WFPOpen**(*hService, lpszLogicalName, hApp, lpszAppID, dwTraceLevel, dwTimeOut, hWnd, ReqID, hProvider, dwSPIVersionsRequired, lpSPIVersion, dwSrvcVersionsRequired, lpSrvcVersion)*

Establishes a connection between the XFS Manager and the service provider that supports the specified service, and initiates a session (a series of service requests terminated with the **WFPClose** function).

Parameters

HSERVICE *hService*
The service handle to be associated with the session being opened..

LPSTR *lpszLogicalName*
Points to a null-terminated string containing the pre-defined logical name of a service. It is a high level name such as "SYSJOURNAL1," "PASSBOOKPTR3" or "ATM02," that is used by the XFS Manager and the service provider as a key to obtain the specific configuration information they need.

HAPP *hApp*
The application handle to be associated with the session being opened.
See **WFSCreateAppHandle** and Sections 3.5 and 3.8.2 for details.

LPSTR *lpszAppID*
Pointer to a null terminated string containing the application ID; the pointer may be NULL if the ID is not used.

DWORD *dwTraceLevel*
See **WFPSetTraceLevel**.

DWORD *dwTimeOut*
Number of milliseconds to wait for completion (WFS_INDEFINITE_WAIT to specify a request that will wait until completion).

HWND *hWnd*
The window handle which is to receive the completion message for this request.

REQUESTID *ReqID*
Request identification number.

HPROVIDER *hProvider*
Service provider handle supplied by the XFS Manager – used by the service provider to identify itself when calling the **WFMReleaseDLL** function.

DWORD *dwSPIVersionsRequired*
Specifies the range of WOSA/XFS SPI versions that the XFS Manager can support. (See Comments.) The low-order word indicates the highest version the XFS Manager can support; the high-order word indicates the lowest version the XFS Manager can support. In each word, the low-order byte specifies the major version number and the high-order byte specifies the minor version number (i.e., the numbers before and after the decimal).
Note: in order to allow intermediate minor revisions (e.g., between 1.10 and 1.20), the minor version number should always be expressed as two decimal digits, i.e., 1.10, 1.11, 1.20, etc.

LPWFSVERSION *lpSPIVersion*
Pointer to the data structure that is to receive SPI version support information and (optionally) other details about the SPI implementation (returned parameter).

DWORD *dwSrvcVersionsRequired*
Service-specific interface versions required; see *dwSPIVersionsRequired* above, and **WFSOpen**.

LPWFSVERSION *lpSrvcVersion*
Pointer to the service-specific interface implementation information; see *lpSPIVersion* above, and **WFSOpen** (returned parameter).

Mode Asynchronous

Comments This function establishes the connection between the XFS Manager and the service provider, including version negotiation and passing of implementation information, and initiates a session between the application and the service. This call is made by the XFS Manager each time any application issues a **WFSOpen** or **WFSAsyncOpen** call to the specified service (immediately after loading the service provider DLL, if it is not already loaded).

In order to support future WOSA/XFS implementations with maximum flexibility, two version negotiations take place in **WFPOpen**. In the first, the XFS Manager specifies in the *dwSPIVersionsRequired* parameter the range of versions of the WOSA/XFS SPI specification which it can support. If the range of versions specified by the XFS Manager overlaps the range of versions that the service provider can support, the call succeeds. Otherwise the call fails.

The WFSVERSION data structure (described in Section 8.2) is used by the service provider to return the version of SPI support it expects the XFS Manager to use (the highest common version), as well as the lowest and highest versions it is capable of. In addition, this structure is used optionally by the XFS Manager to specify other information about the service provider implementation. If the call fails, WFSVERSION is still returned, to help with analysis of the failure.

The version numbers refer to the SPI specification, specifically functions, parameters, data structures, error codes, and messages. If there are any changes to these, the version number should be changed.

This version negotiation allows the XFS Manager and a service provider to operate successfully if there is any overlap in their versions. The following chart gives examples of how **WFPOpen** works in conjunction with different XFS Manager and service provider versions:

XFS Manager versions	Service Provider versions	Return status from **WFPOpen**	Result
1.00	1.00	WFS_SUCCESS	use 1.00
1.00 - 2.10	1.00	WFS_SUCCESS	use 1.00
1.11	1.00 - 2.00	WFS_SUCCESS	use 1.11
2.11 - 3.00	1.00 - 2.20	WFS_SUCCESS	use 2.20
1.00	2.20 - 3.00	WFS_ERR_SPI_VER_TOO_LOW	fails
1.11 - 3.00	1.00	WFS_ERR_SPI_VER_TOO_HIGH	fails

The second negotiation is is in relation to the service-specific interface, between the application program and the service provider. See **WFSOpen**, Section 4.19, for details.

Note that a version negotiation error also generates a system event (see Section 9.7).

Also, see **WFSStartUp**, Section 4.24.

Messages WFS_OPEN_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_INVALID_TRACELEVEL
The *dwTraceLevel* parameter does not correspond to a valid trace level or set of levels.

WFS_ERR_SPI_VER_TOO_HIGH
The range of versions of WOSA/XFS SPI support requested by the XFS Manager is higher than any supported by this particular service provider.

WFS_ERR_SPI_VER_TOO_LOW
The range of versions of WOSA/XFS SPI support requested by the XFS Manager is lower than any supported by this particular service provider.

WFS_ERR_SRVC_VER_TOO_HIGH
The range of versions of the service-specific interface support requested by the application is higher than any supported by the service provider for the logical service being opened.

WFS_ERR_SRVC_VER_TOO_LOW
The range of versions of the service-specific interface support requested by the application is lower than any supported by the service provider for the logical service being opened.

WFS_ERR_VERSION_ERROR_IN_SRVC
Within the service, a version mismatch of two modules occurred.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. The service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_TIMEOUT
The timeout interval expired.

WFS_ERR_VERSION_ERROR_IN_SRVC
Within the service, a version mismatch of two modules occurred.

5.8 WFPRegister

HRESULT **WFPRegister**(*hService, dwEventClass, hWndReg, hWnd, ReqID*)

Enables event monitoring for the specified service by the specified *hWndReg*; all events of the specified class(es) generate messages to the *hWndReg*.

Parameters

HSERVICE *hService*
Handle to the service provider.

DWORD *dwEventClass*
The class(es) of events for which the application is registering. Specified as a set of bit masks that can be logically ORed together.

HWND *hWndReg*
The window handle which is to be registered to receive the specified messages.

HWND *hWnd*
The window handle which is to receive the completion message for this request.

REQUESTID *ReqID*
Request identification number.

Mode Asynchronous

Comments **WFPDeregister** is used to cancel notifications. See **WFSRegister**.

Messages WFS_REGISTER_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_EVENT_CLASS
The *dwEventClass* parameter specifies one or more event classes not supported by the service.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_HWNDREG
The *hWndReg* parameter is not a valid window handle.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

5.9 WFPSetTraceLevel

HRESULT **WFPSetTraceLevel**(*hService, dwTraceLevel*)

Sets the specified trace level(s) at run time, in and/or below the service provider. See **WFMSetTraceLevel**.

Parameters

HSERVICE *hService*
Handle to the service provider.

DWORD *dwTraceLevel*
The level(s) of tracing being requested. See below.

Mode Immediate

Comments

Issuing **WFPSetTraceLevel** for a service enables tracing on that service at various levels. The predefined trace levels that can be used in this function, with their meanings to the service provider, are as follows (see **WFMSetTraceLevel** for the API and support function trace levels):

`WFS_TRACE_SPI 0x00000004`

Trace all the SPI calls to the service provider, and notification and event messages generated by the service provider, that are associated with the specified *hService*.

`WFS_TRACE_ALL_SPI 0x00000008`

Trace ***all*** SPI, notification and event activity of the service provider (the *hService* parameter is not relevant to this trace level).

Other standard trace levels may be defined in the future, and a range of trace level values (the high order 16 bits of this parameter) is reserved for use by individual service providers. Example of other functions that may be traced include network messages, interactions between the service provider and service, and device interface interaction.

Trace level values can be ORed together in a single *dwTraceLevel* parameter to request more than one kind of tracing be started. A NULL value stops all tracing in the service provider.

If more than one process may be using the trace facility, this function should always be preceded with the **WFMGetTraceLevel** function. This value returned by this function is ORed together with the new trace level(s), and the resulting value is used with **WFMSetTraceLevel**, thus adding the new trace level(s) to whatever the existing trace level(s) had been,

This function has the highest priority to the service provider; it activates the trace as soon as possible.

WFPOpen also includes an option to set these trace levels, to allow the open process itself to be traced.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_TRACELEVEL
The *dwTraceLevel* parameter does not correspond to a valid trace level or set of levels.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See Also **WFMGetTraceLevel, WFSOpen, WFSAsyncOpen**

5.10 WFPUnloadService

HRESULT WFPUnloadService( )

Asks the called service provider whether it is OK for the XFS Manager to unload the service provider's DLL.

Parameters None

Mode Immediate

Comments This function is issued after the XFS Manager has received a **WFMReleaseDLL** request from the service provider or during the processing of the **WFSCleanUp** command. The service provider returns WFS_SUCCESS only if it has fully "cleaned up," i.e., has freed any resources it has allocated, has no separate threads running, etc. If this is not true, it returns the error below, and initiates or continues the clean up process.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_NOT_OK_TO_UNLOAD
The XFS Manager may not unload the service provider DLL at this time. It will repeat this request to the service provider until the return is WFS_SUCCESS, or until a new session is started by an application with this service provider.

5.11 WFPUnlock

HRESULT **WFPUnlock**(*hService, hWnd, ReqID*)

Releases a service that has been locked by a previous **WFPLock** function.

Parameters

HSERVICE *hService*
Handle to the service provider

HWND *hWnd*
The window handle which is to receive the completion message for this request.

REQUESTID *ReqID*
Request identification number.

Mode Asynchronous

Comments See **WFPLock**, **WFSLock**, **WFSUnlock** and Section 3.9.

Messages WFS_UNLOCK_COMPLETE

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions, indicating that the asynchronous operation was not initiated. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

The following error conditions are returned via the asynchronous command completion message, as the *hResult* from the WFSRESULT structure. Any service-specific errors that can be returned are defined in the specifications for each service class.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest**.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_NOT_LOCKED
The service to be unlocked is not locked under the calling *hService*.

6. Support Functions

Support functions are services of the XFS Manager used by service providers and applications. All the functions are ***immediate***, since they are completely processed inside the XFS Manager, or use only immediate functions of the service providers.

6.1 WFMAllocateBuffer

HRESULT **WFMAllocateBuffer**(*ulSize, ulFlags, lppvData*)

Allocates a memory buffer for the service provider in which to return results.

Parameters

ULONG *ulSize*
Size (in bytes) of the memory to be allocated.

ULONG *ulFlags*
Flags, see comments below.

LPVOID * *lppvData*
Address of the variable in which the XFS Manager will place the pointer to the allocated memory.

Comments

A service provider ***must*** use this call when creating data structures for the XFS Manager or an application to use, and may use it when allocating memory for its own private use. The flags can be ORed together, and specify:

WFS_MEM_SHARE	Allocates shareable memory.
WFS_MEM_ZEROINIT	Initializes memory contents to zero (not required in 32 bit Windows).

The application, XFS Manager or service provider then ***must***, in turn, use the **WFSFreeResult** or **WFMFreeBuffer** functions to deallocate the memory.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_OUT_OF_MEMORY
There is not enough memory available to satisfy the request.

See also

WFMAllocateMore, **WFMFreeBuffer**, **WFSFreeResult** and Section 3.13.

6.2 WFMAllocateMore

HRESULT **WFMAllocateMore**(*ulSize, lpvOriginal, lppvData*)

Allocates a memory buffer, linking it to an previously allocated one.

Parameters

ULONG *ulSize*
Size (in bytes) of the memory to be allocated

LPVOID *lpvOriginal*
Address of the original buffer to which the newly allocated buffer should be linked

LPVOID * *lppvData*
Address of the variable in which the XFS Manager will place the pointer to the newly allocated memory.

Comments This function allocates an additional memory buffer and link it to one previously allocated by **WFMAllocateBuffer**. The returned buffer has the same properties as the previous buffer (i.e., the WFS_MEM_SHARE and WFS_MEM_ZEROINIT flags) and it can be freed ***only*** by freeing the original buffer (using **WFMFreeBuffer** or **WFSFreeResult**).

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INVALID_ADDRESS
The *lpvOriginal* parameter does not point to a previously allocated buffer.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_OUT_OF_MEMORY
There is not enough memory available to satisfy the request.

See also **WFMAllocateBuffer, WFMFreeBuffer**, **WFSFreeResult** and Section 3.13.

6.3 WFMFreeBuffer

HRESULT **WFMFreeBuffer**(*lpvData*)

Releases the memory buffer(s) allocated by **WFMAllocateBuffer** and **WFMAllocateMore**.

Parameters

LPVOID *lpvData*
Address of the memory buffer to free.

Comments See **WFMAllocateBuffer** and **WFSFreeResult**. This function frees a set of one or more linked buffers, as does the **WFSFreeResult** API function, except that it is used by service providers to free memory that they have allocated for "private" use, via the **WFMAllocateBuffer** and **WFMAllocateMore** functions.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INVALID_BUFFER
The *lpvData* parameter is not a pointer to an allocated buffer structure.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

See also **WFMAllocateBuffer, WFMAllocateMore**, **WFSFreeResult** and Section 3.13.

6.4 WFMGetTraceLevel

HRESULT **WFMGetTraceLevel**(*hService, lpdwTraceLevel*)

Returns the trace level associated with the specified *hService* (at run time). See **WFMSetTraceLevel**.

Parameters **HSERVICE** *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen**.

LPDWORD *lpdwTraceLevel*
Pointer to the value defining the current trace level (returned parameter).

Mode Immediate

Comments This function returns the current tracing levels in the XFS Manager and the service provider specified by *hService*. See **WFMSetTraceLevel**.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See Also **WFMSetTraceLevel, WFSOpen, WFSAsyncOpen**

6.5 WFMKillTimer

HRESULT **WFMKillTimer**(*wTimerID*)

Cancels the timer identified by the *wTimerID* parameter. Any pending WFS_TIMER_EVENT message associated with the timer is removed from the message queue.

Parameters **WORD** *wTimerID*
ID of the timer to be canceled.

Comments See **WFMSetTimer**.

Error Codes If the function return is not WFS_SUCCESS, it is the following error condition:

WFS_ERR_INVALID TIMER
The *usTimerID* parameter does not correspond to a currently active timer.

6.6 WFMOutputTraceData

HRESULT **WFMOutputTraceData**(*lpszData*)

Requests the XFS Manager to output the specified data to the current trace destination.

Parameters **LPSTR** *lpszData*
Pointer to a null-terminated string containing the trace data.

Comments Normally used by a service provider that has been requested via **WFMSetTraceLevel** to trace its operation. The XFS Manager adds standard header information (timestamp, etc.) to the data before writing it to the trace stream. Note that the XFS Manager also writes data to the trace stream if the appropriate trace level(s) have been requested.

Error Codes If the function return is not WFS_SUCCESS, it is the following error condition:

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

6.7 WFMReleaseDLL

HRESULT **WFMReleaseDLL**(*hProvider*)

Notifies the XFS Manager that the service provider is available to be unloaded from memory.

Parameters **HPROVIDER** *hProvider*
Handle to the service provider, obtained from the XFS Manager in the **WFPOpen** call.

Comments This function initiates the process in which the service provider is unloaded from memory by the XFS Manager. However, note that the Manager must issue the **WFPUnloadService** function to the service provider before it actually unloads the service provider DLL. The recommended procedure is as follows:

- The service provider finishes processing the **WFPClose** for its last open session
- The SP does appropriate cleanup (deallocating memory, killing separate threads, etc.)
- The SP posts the WFS_CLOSE_COMPLETE message for the final close
- The SP calls **WFMReleaseDLL**, and after the return from this call, does nothing other than return from the procedure that called **WFMReleaseDLL**
- The XFS Manager calls **WFPUnloadService**, verifying that the SP is in fact still ready to be unloaded
- If the SP says OK, the XFS Manager unloads the SP DLL

Error Codes If the function return is not WFS_SUCCESS, it is the following error condition:

WFS_ERR_INVALID_HPROVIDER
The *hProvider* parameter is not a valid provider handle.

6.8 WFMSetTimer

HRESULT **WFMSetTimer**(*hWnd, lpContext, dwTimeVal, lpwTimerID*)

Starts a system timer.

Parameters

HWND *hWnd*
The window to which the requested timer message is to be posted.

LPVOID *lpContext*
Context pointer supplied by the service provider requesting the timer; may be NULL.

DWORD *dwTimeVal*
Timer value (in milliseconds).

LPWORD *lpwTimerID*
Pointer to the timer identifier (returned parameter).

Comments

The **WFMSetTimer** function requests the XFS Manager to start a system timer with the specified time value; when that time interval expires, the XFS Manager posts a WFS_TIMER_EVENT message to the specified *hWnd*, containing the *wTimerID* value and the *lpContext* pointer.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

6.9 WFMSetTraceLevel

HRESULT **WFMSetTraceLevel**(*hService, dwTraceLevel*)

Sets the specified trace level(s) at run time; to be used for debugging and testing purposes.

Parameters

HSERVICE *hService*
Handle to the service provider as returned by **WFSOpen** or **WFSAsyncOpen**.

DWORD *dwTraceLevel*
The level(s) of tracing being requested. See below.

Mode Immediate

Comments Issuing **WFMSetTraceLevel** for a service enables tracing on that service at various levels. Five standard trace levels are predefined:

`WFS_TRACE_API 0x00000001`

Trace all input and output parameters of all API function calls using the specified *hService*.

`WFS_TRACE_ALL_API 0x00000002`

Trace all input and output parameters of ***all*** API function calls associated with the service provider identified by the specified *hService*, ***not*** just the ones associated with the specified *hService*.

`WFS_TRACE_SPI 0x00000004`

Trace all input and output parameters of all SPI function calls associated with the specified *hService*, as well as all notification and event messages generated by the service provider for the *hService*.

`WFS_TRACE_ALL_SPI 0x00000008`

As for WFS_TRACE_ALL_API, but trace ***all*** SPI, notification and event activity on the service provider, ***not*** just that associated with the specified *hService*.

`WFS_TRACE_MGR 0x00000010`

Trace the support functions (**WFMxxxxx**) of the XFS Manager.

Other standard trace levels may be defined in the future, and a range of trace level values (the high order 16 bits of this parameter) is reserved for use by individual service providers. Examples of other functions that may be traced include network messages, interactions between the service provider and service, and device interface interaction.

Trace level values can be ORed together in a single *dwTraceLevel* parameter to request more than one kind of tracing be started. A NULL value stops all tracing.

If more than one process may be using the trace facility, this function should always be preceded with a call to the **WFMGetTraceLevel** function. This value returned by this function is ORed together with the new trace level(s), and the resulting value is used with **WFMSetTraceLevel**, thus adding the new trace level(s) to whatever the existing trace level(s) had been,

This function has the highest priority to the XFS Manager and the service provider; they activate the trace as soon as possible. Note that the XFS Manager performs all the traces defined above, other than the completion and event messages posted by the service providers.

WFSOpen and **WFSAsyncOpen** also include an option to set these trace levels, to allow the open process itself to be traced.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_TRACELEVEL
The *dwTraceLevel* parameter does not correspond to a valid trace level or set of levels.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_OP_IN_PROGRESS
A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

See Also **WFMGetTraceLevel, WFPSetTraceLevel, WFSOpen, WFSAsyncOpen**

7. Configuration Functions

See Section 3.7 for the overall discussion of configuration information. The configuration functions are used by service providers and applications to write and retrieve the configuration information for a WOSA/XFS subsystem, which is stored in a hierarchical structure called the XFS configuration registry. The structure and the functions are based on the Win32 Registry architecture and API functions, and are implemented in Windows NT and future versions of Windows using the Registry and the associated functions. For Win32s-based implementations on Windows 3.1 and Windows for Workgroups, a subset of the functionality described here will be available; see the SDK for the definition of this subset.

The logical structure of the configuration information is shown below.

The XFS Manager key has the following optional values:

- TraceFile the name of the file containing trace data. If this value is not set in the configuration, trace data is written to the default file path\name C:\XFSTRACE.LOG.
- ShareFilename the name of the memory mapped file used by the memory management functions of the XFS Manager.
- ShareFilesize the size of the memory mapped file used by the memory management functions of the XFS Manager.

Some additional values could be also defined in the WOSA/XFS SDK release notes. Please refer to the related document for more information.

A logical service key has three mandatory values:

- class the service class of the logical service. The standard values are described in the Service Class Definition Document and in the service class include files.
- type the service type of the logical service; the standard values are in the SDK
- provider the name of the service provider that provides the logical service (the key name of the corresponding service provider key)

A service provider key also has three mandatory values:

- dllname the name of the file containing the service provider DLL
- vendor_name the name of the supplier of this service provider
- version the version number of this service provider

WOSA/XFS Registry Root	Second Level Keys	Third Level Keys	Values
WOSA/XFS_ROOT			
	XFS_MANAGER		TraceFile=<path-name>\<trace-file-name> ShareFilename=<path-name>\ <share-file-name> ShareFilesize=<file size in bytes>
	LOGICAL_SERVICES		
	There is one of these keys for each logical service accessible in this system.	**<Logical Service Name>**	class=<service class> type=<service type> provider=<provider name> < optional values >
	SERVICE_PROVIDERS		
	There is one of these keys for each service provider accessible in this system.	**<Provider Name>**	dllname=< DLL name> vendor_name=<vendor name> version=<version> < optional values >
	< other keys >		

7.1 WFMCloseKey

HRESULT **WFMCloseKey** (*hKey*)

Closes the specified key.

Parameters **HKEY** *hKey*
Handle to the currently open key that is to be closed.

Comments The *hkey* handle can not be used after it has been closed, because it will no longer be valid. Note that it is not valid to close the XFS root key (passing WFS_CFG_HKEY_XFS_ROOT as value for *hkey* parameter).

Error Codes If the function return is not WFS_SUCCESS, it is the following error condition:

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key, or it is the XFS root.

7.2 WFMCreateKey

HRESULT **WFMCreateKey** (*hKey, lpszSubKey, phkResult, lpdwDisposition*)

Creates a new key, or if the specified key exists, opens it.

Parameters **HKEY** *hKey*
Handle to a currently open key, or the predefined handle value:
WFS_CFG_HKEY_XFS_ROOT
The key opened or created by this function is a subkey of the key identified by this parameter.

LPSTR *lpszSubKey*
Pointer to a null-terminated string containing the name of the key to be created or opened.

PHKEY *phkResult*
Pointer to a variable that receives the handle of the created or opened key.

LPDWORD *lpdwDisposition*
Pointer to a variable that receives one of the disposition values:
WFS_CFG_CREATED_NEW_KEY
WFS_CFG_OPENED_EXISTING_KEY

Comments If this function creates a new key, it has no values. The **WFMSetValue** function is used to create values.

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions:

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

7.3 WFMDeleteKey

HRESULT **WFMDeleteKey** (*hKey, lpszSubKey*)

Deletes the specified key. This function cannot delete a key that has subkeys.

Parameters

HKEY *hKey*
Handle to a currently open key, or the predefined handle value:
WFS_CFG_HKEY_XFS_ROOT
The key specified by the *lpszSubKey* parameter must be a subkey of the key identified by this parameter.

LPSTR *lpszSubKey*
Pointer to a null-terminated string specifying the name of the key to be deleted.

Comments

If this function succeeds, the specified key is removed from the configuration information. The entire key, including all its values, is removed.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_CFG_INVALID_SUBKEY
The key specified by *lpszSubKey* does not exist.

WFS_ERR_CFG_KEY_NOT_EMPTY
The specified key has subkeys and cannot be deleted. The subkeys must be deleted first.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

7.4 WFMDeleteValue

HRESULT **WFMDeleteValue** (*hKey, lpszValue*)

Deletes the specified value (both name and data).

Parameters

HKEY *hKey*
Handle to a currently open key, or the predefined handle value:
WFS_CFG_HKEY_XFS_ROOT

LPSTR *lpszValue*
Pointer to a null-terminated string specifying the name of the value to be deleted.

Comments

The specified value is removed from the specified open key. The **WFMSetValue** function is used to create or modify values.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_CFG_INVALID_VALUE
The specified value does not exist within the specified open key.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

7.5 WFMEnumKey

HRESULT **WFMEnumKey** (*hKey, iSubKey, lpszName, lpcchName, lpftLastWrite*)

Enumerates the subkeys of the specified open key. Retrieves information about one subkey each time it is called.

Parameters

HKEY *hKey*

Handle to a currently open key, or the predefined handle value:

WFS_CFG_HKEY_XFS_ROOT

The keys enumerated by this function are subkeys of the key identified by this parameter.

DWORD *iSubKey*

The index of the subkey to retrieve. This parameter should be zero for the first call to this function, then incremented for each subsequent call, in order to enumerate all the subkeys of the specified open key.

Because subkeys are not ordered, any new subkey will have an arbitrary index. This means that the function may return subkeys in any order.

LPSTR *lpszName*

Pointer to a buffer that receives the name of the subkey, including the terminating null character.

LPDWORD *lpcchName*

Pointer to a variable that specifies the size, in characters, of the buffer specified by the *lpszName* parameter, including the terminating null character. When the function returns, this variable contains the the number of characters actually stored in the buffer, ***not*** including the terminating null character.

PFILETIME *lpftLastWrite*

Pointer to a variable that receives the time the enumerated subkey was last written to, in the form of a FILETIME structure (see *Microsoft Win32 Programmer's Reference, Vol. 5*):

```
typedef struct _FILETIME {
    DWORD  dwLowDateTime;
    DWORD  dwHighDateTime;
} FILETIME;
```

Comments

While a program is using this function iteratively, it should not call any other configuration functions that would change the key being enumerated.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CFG_INVALID_HKEY

The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_CFG_NO_MORE_ITEMS

There are no more subkeys to be returned (the *iSubKey* parameter is greater than the index of the last subkey).

WFS_ERR_CFG_NAME_TOO_LONG

The length of the name to be returned exceeds the length of the buffer.

WFS_ERR_INVALID_POINTER

A pointer parameter does not point to accessible memory.

7.6 WFMEnumValue

HRESULT **WFMEnumValue** (*hKey, iValue, lpszValue, lpcchValue, lpszData, lpcchData*)

Enumerates the values of the specified open key. Retrieves the name and data for one value each time it is called.

Parameters

HKEY *hKey*
Handle to a currently open key, or the predefined handle value:
WFS_CFG_HKEY_XFS_ROOT
The value enumerated by this function is a value of the key identified by this parameter.

DWORD *iValue*
The index of the value to retrieve. This parameter should be zero for the first call to this function, then incremented for each subsequent call, in order to enumerate all the values of the specified open key.

Because values are not ordered, any new value will have an arbitrary index. This means that the function may return values in any order.

LPSTR *lpszValue*
Pointer to a buffer that receives the name of the value, including the terminating null character.

LPDWORD *lpcchValue*
Pointer to a variable that specifies the size, in characters, of the buffer pointed to by the *lpszValue* parameter. This size should include the terminating null character. When the function returns, this variable contains the the number of characters actually stored in the buffer, ***not*** including the terminating null character.

LPSTR *lpszData*
Pointer to a buffer that receives the data for the value entry, including the terminating null character. This parameter can be NULL, if the data is not required.

LPDWORD *lpcchData*
Pointer to a variable that specifies the size, in characters, of the buffer pointed to by the *lpszData* parameter, including the terminating null character. When the function returns, this variable contains the the number of characters actually stored in the buffer, ***not*** including the terminating null character. Ignored if *lpszData* is NULL.

Comments

While a program is using this function iteratively, it should not call any other configuration functions that would change the key being queried.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_CFG_NO_MORE_ITEMS
There are no more values to be returned (the *iValue* parameter is greater than the index of the last value).

WFS_ERR_CFG_NAME_TOO_LONG
The length of the name to be returned exceeds the length of the buffer.

WFS_ERR_CFG_VALUE_TOO_LONG
The length of the value to be returned exceeds the length of the buffer.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

7.7 WFMOpenKey

HRESULT **WFMOpenKey** (*hKey, lpszSubKey, phkResult*)

Opens the specified key.

Parameters

HKEY *hKey*
Handle to a currently open key, or the predefined handle value:
WFS_CFG_HKEY_XFS_ROOT
The key opened by this function is a subkey of the key identified by this parameter.

LPSTR *lpszSubKey*
Pointer to a null-terminated string containing the name of the key to be opened. If this parameter is NULL, or points to an empty string, the function opens another handle to the key identified by the *hKey* parameter (and does ***not*** close any previously opened handles).

PHKEY *phkResult*
Pointer to a variable that receives the handle of the opened key.

Comments

In contrast with the **WFMCreateKey** function, this function does not create the specified key if it does not exist.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_CFG_INVALID_SUBKEY
The key specified by *lpszSubKey* does not exist.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

7.8 WFMQueryValue

HRESULT **WFMQueryValue** (*hKey, lpszValueName, lpszData, lpcchData*)

Retrieves the data for the value with the specified name, within the specified open key.

Parameters

HKEY *hKey*
Handle to a currently open key, or the predefined handle value:
WFS_CFG_HKEY_XFS_ROOT
The value data returned is within the key identified by this parameter.

LPSTR *lpszValueName*
Pointer to a null-terminated string containing the name of the value being queried.

LPSTR *lpszData*
Pointer to a buffer that receives the data for the value entry, including the terminating null character.

LPDWORD *lpcchData*
Pointer to a variable that specifies the size, in characters, of the buffer pointed to by the *lpszData* parameter, including the terminating null character. When the function returns, this variable contains the the number of characters actually stored in the buffer, ***not*** including the terminating null character.

Comments

Error Codes If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_CFG_INVALID_NAME
The value specified by the *lpszValueName* parameter does not exist in the specified key.

WFS_ERR_CFG_VALUE_TOO_LONG
The length of the value to be returned exceeds the length of the buffer.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

7.9 WFMSetValue

HRESULT **WFMSetValue** (*hKey, lpszValueName, lpszData, cchData*)

Stores data in the specified value of the specified key. If the value does not exist, it is created.

Parameters

HKEY *hKey*
Handle to a currently open key, or the predefined handle value:
WFS_CFG_HKEY_XFS_ROOT
The value set or created is within the key identified by this parameter.

LPSTR *lpszValueName*
Pointer to a null-terminated string containing the name of the value being set. If a value with this name does not already exist in the specified key, it is added to the key.

LPSTR *lpszData*
Pointer to a buffer containing the data (a null-terminated character string) to be stored with the specified value name.

DWORD *cchData*
The size, in characters, of the string pointed to by the *lpszData* parameter, including the terminating null character.

Comments

Value lengths are limited by available memory. Long values (more than 2048 bytes) should be stored as files with the filenames stored in the configuration information.

Error Codes

If the function return is not WFS_SUCCESS, it is one of the following error conditions.

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

8. Data Structures

8.1 WFSRESULT

This structure has three functions:

- It is the parameter which returns the results of the synchronous **WFSLock**, **WFSExecute** and **WFSGetInfo** commands.
- It is pointed to by ***all*** command completion messages, and delivers completion status (as a result handle) and results data (if any) for ***all*** asynchronous API and SPI calls.
- It is pointed to by ***all*** event notification messages to deliver their contents.

Note that even though in many cases one or more members of this structure are not used, the adoption of a single, standard structure for request results simplifies the implementation and maintenance of applications, service providers and the XFS Manager itself.

```
typedef struct _wfs_result {
   REQUESTID RequestID;
   HSERVICE  hService;
   TIMESTAMP tsTimestamp;
   HRESULT   hResult;
   union {
      DWORD     dwCommandCode;
      DWORD     dwEventID;
   } u;
   LPVOID    lpBuffer;
} WFSRESULT, * LPWFSRESULT;
```

The members of this structure are:

Field	Description
RequestID	Request ID of the completed command; not used for event notifications other than Execute events
hService	Service handle identifying the session that created the result
tsTimestamp	Time the event occurred (local time, in a Win32 SYSTEMTIME structure)
hResult	Result handle (note that for synchronous **WFSExecute** and **WFSGetInfo** commands, this value is identical to the synchronous function return value)
u.dwCommandCode	**WFSExecute** "command" code or **WFSGetInfo** "category" code; not used for other command completions
u.dwEventID	ID of the event (for unsolicited events)
lpBuffer	Pointer to the results of the command (if any) or the contents of the event notification

8.2 WFSVERSION

This structure is used to return version information from **WFSStartUp**, **WFSOpen** and **WFPOpen**.

```
typedef  struct _wfsversion {
   WORD      wVersion;
   WORD      wLowVersion;
   WORD      wHighVersion;
   char      szDescription[WFSDDESCRIPTION_LEN+1];
   char      szSystemStatus[WFSDSYSSTATUS_LEN+1];
} WFSVERSION, *LPWFSVERSION;
```

The members of this structure are (note that this structure is used to report version information for three distinct WOSA/XFS interfaces: API, SPI, and the service-specific interface):

Element	Usage
wVersion	The version number to be used.
wLowVersion	The lowest version number that the called DLL can support.
wHighVersion	The highest version number that the called DLL can support.
szDescription	A null-terminated ASCII string into which the called DLL copies a description of the implementation. The text (up to 256 characters in length) may contain any characters: the most likely use that an application will make of this is to display it (possibly truncated) in a status message.
szSystemStatus	A null-terminated ASCII string into which the called DLL copies relevant status or configuration information. Not to be considered as an extension of the *szDescription* field. Used only if the information might be useful to the user or support staff.

9. Messages

This section defines the Windows messages used in the WOSA/XFS subsystem.

9.1 Command Completions and Events

The following messages are sent to indicate:
- the completion of an asynchronous command, or
- the occurrence of an unsolicited event (execute, service, user, or system events).

All these messages have the same definition:

wParam: not used
lParam: points to a WFSRESULT data structure

```
WFS_<message_name>
wParam;   /*  not used  */
lParam = LPWFSRESULT lpWFSResult;
```

9.1.1 Command Completion Messages

WFS_OPEN_COMPLETE

WFS_CLOSE_COMPLETE

WFS_LOCK_COMPLETE

WFS_UNLOCK_COMPLETE

WFS_REGISTER_COMPLETE

WFS_DEREGISTER_COMPLETE

WFS_GETINFO_COMPLETE

WFS_EXECUTE_COMPLETE

9.1.2 Event Messages

WFS_EXECUTE_EVENT

WFS_SERVICE_EVENT

WFS_USER_EVENT

WFS_SYSTEM_EVENT

9.2 Timer Events

The timer event message has the following format (see **WFMSetTimer**, **WFMKillTimer)**:

```
WFS_TIMER_EVENT
wParam  =  wTimerID;    /* timer ID returned by the WFMSetTimer function */
lParam  =  lpContext;   /* context pointer supplied by the service provider */
                        /* that requested the timer; may be NULL */
```

9.3 Device Status Changes

Status changes of logical services (which typically reflect changes in physical devices) are reported as system events. This is in addition to being reported by the WFS_INF_xxx_STATUS query of the **WFSGetInfo** or **WFSAsyncGetInfo** functions. The WFSRESULT data structure (defined in Section 8.1) is utilized as follows:

Field	Description
RequestID	(not used)
hService	Service handle identifying the session that created the result
tsTimestamp	Time the status change occurred (local time, in a Win32 SYSTEMTIME structure)
hResult	(not used)
u.dwEventID	= WFS_SYSE_DEVICE_STATUS
lpBuffer	Pointer to a WFSDEVSTATUS structure:

```
typedef struct   wfs_devstatus {
   LPSTR         lpszPhysicalName;
   LPSTR         lpszWorkstationName;
   DWORD         dwState;
} WFSDEVSTATUS, * LPWFSDEVSTATUS;
```

The members of this structure are:

Field	Description	
lpszPhysicalName	Pointer to the physical service name of the service that changed its state.	
lpszWorkstationName	Pointer to the name of the workstation in which the logical service name is defined.	
dwState	Specifies the new state of the physical device managed by the service as one of the following:	
	Value	**Meaning**
	WFS_STAT_DEVONLINE	The device is online (i.e., powered on and operable).
	WFS_STAT_DEVOFFLINE	The device is offline (e.g., the operator has taken the device offline).
	WFS_STAT_DEVPOWEROFF	The device is powered off.
	WFS_STAT_DEVNODEVICE	There is no device connected.
	WFS_STAT_DEVHWERROR	The device is inoperable due to a hardware error.
	WFS_STAT_DEVUSERERROR	The device is inoperable because a person is preventing proper device operation.

9.4 Undeliverable Messages

If a command completion or event message cannot be delivered, it is reported as a system event. The WFSRESULT data structure (defined in Section 8.1) is utilized as follows:

Field	Description
RequestID	(not used)
hService	Service handle identifying the session associated with the completion or event
tsTimestamp	Time the event occurred (local time, in a Win32 SYSTEMTIME structure)
hResult	(not used)
u.dwEventID	= WFS_SYSE_UNDELIVERABLE_MSG
lpBuffer	Pointer to a WFSUNDEVMSG structure:

```
typedef struct _wfs_undevmsg {
   LPSTR        lpszLogicalName;
   LPSTR        lpszWorkstationName;
   LPSTR        lpszAppID;
   DWORD        dwSize;
   LPBYTE       lpbDescription;
   DWORD        dwMsg;
   LPWFSRESULT  lpWFSResult;
} WFSUNDEVMSG, * LPWFSUNDEVMSG;
```

The members of this structure are:

Field	Description
lpszLogicalName	Pointer to the logical service name of the service that generated the original undeliverable message
lpszWorkstationName	Pointer to the the name of the workstation in which the logical service name is defined
lpszAppID	Pointer to the the application ID associated with the session that generated the original message
dwSize	The size in bytes of the following description
lpbDescription	Pointer to a vendor-specific description of the reason why the message could not be delivered
dwMsg	The message identifier of the original message
lpWFSResult	Pointer to the WFSRESULT structure of the original message (which has the *lpBuffer* parameter set to NULL)

9.5 Application Disconnect

If the WOSA/XFS subsystem loses connection to an application, it closes the session (see Section 3.6) and generates this system event. The WFSRESULT data structure (defined in Section 8.1) is utilized as follows:

Field	Description
RequestID	(not used)
hService	Service handle identifying the session associated with the event
tsTimestamp	Time the event occurred (local time, in a Win32 SYSTEMTIME structure)
hResult	(not used)
u.dwEventID	= WFS_SYSE_APP_DISCONNECT
lpBuffer	Pointer to a WFSAPPDISC structure:

```
typedef struct _wfs_appdisc {
   LPSTR        lpszLogicalName;
   LPSTR        lpszWorkstationName;
   LPSTR        lpszAppID;
} WFSAPPDISC, * LPWFSAPPDISC;
```

The members of this structure are:

Field	Description
lpszLogicalName	Pointer to the logical service name of the service that the application was connected to
lpszWorkstationName	Pointer to the the name of the workstation in which the logical service name is defined
lpszAppID	Pointer to the the application ID associated with the session that generated the event

9.6 Hardware and Software Errors

Hardware and software errors are reported as system events. In most cases, this is in addition to being reported via the WFS_ERR_HARDWARE_ERROR or the WFS_ERR_SOFTWARE_ERROR error code that is returned when a hardware or software error occurs in the course of executing a function. The WFSRESULT data structure (defined in Section 8.1), is utilized as follows:

Field	Description
RequestID	Request ID of the request being processed when the error occurred (if any)
hService	Service handle identifying the session associated with the error (if any)
tsTimestamp	Time the error occurred (local time, in a Win32 SYSTEMTIME structure)
hResult	Result handle of the request being processed when the error occurred (if any)
u.dwEventID	*The ID of the error*

Value	Meaning
WFS_SYSE_HARDWARE_ERROR	The error is a hardware error
WFS_SYSE_SOFTWARE_ERROR	Th error is a software error

lpBuffer Pointer to a WFSHWERROR structure:

```
typedef struct _wfs_hwerror {
   LPSTR        lpszLogicalName;
   LPSTR        lpszWorkstationName;
   LPSTR        lpszAppID;
   DWORD        dwSize;
   LPBYTE       lpbDescription;
} WFSHWERROR, * LPWFSHWERROR;
```

The members of this structure are:

Field	Description
lpszLogicalName	Pointer to the logical service name of the service that generated the error (if any)
lpszWorkstationName	Pointer to the the name of the workstation in which the logical service name is defined (if any)
lpszAppID	Pointer to the application ID associated with the session that generated the error (if any)
dwSize	The size in bytes of the following description
lpbDescription	Pointer to a vendor-specific description of the error

9.7 Version Negotiation Failures

Failures in version negotiation are reported as system events. This is in addition to being reported by the version error code returned by the **WFSStartUp** or **WFSOpen** functions. The WFSRESULT data structure (defined in Section 8.1) is utilized as follows:

Field	Description
RequestID	(not used)
hService	(not used)
tsTimestamp	Time the error occurred (local time, in a Win32 SYSTEMTIME structure)
hResult	The version error code (e.g., WFS_ERR_SPI_VER_TOO_HIGH)
u.dwEventID	= WFS_SYSE_VERSION_ERROR
lpBuffer	Pointer to a WFSVRSNERROR structure:

```
typedef struct _wfs_vrsnerror {
   LPSTR         lpszLogicalName;
   LPSTR         lpszWorkstationName;
   LPSTR         lpszAppID;
   DWORD         dwSize;
   LPBYTE        lpbDescription;
   LPWFSVERSION  lpWFSVersion;
} WFSVRSNERROR, * LPWFSVRSNERROR
```

The members of this structure are:

Field	Description
lpszLogicalName	Pointer to the logical service name of the service being opened (NULL if **WFSStartUp**)
lpszWorkstationName	Pointer to the name of the workstation in which the application made the **WFSStartUp** or **WFSOpen** request
lpszAppID	Pointer to the application ID from the open request that failed (NULL if **WFSStartUp**)
dwSize	The size in bytes of the following description
lpbDescription	Pointer to a vendor-specific description of the version negotiation failure
lpWFSVersion	Pointer to the WFSVERSION structure reporting the results of the version negotiation

10. Error Codes

The following are the error codes that can be returned from a call to a WOSA/XFS API or SPI function, either as a function return or in a result structure pointed to by a completion message. Errors from service-specific commands are defined in the specifications for each service class.

WFS_ERR_ALREADY_STARTED
A **WFSStartUp** has already been issued by the application, without an intervening **WFSCleanUp**.

WFS_ERR_API_VER_TOO_HIGH
The range of versions of WOSA/XFS API support requested by the application is higher than any supported by this particular XFS Manager implementation.

WFS_ERR_API_VER_TOO_LOW
The range of versions of WOSA/XFS API support requested by the application is lower than any supported by this particular XFS Manager implementation.

WFS_ERR_CANCELED
The request was canceled by **WFSCancelAsyncRequest** or **WFSCancelBlockingCall**.

WFS_ERR_CFG_INVALID_HKEY
The specified *hKey* parameter does not correspond to a currently open key.

WFS_ERR_CFG_INVALID_NAME
The value specified by the *lpszValueName* parameter does not exist in the specified key.

WFS_ERR_CFG_INVALID_SUBKEY
The key specified by *lpszSubKey* does not exist.

WFS_ERR_CFG_INVALID_VALUE
The specified value does not exist within the specified open key.

WFS_ERR_CFG_KEY_NOT_EMPTY
The specified key has subkeys and cannot be deleted. The subkeys must be deleted first.

WFS_ERR_CFG_NAME_TOO_LONG
The length of the name to be returned exceeds the length of the buffer.

WFS_ERR_CFG_NO_MORE_ITEMS
There are no more subkeys to be returned (the *iSubKey* parameter is greater than the index of the last subkey).

WFS_ERR_CFG_VALUE_TOO_LONG
The length of the value to be returned exceeds the length of the buffer.

WFS_ERR_CONNECTION_LOST
The connection to the service is lost.

WFS_ERR_DEV_NOT_READY
The function required device access, and the device was not ready or timed out.

WFS_ERR_HARDWARE_ERROR
The function required device access, and an error occured on the device.

WFS_ERR_SOFTWARE_ERROR
The function required access to configuration information, and an error occured on the software.

WFS_ERR_INTERNAL_ERROR
An internal inconsistency or other unexpected error occurred in the WOSA/XFS subsystem.

WFS_ERR_INVALID_ADDRESS
The *lpvOriginal* parameter does not point to a previously allocated buffer.

WFS_ERR_INVALID_APP_HANDLE
The specified application handle is not valid, i.e., was not created by a preceding create call.

WFS_ERR_INVALID_BUFFER
The *lpvData* parameter is not a pointer to an allocated buffer structure.

WFS_ERR_INVALID_CATEGORY
The *dwCategory* issued is not supported by this service class.

WFS_ERR_INVALID_COMMAND
The *dwCommand* issued is not supported by this service class.

WFS_ERR_INVALID_EVENT_CLASS
The *dwEventClass* parameter specifies one or more event classes not supported by the service.

WFS_ERR_INVALID_HSERVICE
The *hService* parameter is not a valid service handle.

WFS_ERR_INVALID_HPROVIDER
The *hProvider* parameter is not a valid provider handle.

WFS_ERR_INVALID_HWND
The *hWnd* parameter is not a valid window handle.

WFS_ERR_INVALID_HWNDREG
The *hWndReg* parameter is not a valid window handle.

WFS_ERR_INVALID_POINTER
A pointer parameter does not point to accessible memory.

WFS_ERR_INVALID_DATA
The data structure passed as input parameter contains invalid data..

WFS_ERR_INVALID_REQ_ID
The *RequestID* parameter does not correspond to an outstanding request on the service.

WFS_ERR_INVALID_RESULT
The *lpResult* parameter is not a pointer to an allocated WFSRESULT structure.

WFS_ERR_INVALID_SERVPROV
The file containing the service provider is invalid or corrupted.

WFS_ERR_INVALID_TIMER
The *hWnd* and *usTimerID* parameters do not correspond to a currently active timer.

WFS_ERR_INVALID_TRACELEVEL
The *dwTraceLevel* parameter does not correspond to a valid trace level or set of levels.

WFS_ERR_LOCKED
The service is locked under a different *hService*.

WFS_ERR_NO_BLOCKING_CALL
There is no outstanding blocking call for the specified thread.

WFS_ERR_NO_SERVPROV
The file containing the service provider does not exist.

WFS_ERR_NO_SUCH_THREAD
The specified thread does not exist.

WFS_ERR_NO_TIMER
The timer could not be created.

WFS_ERR_NOT_LOCKED
The application requesting a service be unlocked had not previously performed a successful **WFSLock** or **WFSAsyncLock**.

WFS_ERR_NOT_OK_TO_UNLOAD
The XFS Manager may not unload the service provider DLL.

WFS_ERR_NOT_STARTED
The application has not previously performed a successful **WFSStartUp**.

WFS_ERR_NOT_REGISTERED
The specified *hWndReg* window was not registered to receive messages for any event classes.

WFS_ERR_OP_IN_PROGRESS

A blocking operation is in progress on the thread; only **WFSCancelBlockingCall** and **WFSIsBlocking** are permitted at this time.

WFS_ERR_OUT_OF_MEMORY
There is not enough memory available to satisfy the request.

WFS_ERR_SERVICE_NOT_FOUND
The logical name is not a valid service provider name.

WFS_ERR_SPI_VER_TOO_HIGH
The range of versions of WOSA/XFS SPI support requested by the XFS Manager is higher than any supported by the service provider for the logical service being opened.

WFS_ERR_SPI_VER_TOO_LOW
The range of versions of WOSA/XFS SPI support requested by the XFS Manager is lower than any supported by the service provider for the logical service being opened.

WFS_ERR_SRVC_VER_TOO_HIGH
The range of versions of the service-specific interface support requested by the application is higher than any supported by the service provider for the logical service being opened.

WFS_ERR_SRVC_VER_TOO_LOW
The range of versions of the service-specific interface support requested by the application is lower than any supported by the service provider for the logical service being opened.

WFS_ERR_TIMEOUT
The timeout interval expired.

WFS_ERR_UNSUPP_CATEGORY
The *dwCategory* issued, although valid for this service class, is not supported by this service provider.

WFS_ERR_UNSUPP_COMMAND
The *dwCommand* issued, although valid for this service class, is not supported by this service provider or device.

WFS_ERR_VERSION_ERROR_IN_SRVC
Within the service, a version mismatch of two modules occurred.

11. Appendix A - Planned Enhancements and Extensions

This section describes functions and facilities that are not fully defined in this version of the WOSA Extensions for Financial Services specification; modifications and complete definitions will be supplied in later versions. Vendor and user input is encouraged on these functions and facilities, as well as suggestions as to additional functionality.

WOSA/XFS currently includes specifications for access to the key classes of financial peripherals for attended and self-service environments. These existing specifications will be extended and enhanced based on vendor and user experience with them. The Service Class Definition Document lists the classes of devices or services that, together with others that customers and vendors request, will be evaluated for inclusion in future versions of this specification.

Also to be considered for future versions of WOSA/XFS are other types of services, such as financial transaction messaging and management, as well as related services for financial networks such as network and systems management and security. As with the current specification, all these capabilities will be specified for access from the familiar, consistent Microsoft Windows user interface and programming environments. Whenever possible, the capabilities will be incorporated into the family of standard WOSA elements, and will utilize existing formal and de facto standards.
Another portion of the WOSA WOSA/XFS API set will deal with administration issues.

11.1 Event and System Management

The WOSA/XFS subsystem will need additional facilities for managing exception conditions (i.e., those that are not anticipated in the error codes, events, etc., that are defined in this specification). One general facility for this is the system event capability, as described in Sections 3.11 and 9. This will utilize a combination of one or more functions provided by the XFS Manager and other methods for applications, the XFS Manager, service providers, and services to report exception conditions in special circumstances (e.g., when the XFS Manager is not available). Such conditions would presumably be monitored by a system management agent responsible for logging and reporting them via a network management facility.

12. Appendix B - Banking Solutions Vendor Council Contacts

Please submit comments and questions on the WOSA Extensions for Financial Services to any of the BSVC members or to:

Email:	bsvc@microsoft.com	
Fax (Europe):	+49 6172 661 160	Attn: Ashley Steele
Mail:	Banking Solutions Vendor Council Attn: John Michael Gross Microsoft Corporation One Microsoft Way 1/1174 Redmond, WA 98052 USA	Banking Solutions Vendor Council Attn: Ashley Steele Microsoft GmbH Siemensstraße 21 D 61352 Bad Homburg Germany

Error reports maybe sent per email to: bsvchelp@microsoft.com

Updated versions of this specification, when released, may also be requested from these contacts.

13. Appendix C - Other WOSA Specifications and Information

The Windows Open Services Architecture and the individual WOSA elements each have one or more specifications or other documents either available or under development, and in most cases, an associated Software Development Kit (SDK). The WOSA specifications or other documents that may be requested include the ones listed below.

- *WOSA Corporate Backgrounder* [Microsoft part number 098-53420]
- *WOSA Extensions for Financial Services* [this document]
- *Windows SNA API Specifications:*
  [all are included in the SDK for SNA Server for Windows NT, or orderable as part number 211-074-027]
  - *Windows LUA (RUI and SLI)*
  - *Windows APPC*
  - *Windows CPI-C*
  - *Windows HLLAPI*
  - *Windows CSV*
- *Windows Sockets Specification*
- *Windows RPC (Remote Procedure Call) Specification* [included in the Windows NT SDK]
- *ODBC (Open Database Connectivity) Specification* [available as a set of Microsoft Press books]
- *MAPI (Messaging API) Specification*
- *License Service API Specification*
- *Windows Telephony API Specification*
- *WOSA Extensions for Real Time Market Data Specification*

Most of these documents are available in the Microsoft developer services sections on the Microsoft's Internet Informations Server ***www.microsoft.com***, and via Internet ftp download from Microsoft's ftp server ***ftp.microsoft.com***. They are all included in the Microsoft Developer Network (MSDN) products: the Development Platform (MSDN Level II subscription) and the Development Library (MSDN Level I subscription). The Development Platform is a set of CD-ROM disks, updated at least quarterly, that contains all Microsoft SDKs, DDKs and operating systems. This offering includes the MSDN Development Library, which is also available separately, and contains all the documentation for the development platform (but no code), as well as a wide variety of other technical reference material on developing software for the Windows operating systems, including sample code.

14. Appendix D - C-Header files

14.1 XFSAPI.H

```
/******************************************************************************
*                                                                             *
* xfsapi.h      WOSA/XFS - API functions, types, and definitions              *
*                                                                             *
*               Version 2.00  --  11/11/96                                    *
*                                                                             *
******************************************************************************/

#ifndef __inc_xfsapi__h
#define __inc_xfsapi__h

#ifdef __cplusplus
extern "C" {
#endif

/*   be aware of alignment   */
#pragma pack(push,1)

/****** Common ***************************************************************/

#include <windows.h>

typedef unsigned short USHORT;
typedef char CHAR;
typedef short SHORT;
typedef unsigned long ULONG;
typedef unsigned char UCHAR;
typedef SHORT * LPSHORT;
typedef LPVOID * LPLPVOID;
typedef ULONG * LPULONG;
typedef USHORT * LPUSHORT;

typedef ULONG REQUESTID;
typedef REQUESTID * LPREQUESTID;

typedef HANDLE HAPP;
typedef HAPP * LPHAPP;

typedef SYSTEMTIME TIMESTAMP;

typedef USHORT HSERVICE;
typedef HSERVICE * LPHSERVICE;

typedef LONG HRESULT;
typedef HRESULT * LPHRESULT;

typedef BOOL (WINAPI * XFSBLOCKINGHOOK)(VOID);
typedef XFSBLOCKINGHOOK * LPXFSBLOCKINGHOOK;

/****** String lengths ********************************************/

#define WFSDDESCRIPTION_LEN                    256
#define WFSDSYSSTATUS_LEN                      256

/****** Values of WFSDEVSTATUS.fwState ********************************/

#define WFS_STAT_DEVONLINE                     (0)
#define WFS_STAT_DEVOFFLINE                    (1)
#define WFS_STAT_DEVPOWEROFF                   (2)
#define WFS_STAT_DEVNODEVICE                   (3)
#define WFS_STAT_DEVHWERROR                    (4)
#define WFS_STAT_DEVUSERERROR                  (5)
#define WFS_STAT_DEVBUSY                       (6)

/****** Value of WFS_DEFAULT_HAPP *************************************/

#define WFS_DEFAULT_HAPP                       (0)
```

```
/****** Data Structures ************************************************/

typedef struct _wfs_result
{
    REQUESTID       RequestID;
    HSERVICE        hService;
    TIMESTAMP       tsTimestamp;
    HRESULT         hResult;
    union {
        DWORD       dwCommandCode;
        DWORD       dwEventID;
    } u;
    LPVOID          lpBuffer;
} WFSRESULT, * LPWFSRESULT;

typedef struct _wfsversion
{
    WORD            wVersion;
    WORD            wLowVersion;
    WORD            wHighVersion;
    CHAR            szDescription[WFSDDESCRIPTION_LEN+1];
    CHAR            szSystemStatus[WFSDSYSSTATUS_LEN+1];
} WFSVERSION, * LPWFSVERSION;

/****** Message Structures *********************************************/

typedef struct _wfs_devstatus
{
    LPSTR           lpszPhysicalName;
    LPSTR           lpszWorkstationName;
    DWORD           dwState;
} WFSDEVSTATUS, * LPWFSDEVSTATUS;

typedef struct _wfs_undevmsg
{
    LPSTR           lpszLogicalName;
    LPSTR           lpszWorkstationName;
    LPSTR           lpszAppID;
    DWORD           dwSize;
    LPBYTE          lpbDescription;
    DWORD           dwMsg;
    LPWFSRESULT     lpWFSResult;
} WFSUNDEVMSG, * LPWFSUNDEVMSG;

typedef struct _wfs_appdisc
{
    LPSTR           lpszLogicalName;
    LPSTR           lpszWorkstationName;
    LPSTR           lpszAppID;
} WFSAPPDISC, * LPWFSAPPDISC;

typedef struct _wfs_hwerror
{
    LPSTR           lpszLogicalName;
    LPSTR           lpszWorkstationName;
    LPSTR           lpszAppID;
    DWORD           dwSize;
    LPBYTE          lpbDescription;
} WFSHWERROR, * LPWFSHWERROR;

typedef struct _wfs_vrsnerror
{
    LPSTR           lpszLogicalName;
    LPSTR           lpszWorkstationName;
    LPSTR           lpszAppID;
    DWORD           dwSize;
    LPBYTE          lpbDescription;
    LPWFSVERSION    lpWFSVersion;
} WFSVRSNERROR, * LPWFSVRSNERROR;

/****** Error codes ****************************************************/

#define WFS_SUCCESS                             (0)
#define WFS_ERR_ALREADY_STARTED                 (-1)
```

```
#define WFS_ERR_API_VER_TOO_HIGH                (-2)
#define WFS_ERR_API_VER_TOO_LOW                 (-3)
#define WFS_ERR_CANCELED                        (-4)
#define WFS_ERR_CFG_INVALID_HKEY                (-5)
#define WFS_ERR_CFG_INVALID_NAME                (-6)
#define WFS_ERR_CFG_INVALID_SUBKEY              (-7)
#define WFS_ERR_CFG_INVALID_VALUE               (-8)
#define WFS_ERR_CFG_KEY_NOT_EMPTY               (-9)
#define WFS_ERR_CFG_NAME_TOO_LONG               (-10)
#define WFS_ERR_CFG_NO_MORE_ITEMS               (-11)
#define WFS_ERR_CFG_VALUE_TOO_LONG              (-12)
#define WFS_ERR_DEV_NOT_READY                   (-13)
#define WFS_ERR_HARDWARE_ERROR                  (-14)
#define WFS_ERR_INTERNAL_ERROR                  (-15)
#define WFS_ERR_INVALID_ADDRESS                 (-16)
#define WFS_ERR_INVALID_APP_HANDLE              (-17)
#define WFS_ERR_INVALID_BUFFER                  (-18)
#define WFS_ERR_INVALID_CATEGORY                (-19)
#define WFS_ERR_INVALID_COMMAND                 (-20)
#define WFS_ERR_INVALID_EVENT_CLASS             (-21)
#define WFS_ERR_INVALID_HSERVICE                (-22)
#define WFS_ERR_INVALID_HPROVIDER               (-23)
#define WFS_ERR_INVALID_HWND                    (-24)
#define WFS_ERR_INVALID_HWNDREG                 (-25)
#define WFS_ERR_INVALID_POINTER                 (-26)
#define WFS_ERR_INVALID_REQ_ID                  (-27)
#define WFS_ERR_INVALID_RESULT                  (-28)
#define WFS_ERR_INVALID_SERVPROV                (-29)
#define WFS_ERR_INVALID_TIMER                   (-30)
#define WFS_ERR_INVALID_TRACELEVEL              (-31)
#define WFS_ERR_LOCKED                          (-32)
#define WFS_ERR_NO_BLOCKING_CALL                (-33)
#define WFS_ERR_NO_SERVPROV                     (-34)
#define WFS_ERR_NO_SUCH_THREAD                  (-35)
#define WFS_ERR_NO_TIMER                        (-36)
#define WFS_ERR_NOT_LOCKED                      (-37)
#define WFS_ERR_NOT_OK_TO_UNLOAD                (-38)
#define WFS_ERR_NOT_STARTED                     (-39)
#define WFS_ERR_NOT_REGISTERED                  (-40)
#define WFS_ERR_OP_IN_PROGRESS                  (-41)
#define WFS_ERR_OUT_OF_MEMORY                   (-42)
#define WFS_ERR_SERVICE_NOT_FOUND               (-43)
#define WFS_ERR_SPI_VER_TOO_HIGH                (-44)
#define WFS_ERR_SPI_VER_TOO_LOW                 (-45)
#define WFS_ERR_SRVC_VER_TOO_HIGH               (-46)
#define WFS_ERR_SRVC_VER_TOO_LOW                (-47)
#define WFS_ERR_TIMEOUT                         (-48)
#define WFS_ERR_UNSUPP_CATEGORY                 (-49)
#define WFS_ERR_UNSUPP_COMMAND                  (-50)
#define WFS_ERR_VERSION_ERROR_IN_SRVC           (-51)
#define WFS_ERR_INVALID_DATA                    (-52)
#define WFS_ERR_SOFTWARE_ERROR                  (-53)
#define WFS_ERR_CONNECTION_LOST                 (-54)

#define WFS_INDEFINITE_WAIT                     0

/****** Messages ****************************************************/

/* Message-No = (WM_USER + No) */

#define WFS_OPEN_COMPLETE                       (WM_USER + 1)
#define WFS_CLOSE_COMPLETE                      (WM_USER + 2)
#define WFS_LOCK_COMPLETE                       (WM_USER + 3)
#define WFS_UNLOCK_COMPLETE                     (WM_USER + 4)
#define WFS_REGISTER_COMPLETE                   (WM_USER + 5)
#define WFS_DEREGISTER_COMPLETE                 (WM_USER + 6)
#define WFS_GETINFO_COMPLETE                    (WM_USER + 7)
#define WFS_EXECUTE_COMPLETE                    (WM_USER + 8)

#define WFS_EXECUTE_EVENT                       (WM_USER + 20)
#define WFS_SERVICE_EVENT                       (WM_USER + 21)
#define WFS_USER_EVENT                          (WM_USER + 22)
#define WFS_SYSTEM_EVENT                        (WM_USER + 23)
```

```
#define WFS_TIMER_EVENT                         (WM_USER + 100)

/****** Event Classes ************************************************/

#define SERVICE_EVENTS                          (1)
#define USER_EVENTS                             (2)
#define SYSTEM_EVENTS                           (4)
#define EXECUTE_EVENTS                          (8)

/****** System Event IDs *********************************************/

#define WFS_SYSE_UNDELIVERABLE_MSG              (1)
#define WFS_SYSE_HARDWARE_ERROR                 (2)
#define WFS_SYSE_VERSION_ERROR                  (3)
#define WFS_SYSE_DEVICE_STATUS                  (4)
#define WFS_SYSE_APP_DISCONNECT                 (5)

/****** WOSA/XFS Trace Level *****************************************/

#define WFS_TRACE_API                           0x00000001
#define WFS_TRACE_ALL_API                       0x00000002
#define WFS_TRACE_SPI                           0x00000004
#define WFS_TRACE_ALL_SPI                       0x00000008
#define WFS_TRACE_MGR                           0x00000010

/****** API functions ************************************************/

HRESULT extern WINAPI WFSCancelAsyncRequest ( HSERVICE hService, REQUESTID
RequestID);

HRESULT extern WINAPI WFSCancelBlockingCall ( DWORD dwThreadID);

HRESULT extern WINAPI WFSCleanUp ();

HRESULT extern WINAPI WFSClose ( HSERVICE hService);

HRESULT extern WINAPI WFSAsyncClose ( HSERVICE hService, HWND hWnd, LPREQUESTID
lpRequestID);

HRESULT extern WINAPI WFSCreateAppHandle ( LPHAPP lphApp);

HRESULT extern WINAPI WFSDeregister ( HSERVICE hService, DWORD dwEventClass, HWND
hWndReg);

HRESULT extern WINAPI WFSAsyncDeregister ( HSERVICE hService, DWORD dwEventClass,
HWND hWndReg, HWND hWnd, LPREQUESTID lpRequestID);

HRESULT extern WINAPI WFSDestroyAppHandle ( HAPP hApp);

HRESULT extern WINAPI WFSExecute ( HSERVICE hService, DWORD dwCommand, LPVOID
lpCmdData, DWORD dwTimeOut, LPWFSRESULT * lppResult);

HRESULT extern WINAPI WFSAsyncExecute ( HSERVICE hService, DWORD dwCommand, LPVOID
lpCmdData, DWORD dwTimeOut, HWND hWnd, LPREQUESTID lpRequestID);

HRESULT extern WINAPI WFSFreeResult ( LPWFSRESULT lpResult);

HRESULT extern WINAPI WFSGetInfo ( HSERVICE hService, DWORD dwCategory, LPVOID
lpQueryDetails, DWORD dwTimeOut, LPWFSRESULT * lppResult);

HRESULT extern WINAPI WFSAsyncGetInfo ( HSERVICE hService, DWORD dwCategory, LPVOID
lpQueryDetails, DWORD dwTimeOut, HWND hWnd, LPREQUESTID lpRequestID);

BOOL extern WINAPI WFSIsBlocking ();

HRESULT extern WINAPI WFSLock ( HSERVICE hService, DWORD dwTimeOut , LPWFSRESULT *
lppResult);

HRESULT extern WINAPI WFSAsyncLock ( HSERVICE hService, DWORD dwTimeOut, HWND hWnd,
LPREQUESTID lpRequestID);

HRESULT extern WINAPI WFSOpen ( LPSTR lpszLogicalName, HAPP hApp, LPSTR lpszAppID,
DWORD dwTraceLevel, DWORD dwTimeOut, DWORD dwSrvcVersionsRequired, LPWFSVERSION
lpSrvcVersion, LPWFSVERSION lpSPIVersion, LPHSERVICE lphService);
```

```
HRESULT extern WINAPI WFSAsyncOpen ( LPSTR lpszLogicalName, HAPP hApp, LPSTR
lpszAppID, DWORD dwTraceLevel, DWORD dwTimeOut, LPHSERVICE lphService, HWND hWnd,
DWORD dwSrvcVersionsRequired, LPWFSVERSION lpSrvcVersion, LPWFSVERSION
lpSPIVersion, LPREQUESTID lpRequestID);

HRESULT extern WINAPI WFSRegister ( HSERVICE hService, DWORD dwEventClass, HWND
hWndReg);

HRESULT extern WINAPI WFSAsyncRegister ( HSERVICE hService, DWORD dwEventClass,
HWND hWndReg, HWND hWnd, LPREQUESTID lpRequestID);

HRESULT extern WINAPI WFSSetBlockingHook ( XFSBLOCKINGHOOK lpBlockFunc,
LPXFSBLOCKINGHOOK lppPrevFunc);

HRESULT extern WINAPI WFSStartUp ( DWORD dwVersionsRequired, LPWFSVERSION
lpWFSVersion);

HRESULT extern WINAPI WFSUnhookBlockingHook ();

HRESULT extern WINAPI WFSUnlock ( HSERVICE hService);

HRESULT extern WINAPI WFSAsyncUnlock ( HSERVICE hService, HWND hWnd, LPREQUESTID
lpRequestID);

HRESULT extern WINAPI WFMSetTraceLevel ( HSERVICE hService, DWORD dwTraceLevel);


/*   restore alignment   */
#pragma pack(pop)

#ifdef __cplusplus
}       /*extern "C"*/
#endif

#endif  /* __inc_xfsapi__h */
```

14.2 XFSADMIN.H

```
/******************************************************************************
*                                                                             *
* xfsadmin.h    WOSA/XFS-Administration and Support functions                 *
*                                                                             *
*               Version 2.00  --  11/11/96                                    *
*                                                                             *
******************************************************************************/

#ifndef __INC_XFSADMIN__H
#define __INC_XFSADMIN__H

#ifdef __cplusplus
extern "C" {
#endif

#include    <xfsapi.h>

/*   be aware of alignment   */
#pragma pack(push,1)


/* values of ulFlags used for WFMAllocateBuffer */

#define WFS_MEM_SHARE                        0x00000001
#define WFS_MEM_ZEROINIT                    0x00000002

/****** Support Functions ***************************************************/

HRESULT extern WINAPI WFMAllocateBuffer( ULONG ulSize, ULONG ulFlags, LPVOID *
lppvData);

HRESULT extern WINAPI WFMAllocateMore( ULONG ulSize, LPVOID lpvOriginal, LPVOID *
lppvData);

HRESULT extern WINAPI WFMFreeBuffer( LPVOID lpvData);

HRESULT extern WINAPI WFMGetTraceLevel ( HSERVICE hService, LPDWORD
lpdwTraceLevel);

HRESULT extern WINAPI WFMKillTimer( WORD wTimerID);

HRESULT extern WINAPI WFMOutputTraceData ( LPSTR lpszData);

HRESULT extern WINAPI WFMReleaseDLL ( HPROVIDER hProvider);

HRESULT extern WINAPI WFMSetTimer ( HWND hWnd, LPVOID lpContext, DWORD dwTimeVal,
LPWORD lpwTimerID);


/*   restore alignment   */
#pragma pack(pop)

#ifdef __cplusplus
}       /*extern "C"*/
#endif

#endif    /* __INC_XFSADMIN__H */
```

14.3 XFSCONF.H

```
/******************************************************************************
*                                                                             *
* xfsconf.h     WOSA/XFS - definitions for the Configuration functions        *
*                                                                             *
*               Version 2.00  --  11/11/96                                    *
*                                                                             *
******************************************************************************/

#ifndef __INC_XFSCONF__H
#define __INC_XFSCONF__H

#ifdef __cplusplus
extern "C" {
#endif

/******* Common ***************************************************************/

#include    <xfsapi.h>

/*   be aware of alignment   */
#pragma pack(push,1)

// following HKEY and PHKEY are already defined in WINREG.H
// so definition has been removed
// typedef HANDLE  HKEY;
// typedef HANDLE * PHKEY;

/******* Value of hKey ********************************************************/
#define     WFS_CFG_HKEY_XFS_ROOT               ((HKEY)1)

/******* Values of lpdwDisposition ********************************************/
#define     WFS_CFG_CREATED_NEW_KEY             (0)
#define     WFS_CFG_OPENED_EXISTING_KEY         (1)

/******* Configuration Functions **********************************************/
HRESULT extern  WINAPI  WFMCloseKey ( HKEY hKey);

HRESULT extern  WINAPI  WFMCreateKey ( HKEY hKey, LPSTR lpszSubKey, PHKEY
phkResult, LPDWORD lpdwDisposition);

HRESULT extern  WINAPI  WFMDeleteKey ( HKEY hKey, LPSTR lpszSubKey);

HRESULT extern  WINAPI  WFMDeleteValue ( HKEY hKey, LPSTR lpszValue );

HRESULT extern  WINAPI  WFMEnumKey ( HKEY hKey, DWORD iSubKey, LPSTR lpszName,
LPDWORD lpcchName, PFILETIME lpftLastWrite);

HRESULT extern  WINAPI  WFMEnumValue ( HKEY hKey, DWORD iValue, LPSTR lpszValue,
LPDWORD lpcchValue, LPSTR lpszData, LPDWORD lpcchData);

HRESULT extern  WINAPI  WFMOpenKey ( HKEY hKey, LPSTR lpszSubKey, PHKEY phkResult);

HRESULT extern  WINAPI  WFMQueryValue ( HKEY hKey, LPSTR lpszValueName, LPSTR
lpszData, LPDWORD lpcchData);

HRESULT extern  WINAPI  WFMSetValue ( HKEY hKey, LPSTR lpszValueName, LPSTR
lpszData, DWORD cchData);


/*   restore alignment   */
#pragma pack(pop)

#ifdef __cplusplus
}       /*extern "C"*/
#endif

#endif  /* __INC_XFSCONF__H */
```

14.4 XFSSPI.H

```
/******************************************************************************
*                                                                             *
* xfsspi.h      WOSA/XFS - SPI functions, types, and definitions              *
*                                                                             *
*               Version 2.00  --  11/11/96                                    *
*                                                                             *
******************************************************************************/

#ifndef __inc_xfsspi__h
#define __inc_xfsspi__h

#ifdef __cplusplus
extern "C" {
#endif

#include <xfsapi.h>

typedef HANDLE HPROVIDER;

#include <xfsconf.h>
#include <xfsadmin.h>

/*   be aware of alignment   */
#pragma pack(push,1)

/****** SPI functions ********************************************************/

HRESULT extern WINAPI WFPCancelAsyncRequest ( HSERVICE hService, REQUESTID
RequestID);

HRESULT extern WINAPI WFPClose ( HSERVICE hService, HWND hWnd, REQUESTID ReqID);

HRESULT extern WINAPI WFPDeregister ( HSERVICE hService, DWORD dwEventClass, HWND
hWndReg, HWND hWnd, REQUESTID ReqID);

HRESULT extern WINAPI WFPExecute ( HSERVICE hService, DWORD dwCommand, LPVOID
lpCmdData, DWORD dwTimeOut, HWND hWnd, REQUESTID ReqID);

HRESULT extern WINAPI WFPGetInfo ( HSERVICE hService, DWORD dwCategory, LPVOID
lpQueryDetails, DWORD dwTimeOut, HWND hWnd, REQUESTID ReqID);

HRESULT extern WINAPI WFPLock ( HSERVICE hService, DWORD dwTimeOut, HWND hWnd,
REQUESTID ReqID);

HRESULT extern WINAPI WFPOpen ( HSERVICE hService, LPSTR lpszLogicalName, HAPP
hApp, LPSTR lpszAppID, DWORD dwTraceLevel, DWORD dwTimeOut, HWND hWnd, REQUESTID
ReqID, HPROVIDER hProvider, DWORD dwSPIVersionsRequired, LPWFSVERSION lpSPIVersion,
DWORD dwSrvcVersionsRequired, LPWFSVERSION lpSrvcVersion);

HRESULT extern WINAPI WFPRegister ( HSERVICE hService,  DWORD dwEventClass, HWND
hWndReg, HWND hWnd, REQUESTID ReqID);

HRESULT extern WINAPI WFPSetTraceLevel ( HSERVICE hService, DWORD dwTraceLevel);

HRESULT extern WINAPI WFPUnloadService (  );

HRESULT extern WINAPI WFPUnlock ( HSERVICE hService, HWND hWnd, REQUESTID );


/*   restore alignment   */
#pragma pack(pop)

#ifdef __cplusplus
}    /*extern "C"*/
#endif

#endif  /* __inc_xfsspi__h */
```