

[MS-PAN-Diff]:

Print System Asynchronous Notification Protocol

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Table of Contents

1	Introduction	8
1.1	Glossary	8
1.2	References	12
1.2.1	Normative References	12
1.2.2	Informative References	13
1.3	Overview	13
1.4	Relationship to Other Protocols	15
1.5	Prerequisites/Preconditions	15
1.6	Applicability Statement	16
1.7	Versioning and Capability Negotiation	16
1.8	Vendor-Extensible Fields	16
1.9	Standards Assignments.....	17
2	Messages.....	18
2.1	Transport.....	18
2.2	Common Data Types	18
2.2.1	PrintAsyncNotificationType.....	18
2.2.2	PrintAsyncNotifyUserFilter.....	19
2.2.3	PrintAsyncNotifyConversationStyle.....	19
2.2.4	PRPCREMOTEOBJECT	19
2.2.5	PNOTIFYOBJECT	20
2.2.6	AsyncUI Default Resource File String Resources	20
2.2.7	AsyncUI XML Notification and Response Formats	24
2.2.7.1	Common AsyncUI Elements.....	25
2.2.7.1.1	asyncPrintUIRequest Element	25
2.2.7.1.2	asyncPrintUIResponse Element	26
2.2.7.1.3	title Element	27
2.2.7.1.4	body Element.....	28
2.2.7.1.5	parameter Element.....	29
2.2.7.2	AsyncUIBalloon.....	30
2.2.7.2.1	action Element	30
2.2.7.2.2	balloonUI Element	31
2.2.7.3	AsyncUIMessageBox.....	32
2.2.7.3.1	button Element	32
2.2.7.3.2	buttons Element.....	33
2.2.7.3.3	bitmap Element.....	33
2.2.7.3.4	messageBoxUI Element.....	34
2.2.7.4	AsyncUIMessageBoxUIReply	35
2.2.7.4.1	buttonID Element	35
2.2.7.4.2	messageBoxUI Element.....	35
2.2.7.5	AsyncUICustomUI	36
2.2.7.5.1	customUI Element	36
2.2.7.6	AsyncUICustomUIReply	37
2.2.7.6.1	CustomUI Element.....	37
2.2.7.7	AsyncUICustomData.....	38
2.2.7.7.1	customData Element.....	38
2.2.8	Printer Configuration Notification Formats.....	39
2.2.8.1	Printer Configuration Notification	40
2.2.8.1.1	Notification Element.....	41
2.2.8.1.2	Schema Element	41
2.2.8.1.3	BIDI_STRING Element	41
2.2.8.1.4	BIDI_TEXT Element	41
2.2.8.1.5	BIDI_ENUM Element	41
2.2.8.1.6	BIDI_INT Element	41
2.2.8.1.7	BIDI_FLOAT Element	41

2.2.8.1.8	BIDI_BOOL Element	42
2.2.8.1.9	BIDI_BLOB Element.....	42
2.2.8.1.10	ReducedSchema Element	42
3	Protocol Details	43
3.1	Server Details.....	43
3.1.1	IRPCAsyncNotify Server Details	43
3.1.1.1	Abstract Data Model	45
3.1.1.2	Timers.....	46
3.1.1.3	Initialization	46
3.1.1.4	Message Processing Events and Sequencing Rules	47
3.1.1.4.1	IRPCAsyncNotify_RegisterClient (Opnum 0)	47
3.1.1.4.2	IRPCAsyncNotify_UnregisterClient (Opnum 1)	50
3.1.1.4.3	IRPCAsyncNotify_GetNewChannel (Opnum 3)	50
3.1.1.4.4	IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4)	52
3.1.1.4.5	IRPCAsyncNotify_GetNotification (Opnum 5).....	54
3.1.1.4.6	IRPCAsyncNotify_CloseChannel (Opnum 6).....	56
3.1.1.5	Timer Events	57
3.1.1.6	Other Local Events	57
3.1.1.6.1	Unidirectional Notification Generated	57
3.1.1.6.2	Bidirectional Notification Channel Opened	57
3.1.1.6.3	Bidirectional Notification Generated	58
3.1.1.6.4	Bidirectional Notification Channel Closed	58
3.1.1.6.5	Impersonate Client	58
3.1.2	IRPCRemoteObject Server Details.....	58
3.1.2.1	Abstract Data Model	59
3.1.2.2	Timers.....	59
3.1.2.3	Initialization	59
3.1.2.4	Message Processing Events and Sequencing Rules	59
3.1.2.4.1	IRPCRemoteObject_Create (Opnum 0)	59
3.1.2.4.2	IRPCRemoteObject_Delete (Opnum 1)	60
3.1.2.5	Timer Events.....	60
3.1.2.6	Other Local Events	60
3.1.3	AsyncUI Server Details	60
3.1.3.1	Abstract Data Model	60
3.1.3.2	Timers.....	60
3.1.3.3	Initialization	61
3.1.3.4	Message Processing Events and Sequencing Rules	61
3.1.3.4.1	IRPCAsyncNotify_RegisterClient (Opnum 0)	61
3.1.3.4.2	IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4)	61
3.1.3.4.3	IRPCAsyncNotify_GetNotification (Opnum 5).....	62
3.1.3.4.4	IRPCAsyncNotify_CloseChannel (Opnum 6).....	62
3.1.3.5	Timer Events.....	62
3.1.3.6	Other Local Events	62
3.1.4	Printer Configuration Server Details	63
3.1.4.1	Abstract Data Model	63
3.1.4.2	Timers.....	63
3.1.4.3	Initialization	63
3.1.4.4	Message Processing Events and Sequencing Rules	63
3.1.4.4.1	IRPCAsyncNotify_RegisterClient (Opnum 0)	64
3.1.4.4.2	IRPCAsyncNotify_GetNotification (Opnum 5).....	64
3.1.4.5	Timer Events.....	64
3.1.4.6	Other Local Events	64
3.2	Client Details.....	64
3.2.1	IRPCRemoteObject Client Details	64
3.2.1.1	Abstract Data Model	64
3.2.1.2	Timers.....	65
3.2.1.3	Initialization	65

3.2.1.4	Message Processing Events and Sequencing Rules	65
3.2.1.5	Timer Events	65
3.2.1.6	Other Local Events	65
3.2.2	IRPCAsyncNotify Client Details	65
3.2.2.1	Abstract Data Model	68
3.2.2.2	Timers	68
3.2.2.3	Initialization	69
3.2.2.4	Message Processing Events and Sequencing Rules	69
3.2.2.5	Timer Events	69
3.2.2.6	Other Local Events	69
3.2.3	AsyncUI Client Details	69
3.2.3.1	Abstract Data Model	70
3.2.3.2	Timers	70
3.2.3.3	Initialization	71
3.2.3.4	Message Processing Events and Sequencing Rules	71
3.2.3.4.1	AsyncUIBalloon Notification	71
3.2.3.4.2	AsyncUIMessageBox Notification	72
3.2.3.4.3	AsyncUICustomUI Notification	72
3.2.3.4.4	AsyncUICustomData Notification	73
3.2.3.5	Timer Events	74
3.2.3.6	Other Local Events	74
3.2.4	Printer Configuration Client Details	74
3.2.4.1	Abstract Data Model	74
3.2.4.2	Timers	74
3.2.4.3	Initialization	74
3.2.4.4	Message Processing Events and Sequencing Rules	75
3.2.4.4.1	Printer Configuration Notification	75
3.2.4.5	Timer Events	75
3.2.4.6	Other Local Events	75
4	Protocol Examples	76
4.1	Unidirectional Communication Mode	76
4.2	AsyncUI Notification in Unidirectional Communication Mode.....	77
4.3	Bidirectional Communication Mode	78
4.4	AsyncUI Notification in Bidirectional Communication Mode.....	79
5	Security	81
5.1	Security Considerations for Implementers	81
5.2	Index of Security Parameters	81
6	Appendix A: Full IDL.....	82
6.1	Appendix A.1: IRPCAsyncNotify.IDL.....	82
6.2	Appendix A.2: IRPCRemoteObject.IDL	83
7	(Updated Section) Appendix B: Product Behavior.....	84
8	Change Tracking.....	87
9	Index.....	88

1 Introduction

The Print System Asynchronous Notification Protocol is used asynchronously by clients to receive print status notifications from a server and to send back responses to those notifications. A set of notifications and responses are defined together as a notification type.

This protocol is based on remote procedure call (RPC) [C706] [MS-RPCE]. The interfaces and methods defined by this protocol provide a transport mechanism for arbitrary notification types.

The Print System Asynchronous Notification Protocol defines a notification type called AsyncUI. The AsyncUI notification type enables a notification source on a server to request the display of an informative alert on a client, the client to send back user input requested by the alert, and the notification source to request the execution of code that is resident on the client.

Sections 1.5, 1.8, 1.9, 2, and 3 of this specification are normative. All other sections and examples in this specification are informative.

1.1 Glossary

This document uses the following terms:

access control entry (ACE): An entry in an access control list (ACL) that contains a set of user rights and a security identifier (SID) that identifies a principal for whom the rights are allowed, denied, or audited.

ASCII: The American Standard Code for Information Interchange (ASCII) is an 8-bit character-encoding scheme based on the English alphabet. ASCII codes represent text in computers, communications equipment, and other devices that work with text. ASCII refers to a single 8-bit ASCII character or an array of 8-bit ASCII characters with the high bit of each character set to zero.

AsyncUI: A notification type that can be used by server-resident notification sources to send informational alerts and user inquiries to a print client component that presents them to users and to execute client-resident printer driver code.

authenticated user identity: The principal that is provided by the underlying protocol. See retrieval of client identity in [MS-RPCE] sections 3.2.3.4.2 and 3.3.3.4.3 for details.

authentication: The ability of one entity to determine the identity of another entity.

authentication level: A numeric value indicating the level of authentication or message protection that remote procedure call (RPC) will apply to a specific message exchange. For more information, see [C706] section 13.1.2.1 and [MS-RPCE].

bidirectional communication mode: A communication mode in which a server sends notifications to a single print client; the client replies to the notifications, and the server accepts that client's response.

bitmap: A collection of structures that contain a representation of a graphical image, a logical palette, dimensions and other information.

bitmap resource: A bitmap stored in a resource file that can be retrieved with a key.

default resource file: The resource file that is used by an AsyncUI client to look up icons, bitmaps, and string resources that are referenced in notifications that do not explicitly name a resource file. String resources that are present in the default resource file are specified in section 2.2.6.

discretionary access control list (DACL): An access control list (ACL) that is controlled by the owner of an object and that specifies the access particular users or groups can have to the object.

Domain Name System (DNS): A hierarchical, distributed database that contains mappings of domain names to various types of data, such as IP addresses. DNS enables the location of computers and services by user-friendly names, and it also enables the discovery of other information stored in the database.

driver-file name: The name of file that is part of a printer driver that was previously installed on an AsyncUI client via point-and-print. Driver-file names are relative to the directories that contain them.

HRESULT: An integer value that indicates the result or status of an operation. A particular HRESULT can have different meanings depending on the protocol using it. See [MS-ERREF] section 2.1 and specific protocol documents for further details.

icon: A graphical image used to supplement alphanumeric text in the visual identification of an object on a computer monitor. Icons are typically small, relative to the size of the area on which they are displayed.

icon resource: An icon stored in a resource file that can be retrieved with a key.

Interface Definition Language (IDL): The International Standards Organization (ISO) standard language for specifying the interface for remote procedure calls. For more information, see [C706] section 4.

Internet Protocol version 4 (IPv4): An Internet protocol that has 32-bit source and destination addresses. IPv4 is the predecessor of IPv6.

Internet Protocol version 6 (IPv6): A revised version of the Internet Protocol (IP) designed to address growth on the Internet. Improvements include a 128-bit IP address size, expanded routing capabilities, and support for authentication and privacy.

NetBIOS: A particular network transport that is part of the LAN Manager protocol suite. NetBIOS uses a broadcast communication style that was applicable to early segmented local area networks. A protocol family including name resolution, datagram, and connection services. For more information, see [RFC1001] and [RFC1002].

Network Data Representation (NDR): A specification that defines a mapping from Interface Definition Language (IDL) data types onto octet streams. NDR also refers to the runtime environment that implements the mapping facilities (for example, data provided to NDR). For more information, see [MS-RPCE] and [C706] section 14.

notification: A typed buffer of data sent by a print server to a print client as a result of an event on the server.

notification channel: A shareable, server-side object capable of routing notifications from a print server to appropriately registered print clients.

notification source: A print-server-resident software component, such as a printer driver, which generates notifications conforming to a particular notification type, or set of notification types, and processes any responses required by those notifications.

notification type: A set of notification and response data formats and their associated semantics. A notification type can be thought of as a higher-level protocol that is transported via the Print System Asynchronous Notification Protocol.

notification type identifier: A 128-bit value that either uniquely identifies a notification type or is a reserved value defined for special purposes by the Print Asynchronous Notification Protocol.

Although defined in Interface Definition Language (IDL) as a GUID, a notification type identifier is considered to be an opaque 128-bit value. This protocol makes no assumptions about the format of those 128 bits or about the mechanism used by the creator of a notification type to assure uniqueness of its notification type identifier.

opnum: An operation number or numeric identifier that is used to identify a specific remote procedure call (RPC) method or a method in an interface. For more information, see [C706] section 12.5.2.12 or [MS-RPCE].

position parameter replacement tags: Indicators within a string that can be replaced by parameter data during a formatting process. The indicators show which parameter of an ordered list should be used for the replacement. For more information, see [MSDN-FMT].

principal: An authenticated entity that initiates a message or channel in a distributed system.

print client: The application or user that is trying to apply an operation on the print system either by printing a job or by managing the data structures or devices maintained by the print system.

print queue: The logical entity to which jobs can be submitted for a particular print device. Associated with a print queue is a print driver, a user's print configuration in the form of a DEVMODE structure, and a system print configuration stored in the system registry.

print server: A machine that hosts the print system and all its different components.

printer driver: The interface component between the operating system and the printer device. It is responsible for processing the application data into a page description language (PDL) that can be interpreted by the printer device.

remote object: An unshared, server-side object capable of representing a registration.

remote procedure call (RPC): A communication protocol used primarily between client and server. The term has three definitions that are often used interchangeably: a runtime environment providing for communication facilities between computers (the RPC runtime); a set of request-and-response message exchanges between computers (the RPC exchange); and the single message from an RPC exchange (the RPC message). For more information, see [C706].

resource file: A file that contains one or more icons, bitmaps, or string resources that can be retrieved with an integer key and used by other software components.

response: A typed buffer of data sent by the client to the server in response to a notification.

RPC context handle: A representation of state maintained between a remote procedure call (RPC) client and server. The state is maintained on the server on behalf of the client. An RPC context handle is created by the server and given to the client. The client passes the RPC context handle back to the server in method calls to assist in identifying the state. For more information, see [C706].

RPC dynamic endpoint: A network-specific server address that is requested and assigned at run time, as described in [C706].

security descriptor: A data structure containing the security information associated with a securable object. A security descriptor identifies an object's owner by its security identifier (SID). If access control is configured for the object, its security descriptor contains a discretionary access control list (DACL) with SIDs for the security principals who are allowed or denied access. Applications use this structure to set and query an object's security status. The security descriptor is used to guard access to an object as well as to control which type of auditing takes place when the object is accessed. The security descriptor format is specified in [MS-DTYP] section 2.4.6; a string representation of security descriptors, called SDDL, is specified in [MS-DTYP] section 2.5.1.

security identifier (SID): An identifier for security principals that is used to identify an account or a group. Conceptually, the SID is composed of an account authority portion (typically a domain) and a smaller integer representing an identity relative to the account authority, termed the relative identifier (RID). The SID format is specified in [MS-DTYP] section 2.4.2; a string representation of SIDs is specified in [MS-DTYP] section 2.4.2 and [MS-AZOD] section 1.1.1.2.

security provider: A pluggable security module that is specified by the protocol layer above the remote procedure call (RPC) layer, and will cause the RPC layer to use this module to secure messages in a communication session with the server. The security provider is sometimes referred to as an authentication service. For more information, see [C706] and [MS-RPCE].

string resource: A string that is stored in a resource file and that can be retrieved with a key. A string resource is localizable into multiple languages. It is up to an AsyncUI client implementation to determine which language string to retrieve for a given key.

Transmission Control Protocol (TCP): A protocol used with the Internet Protocol (IP) to send data in the form of message units between computers over the Internet. TCP handles keeping track of the individual units of data (called packets) that a message is divided into for efficient routing through the Internet.

Unicode: A character encoding standard developed by the Unicode Consortium that represents almost all of the written languages of the world. The Unicode standard [UNICODE5.0.0/2007] provides three forms (UTF-8, UTF-16, and UTF-32) and seven schemes (UTF-8, UTF-16, UTF-16 BE, UTF-16 LE, UTF-32, UTF-32 LE, and UTF-32 BE).

unidirectional communication mode: A communication mode in which a server sends notifications to a client without requesting or accepting responses.

Uniform Resource Identifier (URI): A string that identifies a resource. The URI is an addressing mechanism defined in Internet Engineering Task Force (IETF) Uniform Resource Identifier (URI): Generic Syntax [RFC3986].

Universal Naming Convention (UNC): A string format that specifies the location of a resource. For more information, see [MS-DTYP] section 2.2.57.

universally unique identifier (UUID): A 128-bit value. UUIDs can be used for multiple purposes, from tagging objects with an extremely short lifetime, to reliably identifying very persistent objects in cross-process communication such as client and server interfaces, manager entry-point vectors, and RPC objects. UUIDs are highly likely to be unique. UUIDs are also known as globally unique identifiers (GUIDs) and these terms are used interchangeably in the Microsoft protocol technical documents (TDs). Interchanging the usage of these terms does not imply or require a specific algorithm or mechanism to generate the UUID. Specifically, the use of this term does not imply or require that the algorithms described in [RFC4122] or [C706] must be used for generating the UUID.

user identity filter: A mechanism supported by this protocol that allows notifications to be directed to a particular user.

UTF-16LE: The Unicode Transformation Format - 16-bit, Little Endian encoding scheme. It is used to encode Unicode characters as a sequence of 16-bit codes, each encoded as two 8-bit bytes with the least-significant byte first.

UTF-16LE (Unicode Transformation Format, 16-bits, little-endian): The encoding scheme specified in [UNICODE5.0.0/2007] section 2.6 for encoding Unicode characters as a sequence of 16-bit codes, each encoded as two 8-bit bytes with the least-significant byte first.

XML: The Extensible Markup Language, as described in [XML1.0].

MAY, SHOULD, MUST, SHOULD NOT, MUST NOT: These terms (in all caps) are used as defined in [RFC2119]. All statements of optional behavior use either MAY, SHOULD, or SHOULD NOT.

1.2 References

Links to a document in the Microsoft Open Specifications library point to the correct section in the most recently published version of the referenced document. However, because individual documents in the library are not updated at the same time, the section numbers in the documents may not match. You can confirm the correct section numbering by checking the Errata.

1.2.1 Normative References

We conduct frequent surveys of the normative references to assure their continued availability. If you have any issue with finding a normative reference, please contact dochelp@microsoft.com. We will assist you in finding the relevant information.

[C706] The Open Group, "DCE 1.1: Remote Procedure Call", C706, August 1997, <https://publications.opengroup.org/c706>

Note Registration is required to download the document.

[MS-DTYP] Microsoft Corporation, "Windows Data Types".

[MS-ERREF] Microsoft Corporation, "Windows Error Codes".

[MS-RPCE] Microsoft Corporation, "Remote Procedure Call Protocol Extensions".

[MS-SPNG] Microsoft Corporation, "Simple and Protected GSS-API Negotiation Mechanism (SPNEGO) Extension".

[RFC1001] Network Working Group, "Protocol Standard for a NetBIOS Service on a TCP/UDP Transport: Concepts and Methods", RFC 1001, March 1987, <http://www.ietf.org/rfc/rfc1001.txt>

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1.3 Overview

The Print System Asynchronous Notification Protocol serves two primary functions:

- A print server sending status notifications to a print client.
- A print server receiving the client's response to the notifications.

This protocol has two modes of operation:

- bidirectional communication mode
- unidirectional communication mode

In bidirectional communication mode, data can flow in two directions between a server and client. After a client registers with a server, the client requests a bidirectional notification channel from the server. The client uses the channel to request predefined print status notifications from the server. When the client subsequently receives a notification, the client also uses the channel to send a response back to the server.

In bidirectional communication mode, if multiple clients open the same bidirectional notification channel and attempt to respond to the channel's initial notification, the server accepts only the first response received and continues to send further notifications only to the client whose response was accepted. Subsequent exchanges of notifications and responses on the channel take place only between the server and that client. Because bidirectional notifications each require a response, the initial notification intended to be transmitted on a bidirectional notification channel cannot be discarded before a registered client sends a response on that channel (or the channel is closed).

The following diagram shows bidirectional communication.

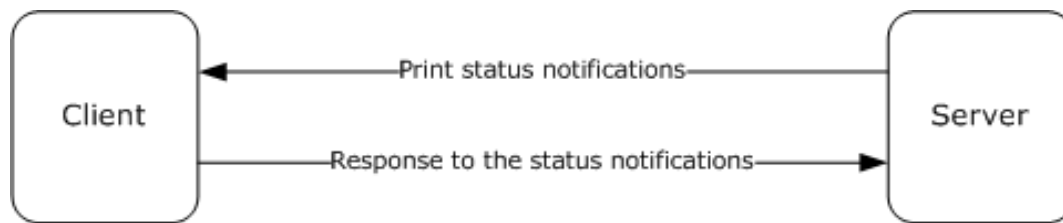


Figure 1: Bidirectional communication

In unidirectional communication mode, multiple clients can register for the same notifications. The server sends a given notification to all clients that have registered for it. Because unidirectional notifications do not require a response, the server can discard the notifications in the absence of an appropriately registered client.

The following diagram shows unidirectional communication.

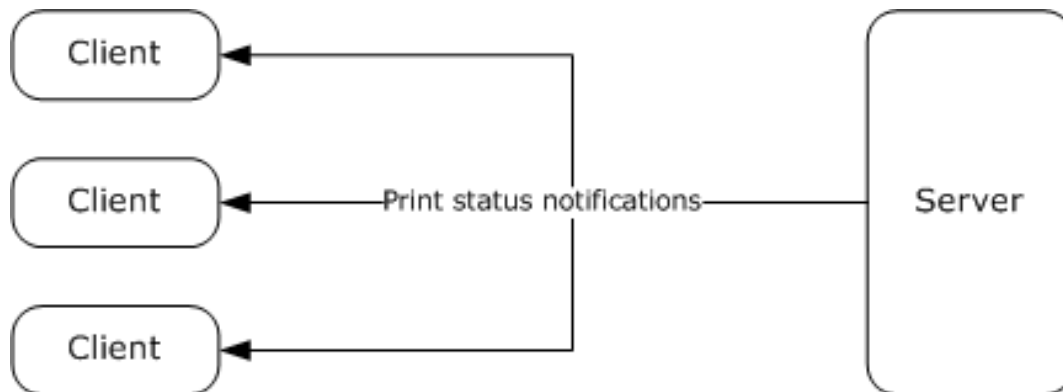


Figure 2: Unidirectional communication

Server-resident notification sources create, on behalf of print clients, notification channels to send notifications as printing events occur. Each channel is created to send only a given notification type in a single communication mode, unidirectional or bidirectional.

Each notification channel is created to send notifications to registered clients, irrespective of their authenticated user identity, or to send notifications to the subset of registered clients with associated authenticated user identity matching that of a specific print client. When registering for notifications, clients specify the notification type identifier, communication mode, and user identity filter for the notifications they are interested in receiving.

Unidirectional notification channels are closed only by the notification source that created the channel. Bidirectional notification channels can be closed by the client that acquired the channel or by the notification source that created the channel. The interaction with notification sources is described in 3.1.1.6.

The Print System Asynchronous Notification Protocol is based on the RPC Protocol, and it defines the following two RPC interfaces, which are called by the client and implemented by the server:

- IRPCAsyncNotify, which is used to register and deregister clients, establish notification channels, and send data back and forth between the client and the server.
- IRPCRemoteObject, which is used to create and destroy remote objects that refer to printers.

This specification also defines the AsyncUI notification type, which exists to support a client component that receives and interprets notifications from server-hosted notification sources, such as printer drivers. The AsyncUI client component can be used to display an informative message, send

user input back to the notification source on the server, or trigger the execution of printer driver code on the client computer. The following diagram illustrates the relationship between a notification source and an AsyncUI client.

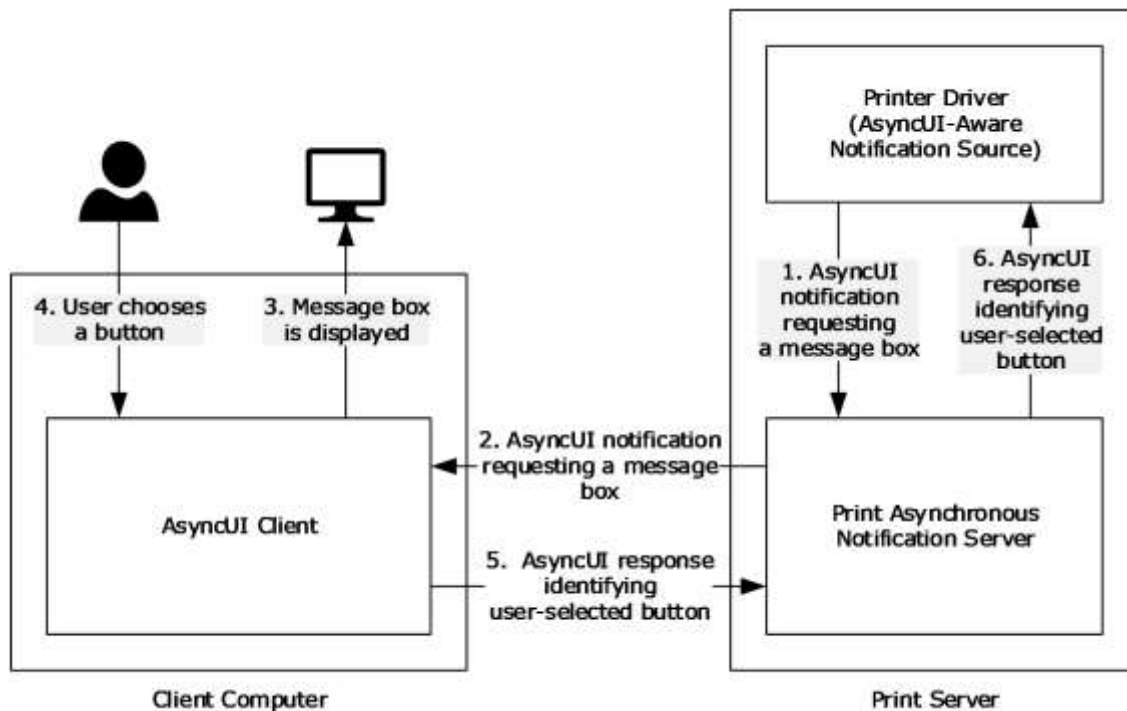


Figure 3: Relationship between a notification source and an AsyncUI client

1.4 Relationship to Other Protocols

The Print System Asynchronous Notification protocol is dependent on RPC [MS-RPCE] running on TCP/IP. These protocol relationships are shown in the following figure:

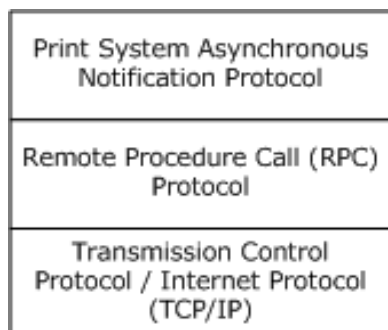


Figure 4: Protocol Relationships

No protocols are dependent on the Print System Asynchronous Notification protocol.

1.5 Prerequisites/Preconditions

The Print System Asynchronous Notification Protocol has the prerequisites common to RPC interfaces ([MS-RPCE] section 1.5). It is a precondition of invoking this protocol that a client obtains the name of a server that supports this protocol.

This specification assumes that a server that generates AsyncUI notifications and the clients that receive them both agree on resource files, resource keys within those files, and positional parameters within string resources that are referenced in those notifications.

1.6 Applicability Statement

The Print System Asynchronous Notification Protocol is applicable only for printing operations between a machine functioning as a client and a machine functioning as a print server. The protocol is intended for the communication of notifications and responses between notification sources operating on a print server and client applications.

The protocol can be used in a broad set of scenarios ranging from home use, where one computer makes its printer available for use by other computers, to enterprise use, where a print server provides printing services for many computers.

The protocol is not applicable outside client/server printing and monitoring print operations.

1.7 Versioning and Capability Negotiation

This specification covers versioning issues in the following areas:

Supported Transports: The Print System Asynchronous Notification Protocol uses RPC over TCP only (section 2.1).

Protocol Versions: There is only one version of this protocol. It has a built-in versioning and extensibility feature that can be used to send and receive new data formats by defining new notification types and creating associated notification type identifiers (section 2.2.1).

Security and Authentication Methods: This protocol uses Simple and Protected Generic Security Service Application Program Interface Negotiation Mechanism (SPNEGO) Protocol Extensions [MS-SPNG] and RPC packet authentication level for security and authentication (section 2.1).

Localization: The AsyncUI notification types pass string resource keys in various message data formats. Localization considerations for the associated string resources are specified in section 2.2.6.

Capability Negotiation: There is no capability negotiation mechanism built into the protocol itself. A vendor can, however, define a new notification type identifier and associate it with a set of notification and response data formats and sequencing rules (section 2.2.1).

1.8 Vendor-Extensible Fields

The Print System Asynchronous Notification Protocol uses HRESULT method return values [MS-ERREF]. In addition to the values defined in this specification and those defined in [MS-ERREF], vendors are free to choose their own values for this field, but the C bit (0x20000000) MUST be set, indicating it is a customer code.

Unless otherwise stated in this specification, a client of this protocol MUST NOT interpret returned error codes. The client MUST simply return error codes to the invoking application without taking any protocol action.

The set of notification types used by this protocol is extensible. New notification types can be defined and associated with new notification type identifiers. This mechanism (section 2.2.1) enables future versioning and extensibility.

1.9 Standards Assignments

Parameter	Value	Reference
RPC UUID for the IRPCAsyncNotify interface (section 3.1)	0b6edbfa-4a24-4fc6-8a23-942b1eca65d1	[C706], Appendix A. For more information, see section 3.1.1.
RPC UUID for the IRPCRemoteObject interface (section 3.2)	ae33069b-a2a8-46ee-a235-ddfd339be281	[C706] Appendix A. For more information, see section 3.1.2.

2 Messages

2.1 Transport

The Print System Asynchronous Notification Protocol MUST use:

- The transport RPC over TCP/IP ([MS-RPCE] section 2.1.1.1).
- RPC dynamic endpoints ([C706] chapter 6).
- UUIDs (section 1.9).

A server of this protocol MUST use:

- A security provider that supports SPNEGO Protocol Extensions ([MS-RPCE] section 3 and [MS-SPNG]).
- The default server principal name for the security provider, which is the authentication-service constant **RPC_C_AUTHN_GSS_NEGOTIATE**. For information concerning Windows authentication-service constants [MSDN-AUTHN].

A client of this protocol MUST use:

- A security provider that supports SPNEGO Protocol Extensions ([MS-RPCE] section 3 and [MS-SPNG]).
- A principal name constructed by appending the name of the print server to the string "host/".
- Packet authentication level ([MS-RPCE] section 3).

2.2 Common Data Types

This protocol MUST indicate to the RPC runtime that it is to support both the Network Data Representation (NDR) and NDR64 transfer syntaxes, and provide a negotiation mechanism for determining which transfer syntax will be used ([MS-RPCE] section 3).

In addition to RPC base types and definitions ([C706] section 4.2.9 and [MS-RPCE] section 2.2.1), additional data types are defined in the following sections.

2.2.1 PrintAsyncNotificationType

The PrintAsyncNotificationType data type supports the definition of unique functional categories of notifications for the Print System Asynchronous Notification Protocol. This type is used for matching notifications from the server to appropriate clients.

This type is declared as follows:

```
typedef GUID PrintAsyncNotificationType;
```

PrintAsyncNotificationType MUST be a notification type identifier.

This protocol defines a reserved notification type identifier value, **NOTIFICATION_RELEASE** (ba9a5027-a70e-4ae7-9b7d-eb3e06ad4157). This value is not associated with any specific set of notification and response data formats, but rather has special meaning in the definition of this protocol. This value indicates that a client or server is not accepting further communication (sections 3.1.1.4.4, 3.1.1.4.5, and 3.1.1.4.6).

This protocol also defines the notification and response data formats for the AsyncUI notification type. Associated with the AsyncUI notification type is its notification type identifier. The value **AsyncPrintNotificationType_AsyncUI** (f6853f92-eb31-4e23-b6e7-fd69056153f0) indicates that the notification data byte arrays contain AsyncUI data formats. For details, see sections 2.2.7, 3.1.3, and 3.2.3.

Finally, this protocol defines notification and response data formats for the printer configuration notification type. The value **AsyncPrintNotificationType_PrinterConfiguration** (2abad223-b994-4aca-82fd4571b1b585ac) indicates that the notification data byte arrays contain printer configuration data formats. For details, see sections 2.2.8, 3.1.4, and 3.2.4.

2.2.2 PrintAsyncNotifyUserFilter

The PrintAsyncNotifyUserFilter enumeration is used by clients when they register to receive notifications from server-resident notification sources. The following types of notifications can be requested:

- Notifications intended specifically for a particular client's user identity.
- Notifications intended for all registered client user identities.

```
typedef [v1_enum] enum
{
    kPerUser = 0,
    kAllUsers = 1,
} PrintAsyncNotifyUserFilter;
```

kPerUser: Indicates that the client is requesting notifications that are intended specifically for its own user identity and notifications that are intended for all registered user identities.

kAllUsers: Indicates that the client is requesting every notification, whether intended for a specific user identity or for all registered user identities.

2.2.3 PrintAsyncNotifyConversationStyle

The PrintAsyncNotifyConversationStyle enumeration MUST specify the communication mode expected between the sender and a registered client.

```
typedef [v1_enum] enum
{
    kBiDirectional = 0,
    kUniDirectional = 1,
} PrintAsyncNotifyConversationStyle;
```

kBiDirectional: Bidirectional communication mode is specified. The sender expects the client to send responses to notifications.

kUniDirectional: Unidirectional communication mode is specified. The sender does not expect the client to respond to notifications.

2.2.4 PRPCREMOTEOBJECT

The PRPCREMOTEOBJECT data type defines an RPC context handle, which corresponds to the server remote object representing a client registration. A client MUST call IRPCRemoteObject_Create to create a PRPCREMOTEOBJECT handle, and IRPCRemoteObject_Delete to delete a PRPCREMOTEOBJECT handle (section 3.1.2.4).

This type is declared as follows:

```
typedef [context_handle] void* PRPCREMOTEOBJECT;
```

2.2.5 PNOTIFYOBJECT

The PNOTIFYOBJECT data type defines an RPC context handle, which corresponds to the server object representing a notification channel. This handle is used in bidirectional communication mode only.

This type is declared as follows:

```
typedef [context_handle] void* PNOTIFYOBJECT;
```

2.2.6 AsyncUI Default Resource File String Resources

AsyncUI default resource file string resources are used to specify localizable text for the user interface of the Print System Asynchronous Notification protocol. Each string resource defines a unique key and a corresponding localizable text string. An AsyncUI client uses the key to retrieve the text string from a resource file.

String resources that convey information equivalent to the localizable text in the following table MUST be present in a default resource file. The string resources MUST include the same number of position parameter replacement tags as are present in the table, with equivalent meanings.

In the text strings that follow, position parameter replacement tags are indicated by "%" characters. Reading from left to right, "%1" is the first parameter, "%2" is the second parameter, and so on. The "format string!" after a position parameter replacement tag specifies the format of the parameter. Specifically, in the case of the string resource localizable text with resource key 2702, the notation "%1!d!" indicates that the first parameter is formatted as a signed decimal integer.

String resource key	String resource localizable text
100	"..."
101	"This document was sent to the printer"
102	"Document: %1\nPrinter: %2\nTime: %3\nTotal pages: %4"
103	"Printer out of paper"
104	"Printer '%1' is out of paper."
105	"This document failed to print"
106	"Document: %1\nPrinter: %2\nTime: %3\nTotal pages: %4"
107	"Printer door open"
108	"The door on '%1' is open."
109	"Printer in an error state"
110	"'%1' is in an error state."
111	"Printer out of toner/ink"

String resource key	String resource localizable text
112	""%1' is out of toner/ink."
113	"Printer not available"
114	""%1' is not available for printing."
115	"Printer offline"
116	""%1' is offline."
117	"Printer out of memory"
118	""%1' has run out of memory."
119	"Printer output bin full"
120	"The output bin on '%1' is full."
121	"Printer paper jam"
122	"Paper is jammed in '%1'."
123	"Printer out of paper"
124	""%1' is out of paper."
125	"Printer paper problem"
126	""%1' has a paper problem."
127	"Printer paused"
128	""%1' is paused."
129	"Printer needs user intervention"
130	""%1' has a problem that requires your intervention."
131	"Printer is low on toner/ink"
132	""%1' is low on toner/ink."
600	"OK"
601	"Cancel"
1000	"Document: %1\n"
1001	"Printer: %1\n"
1002	"Paper size: %1\n"
1003	"Ink: %1\n"
1004	"Cartridge: %1\n"
1005	"Paper jam area: %1\n"
1006	"A printer problem occurred"
1007	"Please check the printer for any problems."

String resource key	String resource localizable text
1008	"Please check the printer status and settings."
1009	"Check if the printer is online and ready to print."
1100	"The printer is ready to print on the other side of the paper."
1101	"To finish double-sided printing, remove the paper from the output tray. Re-insert the paper in the input tray, facing up."
1102	"To finish double-sided printing, remove the paper from the output tray. Re-insert the paper in the input tray, facing down."
1200	"Press the Resume button on the printer when done."
1201	"Press the Cancel button on the printer when done."
1202	"Press the OK button on the printer when done."
1203	"Press the Online button on the printer when done."
1204	"Press the Reset button on the printer when done."
1300	"The printer is offline."
1301	"Windows could not connect to your printer. Please check the connection between the computer and the printer."
1302	"The printer is not responding. Please check the connection between your computer and the printer."
1400	"Paper Jam"
1401	"Your printer has a paper jam."
1402	"Please check the printer and clear the paper jam. The printer cannot print until the paper jam is cleared."
1403	"Please clear the paper jam on the printer."
1500	"Your printer is out of paper."
1501	"Please check the printer and add more paper."
1502	"Please check the printer and add more paper in tray %1."
1503	"Please check the printer and add more %1 paper in tray %2."
1600	"The output tray on your printer is full."
1601	"Please empty the output tray on the printer."
1700	"Your printer has a paper problem"
1701	"Please check your printer for paper problems."
1800	"Your printer is out of ink"
1801	"The ink cartridge in your printer is empty."
1802	"Your printer is out of toner."
1803	"Please check the printer and add more ink."

String resource key	String resource localizable text
1804	"Please check the printer and replace the ink cartridge."
1805	"Please check the printer and add toner."
2000	"Cyan"
2001	"Magenta"
2002	"Yellow"
2003	"Black"
2004	"Light Cyan"
2005	"Light Magenta"
2006	"Red"
2007	"Green"
2008	"Blue"
2009	"Gloss optimizer"
2010	"Photo Black"
2011	"Matte Black"
2012	"Photo Cyan"
2013	"Photo Magenta"
2014	"Light Black"
2015	"Ink optimizer"
2016	"Blue photo"
2017	"Gray photo"
2018	"Tricolor photo"
2100	"Cyan cartridge"
2101	"Magenta cartridge"
2102	"Black cartridge"
2103	"CMYK cartridge"
2104	"Gray cartridge"
2105	"Color cartridge"
2106	"Photo cartridge"
2200	"A door on your printer is open."
2201	"A cover on your printer is open."
2202	"Please check the printer and close any open doors. The printer cannot print while a door is open."

String resource key	String resource localizable text
2203	"Please check the printer and close any open covers. The printer cannot print while a cover is open."
2300	"Your printer is not printing"
2301	"Please check your printer"
2302	"Your printer is out of memory"
2303	"Your document might not print correctly. Please see online help."
2400	"Your printer is low on ink"
2401	"The ink cartridge in your printer is almost empty."
2402	"Your printer is low on toner"
2403	"Please check the printer and add more ink when needed."
2404	"Please check the printer and replace the ink cartridge when needed."
2405	"Please check the printer and add toner when needed."
2500	"The ink system in your printer is not working"
2501	"The ink cartridge in your printer is not working"
2502	"The toner system in your printer is not working"
2503	"Please check the ink system in your printer."
2504	"Please check the ink cartridge in your printer."
2505	"Please check the toner system in your printer."
2506	"Please check that the ink cartridge was installed correctly in the printer."
2600	"Printer has been paused"
2601	"'%1' cannot print, because it has been put into a paused state at the device."
2602	"'%1' cannot print, because it has been put into an offline state at the device."
2700	"Your document has been printed."
2701	"Your document is in the output tray."
2702	"%1!d! document(s) pending for %2"
2703	"<unknown>"

2.2.7 AsyncUI XML Notification and Response Formats

This section specifies the data formats for notifications and responses associated with the notification type identifier value **AsyncPrintNotificationType_AsyncUI** (section 2.2.1). The data formats are specified by using a combination of prose and XML schema syntax [W3C-XSD].

The XML schema fragments contained in this section are drawn from two separate XML schema documents, one for AsyncUI notifications and one for AsyncUI responses. Both schema documents specify a value of "qualified" for the **elementFormDefault** attribute of the root "schema" element.

The XML schema document for AsyncUI notifications MUST specify a **targetNamespace** attribute value of "http://schemas.microsoft.com/2003/print/asyncai/v1/request" and also MUST use that URI as the schema document's default namespace ([XMLNS] sections 2.1 and 3.0).

The XML schema document for AsyncUI responses MUST specify a **targetNamespace** attribute value of "http://schemas.microsoft.com/2003/print/asyncai/v1/response", and also MUST use that URI as the schema document's default namespace.

Server-resident notification sources such as printer drivers can use the AsyncUI notification type to display printing-related, interactive UIs on client systems.

The XML data contained within AsyncUI notifications and responses MUST obey the syntax of well-formed XML 1.0 documents ([XML1.0] section 2.1). Furthermore, those documents MUST be encoded in UTF-16LE (Unicode Transformation Format, 16-bits, little-endian) ([RFC2781] section 4.2).

Note that XML 1.0 [XML1.0], restricts the set of legal characters that can be used. Values that cannot be expressed in XML MUST NOT be represented in an XML document contained within an AsyncUI notification or response. Furthermore, some legal characters, such as "<" and "&", require some form of escaping when encoded in XML. Implementations MUST use an XML-defined mechanism, such as CDATA ([XML1.0] sections 2.4 and 2.7) or numeric character references ([XML1.0] section 4.1), to encode such characters within XML documents.

2.2.7.1 Common AsyncUI Elements

The following sections define XML elements common to some of the AsyncUI notification data formats.

2.2.7.1.1 asyncPrintUIRequest Element

The asyncPrintUIRequest XML element MUST be the root element of XML documents used in the **AsyncUIBalloon** (section 2.2.7.2), **AsyncUIMessageBox** (section 2.2.7.3), **AsyncUICustomUI** (section 2.2.7.5), and **AsyncUICustomData** (section 2.2.7.7) server-to-client notification formats.

The document markup MUST be schema-valid according to the following XML schema, which refers to additional schema fragments (section 2.2.7). Schema-Validity Assessment of the document's root element MUST result in a value of "valid" for the **[validity]** property ([XMLSCHEMA1/2] section 3.3.5).

```
<xs:element name="asyncPrintUIRequest">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="v1">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="requestOpen">
              <xs:complexType>
                <xs:choice>
                  <xs:element
                    ref="balloonUI"
                  />
                  <xs:element
                    ref="messageBoxUI"
                  />
                  <xs:element
                    ref="customUI"
                  />
                  <xs:element
                    ref="customData"
                  />
                </xs:choice>
              </xs:complexType>
            </xs:element>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

```

        </xs:choice>
      </xs:complexType>
    </xs:element>
  </xs:sequence>
</xs:complexType>
</xs:element>
</xs:sequence>
</xs:complexType>
</xs:element>

```

Child Elements

Element	Type	Description
v1	N/A	A required element within an asyncPrintUIRequest element that MUST contain exactly one requestOpen element.
requestOpen	N/A	A required element that MUST contain exactly one balloonUI, messageBoxUI, customUI, or customData element.
balloonUI	balloonUI	See section 2.2.7.2.2.
messageBoxUI	messageBoxUI	See section 2.2.7.3.4.
customUI	customUI	See section 2.2.7.5.1.
customData	customData	See section 2.2.7.7.1.

2.2.7.1.2 asyncPrintUIResponse Element

The asyncPrintUIResponse XML element MUST be the root element of the XML documents used in the **AsyncUIMessageBoxReply** (section 2.2.7.4) and **AsyncUICustomUIReply** (section 2.2.7.6) client-to-server response formats.

The document markup MUST be schema-valid according to the following XML schema, which refers to additional schema fragments (section 2.2.7). Schema-Validity Assessment of the document's root element MUST result in a value of "valid" for the **[validity]** property ([XMLSCHEMA1/2] section 3.3.5).

```

<xs:element name="asyncPrintUIResponse">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="v1">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="requestClose">
              <xs:complexType>
                <xs:choice>
                  <xs:element
                    ref="CustomUI"
                    />
                  <xs:element
                    ref="messageBoxUI"
                    />
                </xs:choice>
              </xs:complexType>
            </xs:element>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
</xs:element>

```

```

</xs:complexType>
</xs:element>

```

Child Elements

Element	Type	Description
v1	N/A	A required element within an asyncPrintUIResponse element that MUST contain exactly one requestClose element.
requestClose	N/A	A required element that MUST contain exactly one messageBoxUI or CustomUI element.
CustomUI	CustomUI	See section 2.2.7.6.1.
messageBoxUI	messageBoxUI	See section 2.2.7.3.4.

2.2.7.1.3 title Element

The title XML element specifies a string using attributes or nested text, optionally combined with nested parameter elements, that SHOULD be used by the AsyncUI client as the displayable title of a printer event.

If any of the strings specified by attributes or nested text contains position parameter replacement tags, the client MUST replace the parameters with strings that are constructed from the sequence of parameter elements.

```

<xs:element name="title">
  <xs:complexType
    mixed="true"
  >
    <xs:sequence>
      <xs:element
        minOccurs="0"
        maxOccurs="unbounded"
        ref="parameter"
      />
    </xs:sequence>
    <xs:attribute name="stringID"
      type="xs:integer"
      use="optional"
    />
    <xs:attribute name="resourceDll"
      type="xs:string"
      use="optional"
    />
  </xs:complexType>
</xs:element>

```

Child Elements

Element	Type	Description
parameter	parameter	See section 2.2.7.1.5.

Attributes

Name	Type	Description
stringID	xs:integer	The value of this optional attribute, if present, is the key of a string resource in the resource file specified by the resourceDll attribute. If the resourceDll attribute is not specified, stringID MUST be used as the key of a string resource in the default resource file. String resources that are present in the default resource file are specified in section 2.2.6.
resourceDll	xs:string	The value of this optional attribute, if present, is the driver-file name of a resource file on the client system that contains the string resources used in this message. If no value is specified, a default resource file MUST be used.

If the **stringID** attribute is not specified, the text content in the title element MUST be present, and it MUST be used by the client as the string to display.

If the **stringID** attribute is specified, the title element MUST NOT contain nested text, and the client MUST treat the presence of such text as an error.

Nested text MUST NOT follow a parameter element.

2.2.7.1.4 body Element

The body XML element specifies a string using attributes or nested text, optionally combined with nested parameter elements that SHOULD be used by the AsyncUI client as the displayable description of a printer event.

If any of the strings specified by attributes or nested text contains position parameter replacement tags, the client MUST replace the parameters with strings that are constructed from the sequence of parameter elements.

If a single notification contains multiple body elements, the client MUST concatenate the text resulting from the processing of each successive body element to determine the complete displayable description. The client SHOULD interpose a single space character between each pair of concatenated strings.

```
<xs:element name="body">
  <xs:complexType
    mixed="true"
  >
    <xs:sequence>
      <xs:element
        minOccurs="0"
        maxOccurs="unbounded"
        ref="parameter"
      />
    </xs:sequence>
    <xs:attribute name="stringID"
      type="xs:integer"
      use="optional"
    />
    <xs:attribute name="resourceDll"
      type="xs:string"
      use="optional"
    />
  </xs:complexType>
</xs:element>
```

Child Elements

Element	Type	Description
parameter	parameter	See section 2.2.7.1.5.

Attributes

Name	Type	Description
stringID	xs:integer	The value of this optional attribute, if present, is the key of a string resource in the resource file specified by the resourceDll attribute. If the resourceDll attribute is not specified, stringID MUST be used as the key of a string resource in the default resource file. String resources that are present in the default resource file are specified in section 2.2.6.
resourceDll	xs:string	The value of this optional attribute, if present, is the driver-file name of a resource file on the client system that contains the string resources used in this message. If no value is specified, a default resource file MUST be used.

If the **stringID** attribute is not specified, the text content in the body element MUST be present, and it MUST be used by the client as the string to display.

If the **stringID** attribute is specified, then the body element MUST NOT contain nested text and the client MUST treat the presence of such text as an error.

Nested text MUST NOT follow a parameter element.

2.2.7.1.5 parameter Element

The parameter XML element specifies a string using attributes or nested text that provides parameter substitution information for a string specified by a body or title element.

```
<xs:element name="parameter">
  <xs:complexType>
    <xs:simpleContent>
      <xs:extension
        base="xs:string"
      >
        <xs:attribute name="type"
          type="xs:string"
          use="optional"
        />
        <xs:attribute name="stringID"
          type="xs:integer"
          use="optional"
        />
        <xs:attribute name="resourceDll"
          type="xs:string"
          use="optional"
        />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>
</xs:element>
```

Attributes

Name	Type	Description
type	xs:string	The value of this optional attribute, if present, MUST be the string "PrinterName". If this value is specified, then the client MUST ignore the stringID and resourceDll

Name	Type	Description
		attributes. For string resource formatting purposes, the client SHOULD use a recognizable name for the printer that triggered the notification.
stringID	xs:integer	The value of this optional attribute, if present, is the key of a string resource in the resource file specified by the resourceDll attribute. If the resourceDll attribute is not specified, stringID MUST be used as the key of a string resource in the default resource file. String resources that are present in the default resource file are specified in section 2.2.6.
resourceDll	xs:string	The value of this optional attribute, if present, is the driver-file name of a resource file on the client system that contains the string resources used in this message. If neither a type attribute nor a resourceDll attribute is specified, then the default resource file MUST be used.

If neither the **type** nor the **stringID** attribute is specified, then the text content in the parameter element MUST be present and MUST be used by the client when processing position parameter replacement tags within a string specified by a title or body element.

If the **type** attribute is specified, then the parameter element SHOULD NOT contain nested text and the client SHOULD treat the presence of such text as an error. If **stringID** is present but the client is unable to load a corresponding string resource, the client SHOULD use the nested text.

2.2.7.2 AsyncUIBalloon

AsyncUIBalloon is a string that contains a well-formed XML document ([XML1.0] section 2.1). The root element of the document MUST be the `asyncPrintUIRequest` element (section 2.2.7.1.1). A `balloonUI` element (section 2.2.7.2.2) MUST be nested within the **AsyncPrintUIRequest** markup at the point where it is referenced in the XML schema.

AsyncUIBalloon SHOULD be used by a printer driver on a server to deliver to a client UI the details of an event or a change in device status. Print servers SHOULD also use AsyncUIBalloon to send details about printer configuration changes, when available, to a client UI. <1>

2.2.7.2.1 action Element

The action XML element directs the client to execute a method at a specific entry point in a specific file on the client computer.

The action element SHOULD contain text data, encoded as a null-terminated UTF-16LE string ([RFC2781] section 4.2), to pass to the method indicated by the **entrypoint** attribute. The mechanism by which the client invokes the executable code is specific to the client implementation. <2>

```
<xs:element name="action">
  <xs:complexType>
    <xs:simpleContent>
      <xs:extension
        base="xs:string"
      >
        <xs:attribute name="dll"
          type="xs:string"
          use="required"
        />
        <xs:attribute name="entrypoint"
          type="xs:string"
          use="required"
        />
      </xs:extension>
    </xs:complexType>
  </xs:element>
```

```

    </xs:simpleContent>
  </xs:complexType>
</xs:element>

```

Attributes

Name	Type	Description
dll	xs:string	The value of this attribute is a string that contains the driver-file name of a file on the client system that contains executable code. The driver-file name MUST NOT contain any of the following Unicode standard [UNICODE] characters: \ (character code U+005C) / (character code U+002F) ? (character code U+003F) * (character code U+002A) < (character code U+003C) > (character code U+003E) " (character code U+0022) (character code U+007C) : (character code U+003A)
entrypoint	xs:string	The value of this attribute is a string that specifies a public method in the file designated by the dll attribute.

2.2.7.2.2 balloonUI Element

The balloonUI XML element contains information on a printer event that can be displayed on the client computer. The notification MUST contain references to string resources that pertain to printer events.

A balloonUI element can optionally call for the execution of code on the client system by means of a nested action element.

```

<xs:element name="balloonUI">
  <xs:complexType>
    <xs:sequence>
      <xs:element
        ref="title"
      />
      <xs:element
        maxOccurs="unbounded"
        ref="body"
      />
      <xs:element
        minOccurs="0"
        ref="action"
      />
    </xs:sequence>
    <xs:attribute name="iconID"
      type="xs:integer"
      use="optional"
    />
    <xs:attribute name="resourceDll"
      type="xs:string"
      use="optional"
    />
  </xs:complexType>
</xs:element>

```

Child Elements

Element	Type	Description
title	title	See section 2.2.7.1.3.
body	body	See section 2.2.7.1.4.
action	action	See section 2.2.7.2.1

Attributes

Name	Type	Description
iconID	xs:integer	The value of this optional attribute, if present, is the key of an icon resource in the resource file specified by the resourceDll attribute. If an iconID is provided, a resourceDll MUST also be specified.
resourceDll	xs:string	The value of this optional attribute, if present, is the driver-file name of a resource file on the client system that contains the icon resource specified by the iconID attribute. If this attribute is not specified, a generic icon SHOULD be used.

2.2.7.3 AsyncUIMessageBox

AsyncUIMessageBox is a string that contains a well-formed XML document ([XML1.0] section 2.1).

The root element of the document MUST be the `asyncPrintUIRequest` element (section 2.2.7.1.1). A `messageBoxUI` element (section 2.2.7.3.4) MUST be nested within the `AsyncPrintUIRequest` markup at the point where it is referenced in the XML schema.

AsyncUIMessageBox SHOULD be used by a printer driver on a server to deliver to a client UI the details of an event or a change in device status and to request input from the user to guide its handling of the event or change in status.

2.2.7.3.1 button Element

The button XML element contains information on a button control in the UI that SHOULD be displayed on the client computer.

```
<xs:element name="button">
  <xs:complexType>
    <xs:sequence />
    <xs:attribute name="stringID"
      type="xs:integer"
      use="optional"
    />
    <xs:attribute name="resourceDll"
      type="xs:string"
      use="optional"
    />
    <xs:attribute name="buttonID"
      use="required"
    />
  >
  <xs:simpleType>
    <xs:restriction
      base="xs:string"
    >
      <xs:pattern
        value="IDOK|IDCANCEL|\s*(\-\|\/)?[0-9]+\s*"
      />
    </xs:restriction>
  </xs:simpleType>
</xs:element>
```



```

        </xs:restriction>
    </xs:simpleType>
</xs:attribute>
</xs:complexType>
</xs:element>

```

Attributes

Name	Type	Description
stringID	xs:integer	This attribute MUST be present if the value of the buttonID attribute is neither "IDOK" nor "IDCANCEL". If present, the value of this attribute MUST be the key of a string resource in the resource file specified by the resourceDll attribute. If the resourceDll attribute is not specified, stringID MUST be the key of a string resource in the default resource file. String resources that are present in the default resource file are specified in section 2.2.6.
resourceDll	xs:string	The value of this optional attribute, if present, is the driver-file name of a resource file on the client system, which contains the string resources used in this message. If no value is specified, the default resource file MUST be used.
buttonID	xs:string	The value of this attribute MUST be a string representation of an integer, or one of the following case-sensitive strings: "IDOK" The button SHOULD correspond to OK button behavior in the dialog. "IDCANCEL" The button SHOULD correspond to Cancel button behavior in the dialog. If the attribute value is "IDOK" or "IDCANCEL", the stringID and resourceDll values MUST be ignored.

2.2.7.3.2 buttons Element

The buttons XML element contains a collection of button elements. The client can display these buttons to present the user with a choice of actions.

```

<xs:element name="buttons">
  <xs:complexType>
    <xs:sequence>
      <xs:element
        maxOccurs="5"
        ref="button"
      />
    </xs:sequence>
  </xs:complexType>
</xs:element>

```

Child Elements

Element	Type	Description
button	button	See section 2.2.7.3.1.

2.2.7.3.3 bitmap Element

The bitmap XML element, if present, specifies a bitmap that can be displayed on the client computer to describe a printer event.

This element can be used to add an informational graphic to the UI for printer events. For example, in the case of a paper jam, a schematic could be displayed that indicates where the paper jam occurred.

```
<xs:element name="bitmap">
  <xs:complexType>
    <xs:sequence />
    <xs:attribute name="bitmapID"
      type="xs:integer"
      use="required"
    />
    <xs:attribute name="resourceDll"
      type="xs:string"
      use="optional"
    />
  </xs:complexType>
</xs:element>
```

Attributes

Name	Type	Description
bitmapID	xs:integer	The value of this attribute is the key of a bitmap resource in the resource file specified by the resourceDll attribute. If no resourceDll value is specified, bitmapID MUST be the key of a bitmap resource in a default resource file.
resourceDll	xs:string	The value of this optional attribute is the driver-file name of a resource file on the client system that contain the bitmap resource used in this message.

2.2.7.3.4 messageBoxUI Element

The messageBoxUI XML element specifies elements that compose a message box for display in a client UI.

```
<xs:element name="messageBoxUI">
  <xs:complexType>
    <xs:sequence>
      <xs:element
        ref="title"
      />
      <xs:element
        minOccurs="0"
        ref="bitmap"
      />
      <xs:element
        maxOccurs="unbounded"
        ref="body"
      />
      <xs:element
        ref="buttons"
      />
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

Child Elements

Element	Type	Description
title	title	See section 2.2.7.1.3.

Element	Type	Description
bitmap	bitmap	See section 2.2.7.3.3.
body	body	See section 2.2.7.1.4.
buttons	buttons	See section 2.2.7.3.2.

2.2.7.4 AsyncUIMessageBoxUIReply

AsyncUIMessageBoxUIReply is a string that contains a well-formed XML document ([XML1.0] section 2.1).

The root element of the document MUST be an asyncPrintUIResponse element. A messageBoxUI element MUST be nested within the asyncPrintUIResponse markup at the point where it is referenced in the XML schema.

The AsyncUIMessageBoxUIReply carries the response from a client to an AsyncUIMessageBoxUIReply notification.

2.2.7.4.1 buttonID Element

The buttonID XML element specifies the button element from an AsyncUIMessageBox string that was selected by the user.

If the selected button element has a **buttonID** attribute value of "IDOK", the buttonID element MUST contain the value 1. If the selected button element has a **buttonID** attribute value of "IDCANCEL", the buttonID element MUST contain the value 2. If the selected button element holds an integer value, the buttonID element MUST contain that value.

```
<xs:element name="buttonID"
  type="xs:integer"
  />
```

2.2.7.4.2 messageBoxUI Element

The messageBoxUI XML element contains a buttonID element that identifies the button that was selected by the user.

```
<xs:element name="messageBoxUI">
  <xs:complexType>
    <xs:sequence>
      <xs:element
        ref="buttonID"
      />
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

Child Elements

Element	Type	Description
buttonID	buttonID	See section 2.2.7.4.1 .

2.2.7.5 AsyncUICustomUI

AsyncUICustomUI is a string that contains a well-formed XML document ([XML1.0] section 2.1).

The root element of the document MUST be an asyncPrintUIRequest element (section 2.2.7.1.1). A customUI element MUST be nested within the asyncPrintUIRequest markup at the point where it is referenced in the XML schema.

AsyncUICustomUI (or the similar AsyncUICustomData) SHOULD be used by a printer driver on a server when it requires client-side handling of an event or a change in device status that cannot be expressed by using an AsyncUIMessageBox or AsyncUIBalloon notification. The AsyncUICustomUI notification calls for the execution of client-resident code that is associated with the server-resident printer driver.

2.2.7.5.1 customUI Element

The customUI XML element directs the client to execute a method at a specific entry point in a specific file on the client computer. This element can also direct the client to respond with the result of the execution.

The customUI element SHOULD contain text data, encoded as a null-terminated UTF-16LE string ([RFC2781] section 4.2), to pass to the method indicated by the **entrypoint** attribute. The mechanism by which the client invokes the executable code is specific to the client implementation.<3>

If the **bidirectional** attribute value is "true", the **entrypoint** method MUST return a text value encoded as a null-terminated UTF-16LE string in the AsyncUICustomUIReply response (section 2.2.7.6) to this notification.

```
<xs:element name="customUI">
  <xs:complexType>
    <xs:simpleContent>
      <xs:extension
        base="xs:string"
      >
        <xs:attribute name="dll"
          type="xs:string"
          use="required"
        />
        <xs:attribute name="entrypoint"
          type="xs:string"
          use="required"
        />
        <xs:attribute name="bidirectional"
          use="required"
        >
          <xs:simpleType>
            <xs:restriction
              base="xs:string"
            >
              <xs:enumeration
                value="true"
              />
              <xs:enumeration
                value="false"
              />
            </xs:restriction>
          </xs:simpleType>
        </xs:attribute>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>
</xs:element>
```

```
</xs:complexType>
</xs:element>
```

Attributes

Name	Type	Description						
dll	xs:string	The value of this attribute is a string that contains the driver-file name of a file on the client system that contains executable code. The driver-file name MUST NOT contain any of the following Unicode standard [UNICODE] characters: \ (character code U+005C) / (character code U+002F) ? (character code U+003F) * (character code U+002A) < (character code U+003C) > (character code U+003E) " (character code U+0022) (character code U+007C) : (character code U+003A)						
entrypoint	xs:string	The value of this attribute is a string that specifies a public method in the file designated by the dll attribute.						
bidi	enumeration	The value of this attribute MUST specify whether the client is expected to send a response to the server. The case-sensitive string MUST be one of the following values. <table border="1" data-bbox="526 926 1430 1234"> <thead> <tr> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>true</td> <td>Indicates that the notification containing the customUI element MUST have been sent over a bidirectional notification channel, and the client MUST send a response back to the print server. The method specified by entrypoint MUST return a string, which MUST be returned to the server in an AsyncUICustomUIReply response.</td> </tr> <tr> <td>false</td> <td>Indicates that the notification containing the customUI element MUST NOT have been sent over a bidirectional notification channel, and the client MUST NOT send a response back to the print server.</td> </tr> </tbody> </table>	Value	Description	true	Indicates that the notification containing the customUI element MUST have been sent over a bidirectional notification channel, and the client MUST send a response back to the print server. The method specified by entrypoint MUST return a string, which MUST be returned to the server in an AsyncUICustomUIReply response.	false	Indicates that the notification containing the customUI element MUST NOT have been sent over a bidirectional notification channel, and the client MUST NOT send a response back to the print server.
Value	Description							
true	Indicates that the notification containing the customUI element MUST have been sent over a bidirectional notification channel, and the client MUST send a response back to the print server. The method specified by entrypoint MUST return a string, which MUST be returned to the server in an AsyncUICustomUIReply response.							
false	Indicates that the notification containing the customUI element MUST NOT have been sent over a bidirectional notification channel, and the client MUST NOT send a response back to the print server.							

2.2.7.6 AsyncUICustomUIReply

AsyncUICustomUIReply is a string that contains a well-formed XML document ([XML1.0] section 2.1).

The root element of the document **MUST** be the asyncPrintUIResponse element. A CustomUI element **MUST** be nested within the asyncPrintUIResponse markup at the point where it is referenced in the XML schema.

AsyncUICustomUIReply **MUST** carry the response from a client to an AsyncUICustomUI or AsyncUICustomData notification.

2.2.7.6.1 CustomUI Element

The CustomUI XML element contains text that encodes the value returned by the call to the **entrypoint** method, which is identified in the customUI element of an AsyncUICustomUI notification or in the customData element of an AsyncUICustomData notification.

```
<xs:element name="CustomUI"
  type="xs:string"
 />
```

2.2.7.7 AsyncUICustomData

AsyncUICustomData is a null-terminated string containing a well-formed XML document ([XML1.0] section 2.1) followed by binary data.

The root element of the document MUST be the asyncPrintUIRequest element (section 2.2.7.1.1). A customData element MUST be nested within the asyncPrintUIRequest markup at the point where it is referenced in the XML schema.

The entry point specified in the customData element MUST be called, passing the binary data as an argument.

AsyncUICustomData can be used in any case where a printer driver on a server might choose to use AsyncUICustomUI. However, because AsyncUICustomData encodes the data passed to the specified entry point in binary form, the AsyncUICustomData notification can transport argument values that cannot be expressed in legal XML within an AsyncUICustomUI notification.

2.2.7.7.1 customData Element

The customData XML element directs the client to execute a method at a specific entry point in a specific file on the client computer. This element can also direct the client to respond with the result of the execution.

The customData element SHOULD contain binary data following the null-terminated XML document to pass to the method indicated by the **entrypoint** attribute. The mechanism by which the client invokes the executable code is specific to the client implementation.<4>

If the **bidi** attribute value is "true", the **entrypoint** method MUST return a text value encoded as a null-terminated UTF-16LE string in the AsyncUICustomUIReply response (section 2.2.7.6) to this notification.

```
<xs:element name="customData">
  <xs:complexType>
    <xs:sequence />
    <xs:attribute name="dll"
      type="xs:string"
      use="required"
    />
    <xs:attribute name="entrypoint"
      type="xs:string"
      use="required"
    />
    <xs:attribute name="bidi"
      use="required"
    />
  >
  <xs:simpleType>
    <xs:restriction
      base="xs:string"
    >
      <xs:enumeration
        value="true"
      />
      <xs:enumeration
        value="false"
      />
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
```

```
</xs:complexType>
</xs:element>
```

Attributes

Name	Type	Description						
dll	xs:string	The value of this attribute is a string that contains the driver-file name of a file on the client system that contains executable code. The driver-file name MUST NOT contain any of the following Unicode standard [UNICODE] characters: \ (character code U+005C) / (character code U+002F) ? (character code U+003F) * (character code U+002A) < (character code U+003C) > (character code U+003E) " (character code U+0022) (character code U+007C) : (character code U+003A)						
entrypoint	xs:string	The value of this attribute is a string that specifies the entry point of a public method in the file designated by the dll attribute.						
bidi	enumeration	The value of this attribute MUST specify whether the client is expected to send a response to the server. The case-sensitive string MUST be one of the following values. <table border="1" data-bbox="527 928 1432 1234"> <thead> <tr> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>true</td> <td>Indicates that the notification containing the customData element MUST have been sent over a bidirectional notification channel and the client MUST send a response back to the print server. The method specified by entrypoint MUST return a string that MUST be returned to the server in an AsyncUICustomUIReply response.</td> </tr> <tr> <td>false</td> <td>Indicates that the notification containing the customData element MUST NOT have been sent over a bidirectional notification channel and the client MUST NOT send a response back to the print server.</td> </tr> </tbody> </table>	Value	Description	true	Indicates that the notification containing the customData element MUST have been sent over a bidirectional notification channel and the client MUST send a response back to the print server. The method specified by entrypoint MUST return a string that MUST be returned to the server in an AsyncUICustomUIReply response.	false	Indicates that the notification containing the customData element MUST NOT have been sent over a bidirectional notification channel and the client MUST NOT send a response back to the print server.
Value	Description							
true	Indicates that the notification containing the customData element MUST have been sent over a bidirectional notification channel and the client MUST send a response back to the print server. The method specified by entrypoint MUST return a string that MUST be returned to the server in an AsyncUICustomUIReply response.							
false	Indicates that the notification containing the customData element MUST NOT have been sent over a bidirectional notification channel and the client MUST NOT send a response back to the print server.							

2.2.8 Printer Configuration Notification Formats

This section specifies the data formats for notifications associated with the notification type identifier value **AsyncPrintNotificationType_PrinterConfiguration** (see section 2.2.1). The data formats are specified by using a combination of text and XML schema syntax (see [W3C-XSD]).

The XML schema document for printer bidirectional notifications **MUST** specify a **targetNamespace** attribute value of "http://schemas.microsoft.com/windows/2005/03/printing/bidi" and also **MUST** use that URI as the schema document's default namespace ([XMLNS] sections 2.1 and 3.0).

Print servers can use the printer configuration notification type to update clients when the printer configuration changes. Clients **MUST** use the unidirectional communication mode for this notification type.

The XML data contained within printer configuration notifications **MUST** conform to the syntax of well-formed XML 1.0 documents ([XML1.0] section 2.1). Furthermore, those documents **MUST** be encoded in UTF-16LE ([RFC2781] section 4.2).

Note that XML 1.0 [XML1.0], restricts the set of legal characters that can be used. Values that cannot be expressed in XML MUST NOT be represented in an XML document contained within an AsyncUI notification or response. Furthermore, some legal characters, such as "<" and "&", require some form of escaping when encoded in XML. Implementations MUST use an XML-defined mechanism, such as CDATA ([XML1.0] sections 2.4 and 2.7) or numeric character references ([XML1.0] section 4.1), to encode such characters within XML documents.

2.2.8.1 Printer Configuration Notification

Printer Configuration Notification is a string that contains a well-formed XML document ([XML1.0] section 2.1). The root element of the document MUST be the Notification element (section 2.2.8.1.1). Notification SHOULD be used by a print server to notify a client of change in printer configuration; the Notification element SHOULD contain one or more Schema elements (section 2.2.8.1.2) representing the names and values for the new printer configuration settings. If the size of the Printer Configuration Notification containing all of the changed printer configuration settings exceeds the server's maximum notification size, the server MUST replace Schema elements in the Printer Configuration Notification message with ReducedSchema elements (section 2.2.8.1.10) until the size of the Printer Configuration Notification message is smaller than the maximum notification size.

The document markup MUST be valid according to the following XML schema, whose elements are described in more detail in the following sections. Schema-Validity Assessment of the document's root element MUST result in a value of "valid" for the [validity] property ([XMLSCHEMA1/2] section 3.3.5).

```
<xs:element name='Notification'>
  <xs:complexType>
    <xs:choice maxOccurs='unbounded'>
      <xs:element name='Schema'>
        <xs:complexType>
          <xs:choice>
            <xs:element name='BIDI_STRING' type='string'/>
            <xs:element name='BIDI_TEXT' type='string'/>
            <xs:element name='BIDI_ENUM' type='string'/>
            <xs:element name='BIDI_INT' type='integer'/>
            <xs:element name='BIDI_FLOAT' type='float'/>
            <xs:element name='BIDI_BOOL' type='boolean'/>
            <xs:element name='BIDI_BLOB' type='base64Binary'/>
          </xs:choice>
          <xs:attribute name='name' use='required'>
            <xs:simpleType>
              <xs:restriction base='string'>
                <xs:pattern value='\\w+(\.w+)*\w+'/>
              </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
        </xs:complexType>
      </xs:element>
      <xs:element name='ReducedSchema'>
        <xs:complexType>
          <xs:attribute name='name' use='required'>
            <xs:simpleType>
              <xs:restriction base='string'>
                <xs:pattern value='\\(w+(\.w+)*(:w+)?)?'/>
              </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
        </xs:complexType>
      </xs:element>
    </xs:choice>
    <xs:attribute name='printerName' type='string' use='required'/>
  </xs:complexType>
</xs:element>
```


2.2.8.1.1 Notification Element

The Notification element represents changes in the configuration of a printer and contains a list of Schema elements (section 2.2.8.1.2) and ReducedSchema elements (section 2.2.8.1.10) representing these changes.

Name	Type	Description
printerName	xs:string	The value of this attribute is a string that contains the name of the print queue whose configuration has changed.

2.2.8.1.2 Schema Element

The Schema XML element represents a configuration setting for a printer. It contains exactly one BIDI_STRING (section 2.2.8.1.3), BIDI_TEXT (section 2.2.8.1.4), BIDI_ENUM (section 2.2.8.1.5), BIDI_INT (section 2.2.8.1.6), BIDI_FLOAT (section 2.2.8.1.7), BIDI_BOOL (section 2.2.8.1.8), or BIDI_BLOB (section 2.2.8.1.9) element representing the value of the new configuration for the printer.

Name	Type	Description
name	xs:string	The name of the configuration attribute that has changed, corresponding to a name in the implementation-specific list of printer configuration attributes.<5>

2.2.8.1.3 BIDI_STRING Element

The BIDI_STRING XML element represents a configuration attribute of a printer. It contains a string that is the value of the configuration setting represented by the Schema element (section 2.2.8.1.2) containing the BIDI_STRING element.

2.2.8.1.4 BIDI_TEXT Element

The BIDI_TEXT XML element represents a configuration attribute of a printer. It contains a string that is the value for the configuration setting represented by the Schema element (section 2.2.8.1.2) containing the BIDI_TEXT element.

2.2.8.1.5 BIDI_ENUM Element

The BIDI_ENUM XML element represents a configuration attribute for a printer. It contains a string that is the value of the configuration setting represented by the Schema element (section 2.2.8.1.2) containing the BIDI_ENUM element.

2.2.8.1.6 BIDI_INT Element

The BIDI_INT XML element represents a configuration attribute for a printer. It contains an integer that is the value of the configuration setting represented by the Schema element (section 2.2.8.1.2) containing the BIDI_INT element.

2.2.8.1.7 BIDI_FLOAT Element

The BIDI_FLOAT XML element represents a configuration attribute of a printer. It contains a value of the **float** datatype, as defined in [W3C-XSD] section 3.2.4, which is the value of the configuration setting represented by the Schema element (section 2.2.8.1.2) containing the BIDI_FLOAT element.

2.2.8.1.8 BIDI_BOOL Element

The BIDI_BOOL XML element represents a configuration attribute for a printer. It contains a value of the **Boolean** datatype, as defined in [W3C-XSD] section 3.2.2, which is the value of the configuration setting represented by the Schema element (section 2.2.8.1.2) containing the BIDI_BOOL element.

2.2.8.1.9 BIDI_BLOB Element

The BIDI_BLOB XML element represents a configuration attribute for a printer. It contains a value of the **base64Binary** datatype, as defined in [W3C-XSD] section 3.2.16, which is the value of the configuration setting represented by the Schema element (section 2.2.8.1.2) containing the BIDI_BLOB element.

2.2.8.1.10 ReducedSchema Element

The ReducedSchema XML element represents only the name of a configuration setting for a printer. Print servers SHOULD use it only when using the Schema element (section 2.2.8.1.2), which includes the value of the configuration setting, results in a Printer Configuration Notification (section 2.2.8.1) message that is too large.

Name	Type	Description
name	xs:string	The name of the configuration attribute that has changed, corresponding to a name in the implementation-specific list of printer configuration attributes.<6>

3 Protocol Details

The IRPCAsyncNotify interface is identified by UUID 0b6edbfa-4a24-4fc6-8a23-942b1eca65d1.

The IRPCRemoteObject interface is identified by UUID ae33069b-a2a8-46ee-a235-ddfd339be281.

3.1 Server Details

3.1.1 IRPCAsyncNotify Server Details

Unidirectional message passing mode in the IRPCAsyncNotify interface is illustrated by the following server state diagram.

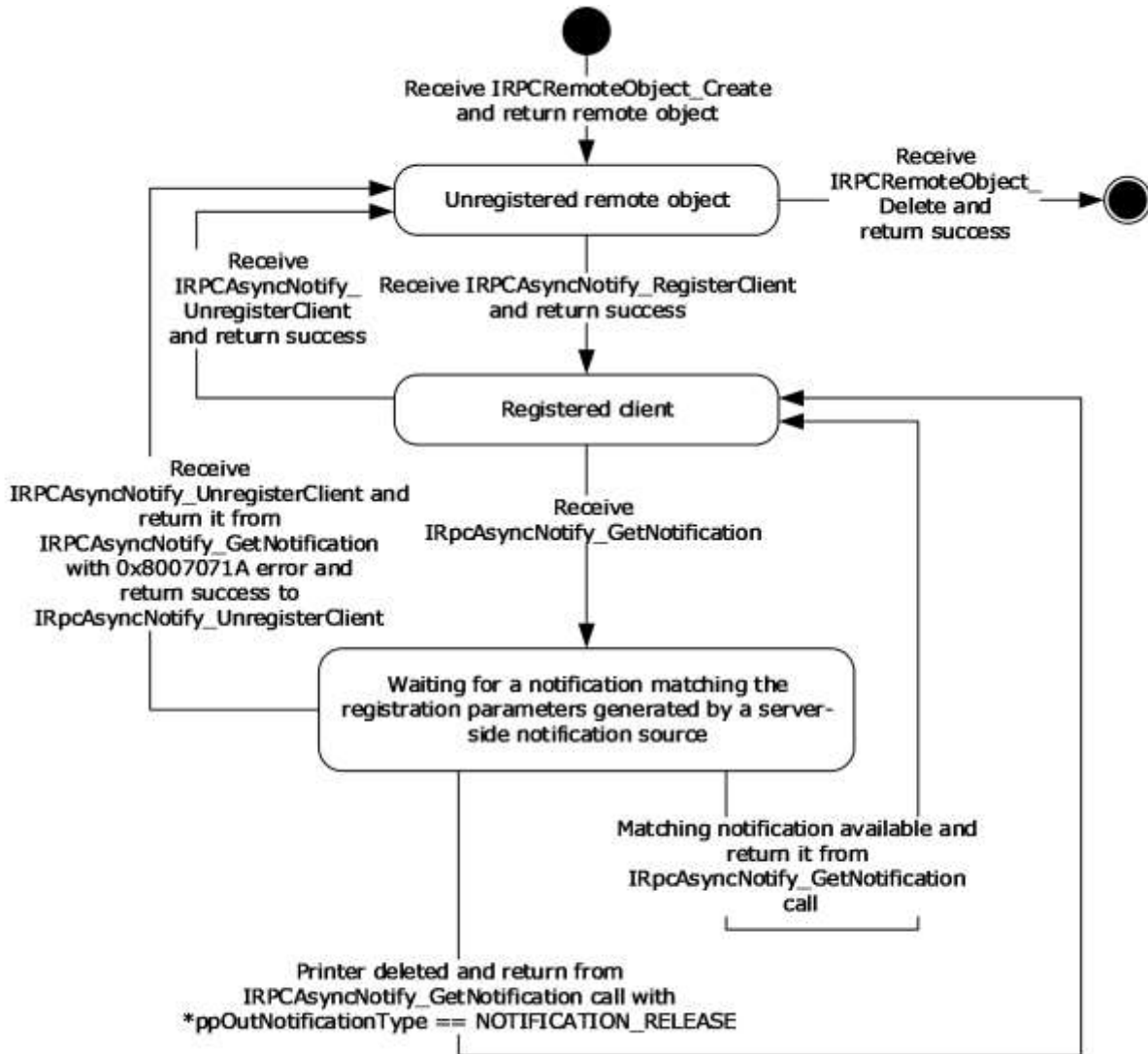


Figure 5: Unidirectional message passing mode

Bidirectional message passing mode is illustrated by the following two server state diagrams. The first diagram illustrates remote object creation and deletion, client registration, and the opening of

notification channels. The second diagram details the processing of an open channel, including its eventual closure.

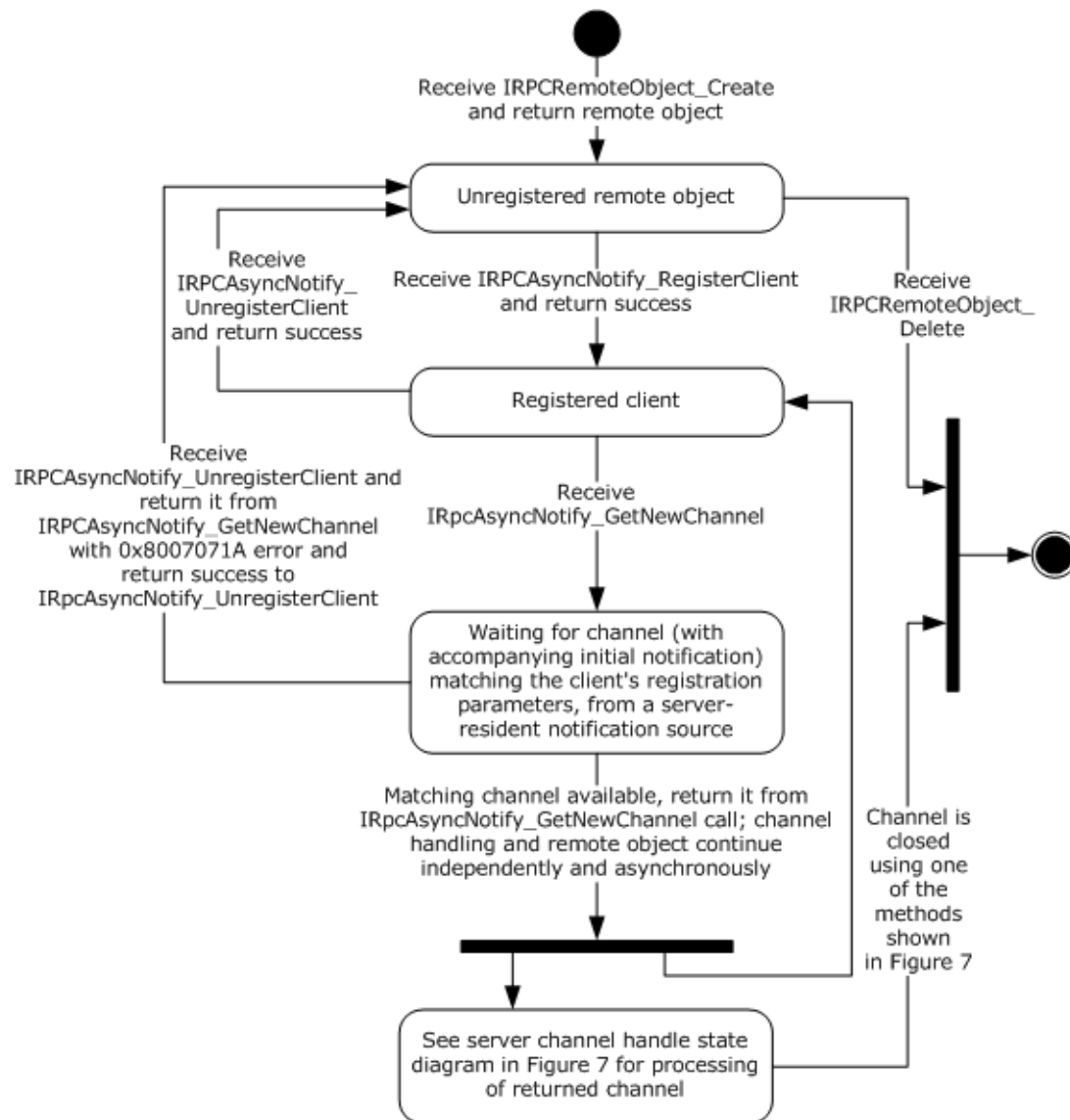


Figure 6: Bidirectional message passing mode

The following diagram illustrates the processing of a single open channel.

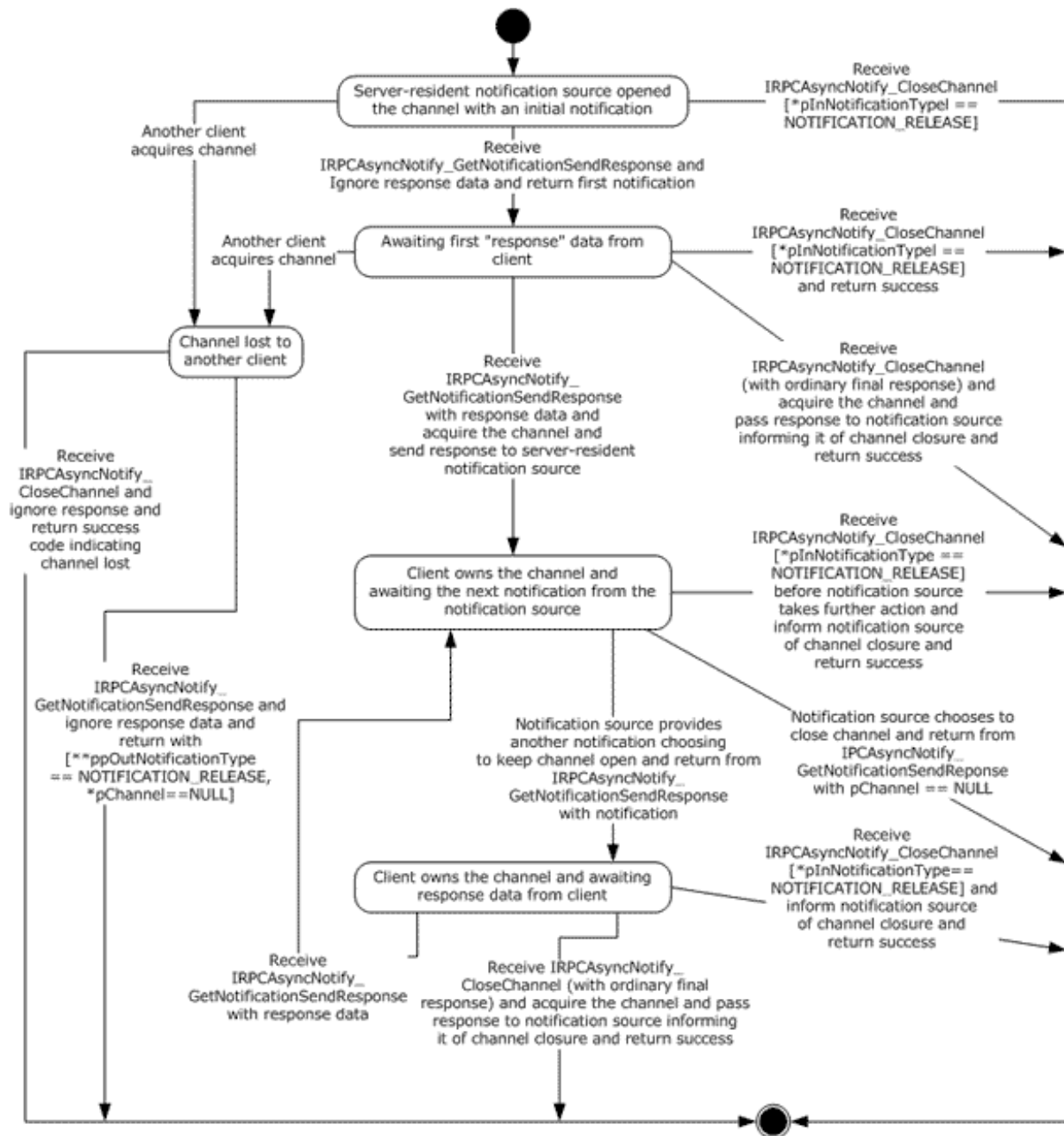


Figure 7: Processing a single open channel

3.1.1.1 Abstract Data Model

This section describes a conceptual model of the possible data organization that an implementation SHOULD maintain to participate in this protocol. The organization that is described in this section is provided to facilitate the explanation of how the protocol behaves. This specification does not mandate that implementations adhere to this model as long as their external behavior is consistent with the behavior described in this specification.

This section describes the Print System Asynchronous Notification Protocol in terms of an abstract data model that represents physical devices as objects and provides interfaces for communication and configuration management.

Current Authenticated User: A print server data structure scoped to the context of processing a particular message. This data structure holds an implementation-specific identifier for the authenticated user identity.

Client Registration: A print server data structure that holds all the information provided by a print client via input parameters in its call to `IRPCAsyncNotify_RegisterClient` (section 3.1.1.4.1), as well as the **Current Authenticated User** when the server processed the message for the clients call. The **Client Registration** maps directly to a registered `PRPCREMOTEOBJECT` (section 2.2.4). The server **MUST** use this information to filter **Bidirectional Notification Channels** and unidirectional notifications that are sent to the client from notification sources. Other Local Events (section 3.1.1.6) specifies this filtering mechanism, which is based upon information associated with requests that originate from notification sources.

Unidirectional Notification Queue: Associated with each **Client Registration** in unidirectional communication mode, a queue of unidirectional notifications that have been initiated by server-resident notification sources, but which have not yet been returned to the client of the **Client Registration** by `IRPCAsyncNotify_GetNotification` (section 3.1.1.4.5).

Bidirectional Notification Channel Queue: Associated with each **Client Registration** in bidirectional communication mode, a queue of bidirectional notification channels that have been opened by server-resident notification sources, but which have not yet been acquired by a client, as specified in `IRPCAsyncNotify_GetNotificationSendResponse` (section 3.1.1.4.4).

Bidirectional Notification Channel: A notification channel that is created for use by a single notification source in bidirectional communication mode. Associated with each **Bidirectional Notification Channel** are `PrintAsyncNotificationType` and `PrintAsyncNotifyUserFilter` values (sections 2.2.1 and 2.2.2), and an authenticated user identity, which are provided by the notification source when the channel is opened, as specified by the local event `Bidirectional Notification Channel Opened` (section 3.1.1.6.2).

The **Bidirectional Notification Channel** is exposed to zero, one, or more clients as a `PNOTIFYOBJECT` (section 2.2.5) that is returned by `IRPCAsyncNotify_GetNewChannel` (section 3.1.1.4.3). Each client is distinguished by a specific `PNOTIFYOBJECT`, and one client, at most, can be marked as having acquired the **Bidirectional Notification Channel**. After a particular client has acquired the channel, none of the responses from other clients will be successfully accepted by the server. This continues even after the channel is closed; once acquired, the channel can never be acquired again.

Zero or one unsent notifications can be associated with the **Bidirectional Notification Channel**. Held notifications are discussed in `Bidirectional Notification Generated` (section 3.1.1.6.3). A held unsent notification is used for the initial notification mediating behavior specified in `IRPCAsyncNotify_GetNotificationSendResponse` (Opnum 4) (section 3.1.1.4.4).

Note The preceding conceptual data can be implemented using a variety of techniques.

3.1.1.2 Timers

No timer events are required on the client outside of the timers required in the underlying RPC ([MS-RPCE] section 3).

3.1.1.3 Initialization

The server **MUST** listen on dynamically assigned endpoints ([C706] section 6.2.2).

3.1.1.4 Message Processing Events and Sequencing Rules

This protocol MUST direct the RPC runtime ([MS-RPCE] section 3) to do the following:

- Perform a strict NDR data consistency check at target level 6.0.
- Reject a null unique or full pointer with a nonzero conforming value.

Methods in RPC Opnum Order

Method	Description
IRPCAsyncNotify_RegisterClient	This method is called by clients to register to receive notifications and to associate the parameters describing the set of notifications they are registering to receive with a remote object. Opnum: 0
IRPCAsyncNotify_UnregisterClient	This method is called by registered clients to unregister remote objects. Opnum: 1
Opnum2NotUsedOnWire	Reserved for local use. Opnum: 2
IRPCAsyncNotify_GetNewChannel	This method returns an array of pointers to print notification channels. Opnum: 3
IRPCAsyncNotify_GetNotificationSendResponse	This method sends a client response to the server and returns the next notification sent by way of the same channel when it becomes available. Opnum: 4
IRPCAsyncNotify_GetNotification	This method returns notification data from the server. Opnum: 5
IRPCAsyncNotify_CloseChannel	This method sends a final response on the notification channel and closes it. Opnum: 6

In the preceding table, the term "Reserved for local use" means that the client MUST NOT send the opnum, and the server behavior is undefined because it does not affect interoperability.

3.1.1.4.1 IRPCAsyncNotify_RegisterClient (Opnum 0)

The IRPCAsyncNotify_RegisterClient method is called by clients to register to receive notifications and to associate the parameters describing the set of notifications they are registering to receive with a remote object.

```
HRESULT IRPCAsyncNotify_RegisterClient(  
    [in] PRPCREMOTEOBJECT pRegistrationObj,  
    [in, string, unique] const wchar_t* pName,  
    [in] PrintAsyncNotificationType* pInNotificationType,  
    [in] PrintAsyncNotifyUserFilter NotifyFilter,  
    [in] PrintAsyncNotifyConversationStyle conversationStyle,  
    [out, string] wchar_t** ppRmtServerReferral  
);
```

pRegistrationObj: MUST be the remote object context handle that was returned by the server in the *ppRemoteObject* output parameter of a prior call to *IRPCRemoteObject_Create* (section 3.1.2.4.1). This value MUST NOT be NULL.

pName: MUST be NULL or a pointer to a NULL-terminated string, encoded in Unicode UTF-16LE ([RFC2781] section 4.2), which specifies the full UNC name of the print queue from which the print client is registering to receive notifications.

This UNC name MUST be in the following format:

```
"\\\" SERVER_NAME \"\" LOCAL_PRINTER_NAME
```

SERVER_NAME is a DNS, NetBIOS, IPv4, or IPv6 host name.

LOCAL_PRINTER_NAME is a string that MUST NOT contain the characters "\" or ",".

DNS names are specified in [RFC819] section 2, and NetBIOS names are specified in [RFC1001] section 14. Basic notational conventions are specified in [RFC2616] section 2, and "host" is defined in [RFC3986] section 3.2.2.

If *pName* is NULL, the registration MUST be made for the remote print server itself.

pInNotificationType: MUST be a pointer to a *PrintAsyncNotificationType* structure that specifies the notification type identifier for the notifications that the client is registering to receive.

NotifyFilter: MUST be a value of type *PrintAsyncNotifyUserFilter* that specifies whether the client is registering to receive notifications that are issued to all registered clients, irrespective of their authenticated user identity, or to receive notifications that are issued only to the specific authenticated user identity of the registering RPC client.

conversationStyle: MUST be a value of type *PrintAsyncNotifyConversationStyle* that specifies whether the client is registering for bidirectional communication mode or unidirectional communication mode.

ppRmtServerReferral: Servers SHOULD return NULL for this parameter, and clients MUST ignore it on receipt.

Return Values: This method MUST return zero to indicate success, or an HRESULT error value ([MS-ERREF] section 2.1.1) to indicate failure. Protocol-specific error values are defined in the following table. The client SHOULD treat all error return values the same, except where noted.

Return value	Description
0x80070005	The client does not have authorization to register for notifications with the set of parameters specified in this call. If this error value is returned, the client SHOULD NOT retry this call; the client SHOULD consider the error to be fatal and report it to the higher level caller.
0x8007000E	The server does not have enough memory for the new registration.
0x80070015	The server has reached its maximum registration limit.
0x8007007B	The <i>pName</i> parameter does not conform to the format specified above. If this error value is returned, the client SHOULD NOT retry this call; the client SHOULD consider the error to be fatal and report it to the higher level caller.

Exceptions Thrown: No exceptions are thrown beyond those thrown by the underlying RPC protocol [MS-RPCE].

Unless specified otherwise, if a failure is indicated by an error return or an exception, the client SHOULD retry this method call by performing the following steps:

1. Call `IRPCRemoteObject_Create` to generate a new `PRPCREMOTEOBJECT` (section 2.2.4).
2. Call `IRPCAsyncNotify_RegisterClient` with the new `PRPCREMOTEOBJECT`.

Retries SHOULD be separated by time intervals decaying from 1 second to 1 minute to reduce a potential burden on the server.

The `IRPCAsyncNotify_RegisterClient` method MUST be called by clients to register for receiving notifications. Servers MUST associate the given remote object with the registration parameters specified.

A client MUST NOT call `IRPCAsyncNotify_RegisterClient` if a prior call to `IRPCAsyncNotify_RegisterClient` succeeded using the same `PRPCREMOTEOBJECT` value, unless a later call to `IRPCAsyncNotify_UnregisterClient` also succeeded.

If registering for unidirectional communication mode, a client SHOULD call `IRPCAsyncNotify_GetNotification` after a successful call to `IRPCAsyncNotify_RegisterClient` using the same `PRPCREMOTEOBJECT` value.

If registering for bidirectional communication mode, a client SHOULD call `IRPCAsyncNotify_GetNewChannel` after a successful call to `IRPCAsyncNotify_RegisterClient` using the same `PRPCREMOTEOBJECT` value.

Servers MUST support the concurrent registration of multiple remote objects with different registration parameters, including notification type, filter, and communication mode.

Servers SHOULD consider the security and privacy context prior to letting clients monitor and receive notifications for all user identities. Relevant access rights are defined in the following table.

Name/Value	Description
<code>SERVER_ALL_ACCESS</code> 0x000F0003	Combines the WO (Write Owner), WD (Write DACL), RC (Read Control), and DE (Delete) bits of the <code>ACCESS_MASK</code> data type ([MS-DTYP] section 2.4.3) with the following protocol-specific bits: <ul style="list-style-type: none">0x00000001 (bit 31): Access rights to administer print servers.0x00000002 (bit 30): Access rights to enumerate print servers. These printing-specific access rights allow a client to administer the server and to enumerate server components such as print queues.
<code>PRINTER_ALL_ACCESS</code> 0x000F000C	Combines the WO (Write Owner), WD (Write DACL), RC (Read Control), and DE (Delete) bits of the <code>ACCESS_MASK</code> data type with the following protocol-specific bits: <ul style="list-style-type: none">0x00000004 (bit 29): Access rights for printers to perform administrative tasks.0x00000008 (bit 28): Access rights for printers to perform basic printing operations. These printing-specific access rights allow a client basic and administrative use of print queues.

For calls to `IRPCAsyncNotify_RegisterClient` with `NotifyFilter` set to **kAllUsers**, if `pName` is set to `NULL`, the server SHOULD fail the call if the calling principal lacks any of the server access rights specified by **SERVER_ALL_ACCESS**. If `pName` points to the name of a print queue, the server SHOULD fail the

call if the calling principal lacks any of the print queue access rights specified by **PRINTER_ALL_ACCESS**. For additional information concerning access rights, see [MS-AZOD] section 1.1.1.5.

3.1.1.4.2 IRPCAsyncNotify_UnregisterClient (Opnum 1)

The IRPCAsyncNotify_UnregisterClient method is called by registered clients to unregister previously-registered remote objects. For this call to succeed, the remote object MUST have already successfully called IRPCAsyncNotify_RegisterClient.

```
HRESULT IRPCAsyncNotify_UnregisterClient(  
    [in] PRPCREMOTEOBJECT pRegistrationObj  
);
```

pRegistrationObj: MUST be the remote object context handle that MUST have been successfully registered by a prior call to IRPCAsyncNotify_RegisterClient. This value MUST NOT be NULL.

Return Values: This method MUST return an HRESULT success value ([MS-ERREF] section 2.1.1) to indicate success, or an HRESULT error value to indicate failure. The client MUST consider all error return values fatal and report them to the higher-level caller.

Exceptions Thrown: No exceptions are thrown beyond those thrown by the underlying RPC protocol [MS-RPCE].

If a client call to IRPCAsyncNotify_GetNewChannel or IRPCAsyncNotify_GetNotification is blocked on the server waiting for a notification channel or notification to become available, the server MUST process a client call to IRPCAsyncNotify_UnregisterClient without waiting for the notification channel or notification.

A server MUST NOT do the following:

- Indicate success to a client call of IRPCAsyncNotify_UnregisterClient unless a prior call to IRPCAsyncNotify_RegisterClient succeeded using the same PRPCREMOTEOBJECT value.
- Indicate success to a client call of IRPCAsyncNotify_UnregisterClient following a prior successful call to IRPCAsyncNotify_UnregisterClient by using the same PRPCREMOTEOBJECT value.

A client MUST NOT do the following:

- Call IRPCAsyncNotify_UnregisterClient, unless a prior call to IRPCAsyncNotify_RegisterClient succeeded by using the same PRPCREMOTEOBJECT value.
- Call IRPCAsyncNotify_UnregisterClient following a prior call to IRPCAsyncNotify_UnregisterClient by using the same PRPCREMOTEOBJECT value.

3.1.1.4.3 IRPCAsyncNotify_GetNewChannel (Opnum 3)

The IRPCAsyncNotify_GetNewChannel method returns an array of pointers to print notification channels. This method MUST only be used with bidirectional communication mode.

```
HRESULT IRPCAsyncNotify_GetNewChannel(  
    [in] PRPCREMOTEOBJECT pRemoteObj,  
    [out] unsigned long* pNoOfChannels,  
    [out, size_is( , *pNoOfChannels)]  
    PNOTIFYOBJECT** ppChannelCtxt  
);
```

pRemoteObj: MUST be the remote object context handle. This handle is obtained from IRPCRemoteObject_Create (section 3.1.2.4.1). This remote object MUST have been registered for

bidirectional communication mode by a prior successful call to IRPCAsyncNotify_RegisterClient (section 3.1.1.4.1).

pNoOfChannels: MUST specify the number of notification channels returned. The array of notification channels is specified by the **ppChannelCtxt** parameter.

The server SHOULD return all not-yet-acquired bidirectional channels in response to a single IRPCAsyncNotify_GetNewChannel call. The server SHOULD return such channels regardless of whether they were created before or after client registration or the call to IRPCAsyncNotify_GetNewChannel.

ppChannelCtxt: MUST specify a pointer to the array of returned notification channels. This data is represented by a **Bidirectional Notification Channel** structure in the Abstract Data Model (section 3.1.1.1).

Return Values: This method MUST return zero to indicate success, or an HRESULT error value ([MS-ERREF] section 2.1.1) to indicate failure. Protocol-specific error values are defined in the following table. The client SHOULD treat all error return values the same, except where noted.

Return value	Description
0x8004000C	The server has not yet returned from a previous call to this method with the same remote object. If this error value is returned, the client SHOULD NOT retry this call before the previous call to this method with the specified remote object has completed.
0x8007000E	The server does not have enough memory for the new channel.
0x8007071A	Incoming notifications have been terminated. Upon completion of this call with this return value, the server MUST fail subsequent calls to this method with the same remote object. If this error value is returned, the client SHOULD NOT retry this call.

Exceptions Thrown: An exception code of 0x8004000C or 0x8007071A SHOULD be thrown by the server under the circumstances described in the preceding table for the corresponding return values. The client MUST treat these exception codes exactly as it would treat the same return values. No additional exceptions are thrown beyond those thrown by the underlying RPC protocol [MS-RPCE].

Unless specified otherwise, if a failure is indicated by an error return or an exception, the client SHOULD retry this method call by performing the following steps:

1. Call IRPCRemoteObject_Create to generate a new PRPCREMOTEOBJECT (section 2.2.4).
2. Call IRPCAsyncNotify_RegisterClient with the new PRPCREMOTEOBJECT.
3. Call IRPCAsyncNotify_GetNewChannel with the new PRPCREMOTEOBJECT.

Retries SHOULD be separated by time intervals decaying from 1 second to 1 minute to reduce a potential burden on the server. Retries SHOULD terminate when the above sequence succeeds or the client determines that it is no longer interested in notifications for the particular combination of notification type, print queue name, conversation style, and user identity filter that were originally specified in the call to IRPCAsyncNotify_RegisterClient.

If successful, the IRPCAsyncNotify_GetNewChannel method MUST return an array of pointers to print notification channels.

A server MUST NOT do the following:

- Indicate success to a client call of IRPCAsyncNotify_GetNewChannel unless a prior call to IRPCAsyncNotify_RegisterClient succeeded using the same PRPCREMOTEOBJECT value.

- Indicate success to a client call of IRPCAsyncNotify_GetNewChannel following a prior successful call to IRPCAsyncNotify_UnregisterClient using the same PRPCREMOTEOBJECT value.
- Complete a call to IRPCAsyncNotify_GetNewChannel unless an unreturned notification channel is available on the **Bidirectional Notification Channel Queue** associated with the **Client Registration** (Abstract Data Model, section 3.1.1.1), or an abnormal event happened, such as an initiated server shutdown sequence.

A client SHOULD do the following:

- Call IRPCAsyncNotify_GetNewChannel in response to a prior successful return from IRPCAsyncNotify_RegisterClient or IRPCAsyncNotify_GetNewChannel.
- Call IRPCAsyncNotify_GetNotificationSendResponse in response to a prior successful return from IRPCAsyncNotify_GetNewChannel.

A client MUST NOT do the following:

- Call IRPCAsyncNotify_GetNewChannel, unless a prior call to IRPCAsyncNotify_RegisterClient succeeded by using the same PRPCREMOTEOBJECT value.<8>
- Call IRPCAsyncNotify_GetNewChannel following a prior call to IRPCAsyncNotify_UnregisterClient by using the same PRPCREMOTEOBJECT value.<9>

3.1.1.4.4 IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4)

The IRPCAsyncNotify_GetNotificationSendResponse method sends a client response to the server and returns the next notification sent by way of the same channel when it becomes available. This method MUST be used only with bidirectional communication mode.

```
HRESULT IRPCAsyncNotify_GetNotificationSendResponse(
    [in, out] PNOTIFYOBJECT* pChannel,
    [in, unique] PrintAsyncNotificationType* pInNotificationType,
    [in] unsigned long InSize,
    [in, size_is(InSize), unique] byte* pInNotificationData,
    [out] PrintAsyncNotificationType** ppOutNotificationType,
    [out] unsigned long* pOutSize,
    [out, size_is( , *pOutSize)] byte** ppOutNotificationData
);
```

pChannel: A pointer to a notification channel that MUST NOT be closed or zero, and which MUST have been returned by the server in the *ppChannelCtxt* output parameter of a prior call to IRPCAsyncNotify_GetNewChannel. If the server closes the notification channel, it MUST set the *pChannel* value to NULL upon return from this method. If the notification channel was acquired by a different client, the server MUST set the *pChannel* value to NULL upon return from this method.

pInNotificationType: A NULL value or a pointer to a PrintAsyncNotificationType structure that specifies the notification type identifier of the notification type in which the registered client is interested.

On the first call to this method, the value of *pInNotificationType* MUST be NULL. On subsequent calls to this method, the value of *pInNotificationType* MUST be a pointer to a PrintAsyncNotificationType structure that specifies the notification type identifier for which the client has registered.

InSize: The size, in bytes, of the input data that the *pInNotificationData* parameter points to. The server SHOULD impose an upper limit of 0x00A00000 on this value. If the client exceeds the server-imposed limit, the server MUST return an error result.

pInNotificationData: A pointer to input data holding the client's response to the previous notification that was received on the same bidirectional notification channel.

On the first call to this method for a given channel, the client SHOULD provide zero bytes of response data and the server MUST ignore any response data sent. On subsequent calls to this method, the response format MUST conform to the requirements of the notification channel's notification type, and those notification type requirements determine whether or a not a zero-byte response is acceptable.

If the value of *InSize* is not 0x00000000, *pInNotificationData* MUST NOT be NULL.

ppOutNotificationType: A pointer to the returned pointer to the notification type identifier of the server-to-client notification. If the notification channel was acquired by a different client, the value MUST be **NOTIFICATION_RELEASE** (section 2.2.1). If the server needs to close the notification channel without sending a final response, the value SHOULD be **NOTIFICATION_RELEASE**. In all other cases, the value MUST be the same as the notification type identifier of the notification type for which the client has registered.

pOutSize: A pointer to the returned length of server-to-client notification data, in number of bytes. The client MAY impose an upper limit on this value that is smaller than the maximum unsigned 32-bit integer. If the notification channel was acquired by a different client, the server SHOULD set the value of *pOutSize* to 0x00000000. If the value of *ppOutNotificationType* points to **NOTIFICATION_RELEASE**, the server SHOULD set the value of *pOutSize* to 0x00000000.

ppOutNotificationData: A pointer to the returned pointer to server-to-client notification data in a format that MUST conform to the notification channel's notification type. If the notification channel was acquired by a different client, the server SHOULD set the value of *ppOutNotificationData* to NULL. If the value of *ppOutNotificationType* points to **NOTIFICATION_RELEASE**, the client MUST ignore the content of *ppOutNotificationData*.

Return Values: This method MUST return zero to indicate success, or an HRESULT error value ([MS-ERREF] section 2.1.1) to indicate failure. Protocol-specific error values are defined in the following table. The client MUST consider all error return values fatal and report them to the higher-level caller.

Return value	Description
0x80040008	The notification channel represented by <i>pChannel</i> was previously closed.
0x8004000C	The server has not yet returned from a previous call to <i>IRPCAsyncNotify_GetNotificationSendResponse</i> or <i>IRPCAsyncNotify_CloseChannel</i> (section 3.1.1.4.6) with the same notification channel.
0x80040012	The size of the client-to-server response exceeded the maximum size.
0x80040014	The notification type identifier is different from the notification type of the notification channel.
0x8007000E	The server does not have enough memory to complete the request.

Exceptions Thrown: No exceptions are thrown beyond those thrown by the underlying RPC protocol [MS-RPCE].

If a failure is indicated by an error return or an exception, the client SHOULD close the channel.

The first call to this method on the newly opened notification channel serves as a mediator among all the clients that registered themselves for the given notification type. This MUST be done by blocking all calls from clients until a matching server-side event occurs, including the following:

- The channel issues a notification.

- An abnormal condition occurs, such as an initiated server shutdown sequence.
- The server receives a client request to close the channel.

The server MUST do the following.

- Choose the first client that sent a response, whether by calling this method or by calling `IRPCAsyncNotify_CloseChannel` with a notification type identifier other than **NOTIFICATION_RELEASE**, and assign the opened notification channel to that client.
- For all other clients, set the value of the `ppOutNotificationType` output parameter to **NOTIFICATION_RELEASE** and the value of the `pChannel` parameter to NULL.
- Return an HRESULT success value [MS-ERREF] to all the other clients that have outstanding blocked calls to this method.

All subsequent calls to this method MUST take the response provided by the client that was assigned to the notification channel and pass it to the server-resident notification source that opened the notification channel. The call MUST return when a subsequent notification is sent from a notification source using the bidirectional notification channel; the channel is closed; or an abnormal event happens, such as the print spooler server terminating its execution.

The server MUST NOT indicate success to a client call to this method if a prior call to `IRPCAsyncNotify_CloseChannel` succeeded specifying the same notification channel.

A client MUST NOT call `IRPCAsyncNotify_GetNotificationSendResponse` following a prior successful return from `IRPCAsyncNotify_GetNotificationSendResponse` with a NULL output value of the `pChannel` parameter or following a prior successful return from `IRPCAsyncNotify_CloseChannel`.

A client SHOULD call `IRPCAsyncNotify_GetNotificationSendResponse` or `IRPCAsyncNotify_CloseChannel` following a prior successful return from `IRPCAsyncNotify_GetNotificationSendResponse` with a non-NULL output value of the `pChannel` parameter.

3.1.1.4.5 IRPCAsyncNotify_GetNotification (Opnum 5)

The `IRPCAsyncNotify_GetNotification` method returns notification data from the print server. This method MUST NOT be used with bidirectional communication mode.

```
HRESULT IRPCAsyncNotify_GetNotification(
    [in] PRPCREMOTEOBJECT pRemoteObj,
    [out] PrintAsyncNotificationType** ppOutNotificationType,
    [out] unsigned long* pOutSize,
    [out, size_is(*pOutSize)] byte** ppOutNotificationData
);
```

pRemoteObj: MUST be the remote object context handle. This remote object MUST have been registered for unidirectional communication mode by a prior successful call to `IRPCAsyncNotify_RegisterClient` (section 3.1.1.4.1).

ppOutNotificationType: MUST return a pointer to the notification type identifier of the server-to-client notification. If the registered remote object has been deleted, the value MUST be **NOTIFICATION_RELEASE** (section 2.2.1). In all other cases the value MUST be the same as the notification type identifier of the notification type for which the print client has registered.

pOutSize: MUST be the length of server-to-client notification data, in number of bytes. The client MAY impose an upper limit on this value that is smaller than the maximum unsigned 32-bit integer.

ppOutNotificationData: MUST be a pointer to server-to-client notification data in a format that MUST conform to the channel's notification type.

Return Values: This method MUST return zero to indicate success, or an HRESULT error value ([MS-ERREF] section 2.1.1) to indicate failure. Protocol-specific error values are defined in the following table. The client SHOULD treat all error return values the same, except where noted.

Return value	Description
0x8004000C	The server has not yet returned from a previous call to this method with the same remote object. If this error value is returned, the client SHOULD NOT retry this call before the previous call to this method with the specified remote object has completed.
0x8007000E	The server does not have enough memory to complete the request.
0x8007071A	Incoming notifications have been terminated. Upon completion of this call with this return value, the server MUST fail subsequent calls to this method with the same remote object. If this error value is returned, the client SHOULD NOT retry this call.

Exceptions Thrown: An exception code of 0x8004000C or 0x8007071A SHOULD be thrown by the server under the circumstances described in the preceding table for the corresponding return values. The client MUST treat these exception codes exactly as it would treat the same return values. No additional exceptions are thrown beyond those thrown by the underlying RPC protocol [MS-RPCE].

Unless specified otherwise, if a failure is indicated by an error return or an exception, the client SHOULD retry this method call by performing the following steps:

1. Call IRPCRemoteObject_Create (section 3.1.2.4.1) to generate a new PRPCREMOTEOBJECT (section 2.2.4).
2. Call IRPCAsyncNotify_RegisterClient with the new PRPCREMOTEOBJECT.
3. Call IRPCAsyncNotify_GetNotification with the new PRPCREMOTEOBJECT.

Retries SHOULD be separated by time intervals decaying from 1 second to 1 minute to reduce a potential burden on the server. Retries SHOULD terminate when the above sequence succeeds or the client determines that it is no longer interested in notifications for the particular combination of notification type, print queue name, conversation style, and user identity filter that were originally specified in the call to IRPCAsyncNotify_RegisterClient.

The IRPCAsyncNotify_GetNotification method MUST return data from the server that matches the registration for the given remote object.

A server MUST NOT do the following:

- Indicate success to a client call of IRPCAsyncNotify_GetNotification unless a prior call to IRPCAsyncNotify_RegisterClient succeeded using the same PRPCREMOTEOBJECT value.
- Indicate success to a client call of IRPCAsyncNotify_GetNotification following a prior successful call to IRPCAsyncNotify_UnregisterClient using the same PRPCREMOTEOBJECT value.
- Complete a call to IRPCAsyncNotify_GetNotification until the **Unidirectional Notification Queue** associated with the **Client Registration** (Abstract Data Model (section 3.1.1.1)) contains an unreturned notification, or an abnormal condition occurs. An example of an abnormal condition is an initiated server shutdown sequence or remote object unregistration. An abnormal condition will result in a failure error code returned prior to the server having data.

A server SHOULD do the following:

- Discard unidirectional notifications in the absence of corresponding registered clients.

- Buffer unidirectional notifications, up to some implementation-defined limit, <10> for each registered client that does not have pending IRPCAsyncNotify_GetNotification calls.

If a client wants to receive further notifications from the server, the client SHOULD call IRPCAsyncNotify_GetNotification in response to a prior successful return from IRPCAsyncNotify_GetNotification. When the client no longer wants to receive notifications from the server, it SHOULD call IRPCAsyncNotify_UnregisterClient, either before or after the return from IRPCAsyncNotify_GetNotification.

A client MUST NOT do the following:

- Call IRPCAsyncNotify_GetNotification unless a prior call to IRPCAsyncNotify_RegisterClient succeeded, using the same PRPCREMOTEOBJECT value.
- Call IRPCAsyncNotify_GetNotification following a prior call to IRPCAsyncNotify_UnregisterClient by using the same PRPCREMOTEOBJECT value.

3.1.1.4.6 IRPCAsyncNotify_CloseChannel (Opnum 6)

The IRPCAsyncNotify_CloseChannel method sends a final response on the notification channel and closes it. This method MUST NOT be used with unidirectional communication mode.

```
HRESULT IRPCAsyncNotify_CloseChannel(
    [in, out] PNOTIFYOBJECT* pChannel,
    [in] PrintAsyncNotificationType* pInNotificationType,
    [in] unsigned long InSize,
    [in, size_is(InSize), unique] byte* pReason
);
```

pChannel: MUST be a pointer to a notification channel that MUST NOT be closed or zero and that MUST have been returned by the server in the *ppChannel/Ctxt* output parameter of a prior call to IRPCAsyncNotify_GetNewChannel. Upon receipt, the server MUST set the **pChannel** value to NULL.

pInNotificationType: MUST be a pointer to a PrintAsyncNotificationType value. If the client needs to close the notification channels without sending a final response, then this value SHOULD point to **NOTIFICATION_RELEASE**. In all other cases, this value MUST point to the notification type identifier of the notification type for which the client has registered.

InSize: The server SHOULD impose an upper limit on this value that is smaller than the maximum unsigned 32-bit integer. That limit SHOULD be 0x00A00000. If the client exceeds the server-imposed limit, the server MUST return an error result.

If **pInNotificationType** is **NOTIFICATION_RELEASE**, then *InSize* SHOULD be 0x00000000.

pReason: MUST be a pointer to a sequence of bytes conveying final client-to-server response data. The number of bytes MUST be provided in the *InSize* parameter. If *InSize* is not 0x00000000, then *pReason* MUST NOT be NULL.

If **pInNotificationType** is **NOTIFICATION_RELEASE**, then the client SHOULD provide zero bytes of response data and the server MUST ignore any response data pointed to by **pReason**. If **pInNotificationType** is not **NOTIFICATION_RELEASE**, then the response format MUST conform to the requirements of the notification channel's notification type and those notification type requirements determine whether or not a zero-byte response is acceptable.

Return Values: This method MUST return zero or an HRESULT success value ([MS-ERREF] section 2.1.1) to indicate success, or an HRESULT error value to indicate failure.

Protocol-specific success values are defined in the following table.

Return value	Description
0x00040010	Another client has acquired the channel.

Protocol-specific error values are defined in the following table. The client MUST consider all error return values fatal and report them to the higher-level caller.

Return value	Description
0x80040012	The response exceeds the maximum size allowed by the server.
0x80040014	The notification type identifier is different from the notification type of the notification channel.
0x8007000E	The server does not have enough memory to complete the request.

Exceptions Thrown: No exceptions are thrown beyond those thrown by the underlying RPC protocol [MS-RPCE].

If a client call to `IRPCAsyncNotify_GetNotificationSendResponse` is blocked on the server, waiting for a notification to become available on a notification channel, then the server MUST process a client call to this method on the same notification channel without waiting for a notification.

A client MUST NOT call `IRPCAsyncNotify_CloseChannel` following a prior successful return from `IRPCAsyncNotify_GetNotificationSendResponse` with a NULL value of `pChannel` parameter or following a prior successful return from `IRPCAsyncNotify_CloseChannel`. <11>

3.1.1.5 Timer Events

No timer events are required on the server outside of the timers required in the underlying RPC Protocol ([MS-RPCE] section 3).

3.1.1.6 Other Local Events

This protocol does not define the set of printing events that cause notification sources to trigger notifications.

When a notification source opens a **Bidirectional Notification Channel** (section 3.1.1.1) or sends a unidirectional notification, it MUST associate a `PrintAsyncNotificationType` value (section 2.2.1) with the request. That value SHOULD be used to match the request to a **Client Registration** (section 3.1.1.1). The notification source MUST also associate a `PrintAsyncNotifyUserFilter` value (section 2.2.2) with the request, to facilitate the application of a user identity filter in performing such matches. If the `PrintAsyncNotifyUserFilter` value is **kPerUser**, the notification source MUST also associate with the request the authenticated user identity of the user who is the intended target for receiving the notifications. The rules for interpreting `PrintAsyncNotifyUserFilter` values to apply a user identity filter are specified in section 2.2.2.

3.1.1.6.1 Unidirectional Notification Generated

A notification source that provides unidirectional notifications to a print client MUST provide the following with each notification:

- A `PrintAsyncNotificationType` value (section 2.2.1).
- A `PrintAsyncNotifyUserFilter` value (section 2.2.2).
- An authenticated user identity.

3.1.1.6.2 Bidirectional Notification Channel Opened

A notification source that initiates the exchange of a sequence of one or more notifications and responses with a print client MUST open a **Bidirectional Notification Channel** (section 3.1.1.1) to do so. When opening a **Bidirectional Notification Channel**, the notification source MUST provide the following:

- A PrintAsyncNotificationType value (section 2.2.1).
- A PrintAsyncNotifyUserFilter value (section 2.2.2).
- An authenticated user identity.

3.1.1.6.3 Bidirectional Notification Generated

When generating a bidirectional notification, a notification source MUST identify an opened **Bidirectional Notification Channel** (section 3.1.1.1). In order to successfully generate a bidirectional notification, a notification source MUST NOT identify a particular bidirectional notification channel if a prior notification sent on that channel has not been responded to by a client's call to IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4) (section 3.1.1.4.4) or IRPCAsyncNotify_CloseChannel (Opnum 6) (section 3.1.1.4.6).

When a notification source generates the initial notification for a bidirectional notification channel, the server MUST hold that notification until one of two events occurs.

- A client acquires the channel by sending a response as an input parameter to a call to IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4) or IRPCAsyncNotify_CloseChannel (Opnum 6).
- The bidirectional notification channel is closed by the notification source.

When a notification source generates any subsequent notification for a bidirectional notification channel, the server MUST immediately send it to the client as an output parameter to the IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4) call that was used by the client to send its response to the preceding notification.

3.1.1.6.4 Bidirectional Notification Channel Closed

A notification source that terminates the exchange of a sequence of notifications and responses with a print client MUST close the **Bidirectional Notification Channel** (section 3.1.1.1). Such a closure can be due to normal processing or a critical failure in the notification source.

3.1.1.6.5 Impersonate Client

This protocol uses local interfaces provided by the server implementation of [MS-RPCE] to impersonate the user associated to the security context defined in [MS-RPCE] sections 3.1.1.1.1 and 3.2.1.4.1.1. This local interface is specified in [MS-RPCE] sections 3.1.1.4.2. This event stores an implementation-specific identifier for the authenticated user identity for the duration of processing the message reflected in the abstract data model as **Current Authenticated User**. This local event occurs for the processing of all messages in section 3.1.1.4.

3.1.2 IRPCRemoteObject Server Details

The IRPCRemoteObject server interface provides methods that allow a client to define a generic remote object on a server. The version for this interface is 1.0. To receive incoming remote calls for this interface, the client MUST establish an RPC dynamic endpoint by using the UUID ae33069b-a2a8-46ee-a235-ddfd339be281.

3.1.2.1 Abstract Data Model

No abstract data model is required.

3.1.2.2 Timers

No protocol timer events are required on the client beyond the timers required in the underlying RPC protocol ([MS-RPCE] section 3).

3.1.2.3 Initialization

The server MUST listen on dynamically assigned endpoints (see [C706] section 6.2.2).

3.1.2.4 Message Processing Events and Sequencing Rules

This protocol MUST direct the RPC protocol ([MS-RPCE] section 3) runtime to the following:

- Perform a strict NDR data consistency check at target level 6.0.
- Reject a NULL unique or full pointer with non-zero conforming value.

The sections that follow specify the syntax and behavior for each method defined in this interface:

Methods in RPC Opnum Order

Method	Description
IRPCRemoteObject_Create	The method creates a remote object on a server and returns it to the client. Opnum: 0
IRPCRemoteObject_Delete	The method destroys the specified remote object. Opnum: 1

3.1.2.4.1 IRPCRemoteObject_Create (Opnum 0)

The IRPCRemoteObject_Create method creates a remote object on a server and returns it to the client.

```
HRESULT IRPCRemoteObject_Create(  
    [in] handle_t hRemoteBinding,  
    [out] PRPCREMOTEOBJECT* ppRemoteObj  
);
```

hRemoteBinding: MUST be a client-generated RPC binding handle ([C706] section 2.3) by using a Universal Naming Convention (UNC) name that MUST uniquely identify a print server on the network.

ppRemoteObj: MUST be a remote object context handle returned by the server. It MUST be a non-NULL value.

Return Values: This method MUST return zero to indicate success, or an HRESULT error value ([MS-ERREF] section 2.1.1) to indicate failure. The client MUST consider all error return values fatal and report them to the higher-level caller.

Exceptions Thrown: No exceptions are thrown beyond those thrown by the underlying RPC protocol [MS-RPCE].

3.1.2.4.2 IRPCRemoteObject_Delete (Opnum 1)

The IRPCRemoteObject_Delete method destroys the specified remote object.

```
void IRPCRemoteObject_Delete(  
    [in, out] PRPCREMOTEOBJECT* ppRemoteObj  
);
```

ppRemoteObj: MUST be the remote object to delete. The handle MUST have been returned by the server in the ppRemoteObj output parameter of a prior call to IRPCRemoteObject_Create and MUST NOT have been previously deleted. If this handle were previously registered by a successful call to IRPCAsyncNotify_RegisterClient, then it MUST have been subsequently unregistered by a call to IRPCAsyncNotify_UnregisterClient. It MUST NOT be NULL.

Upon receipt, the server MUST set the ppRemoteObj value to NULL.

Return Values: This method has no return values.

Exceptions Thrown: No exceptions are thrown beyond those thrown by the underlying RPC protocol [MS-RPCE].

3.1.2.5 Timer Events

No protocol timer events are required on the server outside of the timers required in the underlying RPC protocol ([MS-RPCE] section 3).

3.1.2.6 Other Local Events

No higher-level triggered events are processed.

3.1.3 AsyncUI Server Details

The AsyncUI notification type allows for a print-server-resident notification source to request the following:

- The display of an informative alert on a client machine.
- The client sends user input requested by the alert back to the server.
- The client executes code that is resident on the client machine.

The AsyncUI notification type MUST use the notification type identifier value **AsyncPrintNotificationType_AsyncUI** (section 2.2.1).

3.1.3.1 Abstract Data Model

No abstract data model is required.

3.1.3.2 Timers

No timer events are required on the client besides those required in the underlying RPC protocol ([MS-RPCE] section 3).

3.1.3.3 Initialization

A remote object server (section 3.1.2) and an asynchronous notification server (section 3.1.1) MUST be fully initialized on the server.

3.1.3.4 Message Processing Events and Sequencing Rules

The Print System Asynchronous Notification Protocol MUST specify the notification type identifier `AsyncPrintNotificationType_AsyncUI` when registering for notifications or when requesting or returning notifications or response data using the methods of the `IRPCAsyncNotify` interface. The sections that follow specify the `AsyncUI` server syntax and behavior for the parameters for those methods.

Methods in RPC Opnum Order

Method	Description
<code>IRPCAsyncNotify_RegisterClient</code>	AsyncUI server parameter details are specified in section 3.1.3.4.1. Opnum: 0
<code>IRPCAsyncNotify_UnregisterClient</code>	There are no AsyncUI server parameter details for this method. Opnum: 1
<code>Opnum2NotUsedOnWire</code>	Reserved for local use Opnum: 2
<code>IRPCAsyncNotify_GetNewChannel</code>	There are no AsyncUI server parameter details for this method. Opnum: 3
<code>IRPCAsyncNotify_GetNotificationSendResponse</code>	AsyncUI server parameter details are specified in section 3.1.3.4.2. Opnum: 4
<code>IRPCAsyncNotify_GetNotification</code>	AsyncUI server parameter details are specified in section 3.1.3.4.3. Opnum: 5
<code>IRPCAsyncNotify_CloseChannel</code>	AsyncUI server parameter details are specified in section 3.1.3.4.4. Opnum: 6

The specific notification and response formats referenced are defined in section 2.2.7. The behavior of methods reserved for local use is specified in section 3.1.1.4.

There is no AsyncUI server syntax or behavior for methods of the `IRPCRemoteObject` interface (section 3.2).

3.1.3.4.1 IRPCAsyncNotify_RegisterClient (Opnum 0)

The `IRPCAsyncNotify_RegisterClient` method is specified in section 3.1.1.4.1. Additional AsyncUI-specific server parameter details are defined here.

pInNotificationType: MUST hold the notification type identifier value.
AsyncPrintNotificationType_AsyncUI (section 2.2.1).

3.1.3.4.2 IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4)

The `IRPCAsyncNotify_GetNotificationSendResponse` method is specified in section 3.1.1.4.4. Additional AsyncUI-specific server parameter details are defined here.

pInNotificationType: MUST hold the notification type identifier value **AsyncPrintNotificationType_AsyncUI** (section 2.2.1).

InSize: SHOULD be 0 (section 3.1.1.4.4) on the first `IRPCAsyncNotify_GetNotificationSendResponse` call using a given notification channel, the client SHOULD provide 0 bytes of data, and the server MUST ignore any response data. The `AsyncUI` notification type requires that any response to the initial notification sent on a bidirectional notification channel MUST be sent using a call to `IRPCAsyncNotify_CloseChannel` and MUST NOT be sent by using a call to `IRPCAsyncNotify_GetNotificationSendResponse`.

pInNotificationData: SHOULD be NULL, consistent with the guidance of section 3.1.1.4.4 and the specification of the **InSize** parameter.

ppOutNotificationData: MUST hold server-to-client notification data, which conforms to the format for **AsyncUIMessageBox** (section 2.2.7.3), **AsyncUICustomUI** (section 2.2.7.5), or **AsyncUICustomData** (section 2.2.7.7). If the notification is of format **AsyncUICustomUI** (section 2.2.7.5.1) or **AsyncUICustomData** (section 2.2.7.7.1), the value of the **bidirectional** attribute of the contained "customUI" or "customData" element, specified in sections and respectively, MUST be "true".

3.1.3.4.3 `IRPCAsyncNotify_GetNotification` (Opnum 5)

The `IRPCAsyncNotify_GetNotification` method is specified in section 3.1.1.4.5. Additional `AsyncUI`-specific server parameter details are defined here.

ppOutNotificationType: MUST hold either notification type identifier value **AsyncPrintNotificationType_AsyncUI** or **NOTIFICATION_RELEASE**, as specified in section 2.2.1.

ppOutNotificationData: MUST hold server-to-client notification data, which conforms to the data format for **AsyncUIBalloon** (section 2.2.7.2), **AsyncUICustomUI** (section 2.2.7.5), or **AsyncUICustomData** (section 2.2.7.7). If the notification is of format **AsyncUICustomUI** (section 2.2.7.5.1) or **AsyncUICustomData** (section 2.2.7.7.1), the value of the **bidirectional** attribute of the contained "customUI" or "customData" element, MUST be "false".

3.1.3.4.4 `IRPCAsyncNotify_CloseChannel` (Opnum 6)

The `IRPCAsyncNotify_CloseChannel` method is specified in section 3.1.1.4.6. Additional `AsyncUI`-specific server parameter details are defined here.

pInNotificationType: MUST hold either notification type identifier value **AsyncPrintNotificationType_AsyncUI** or **NOTIFICATION_RELEASE** (section 2.2.1).

pReason: If **pInNotificationType** does hold **NOTIFICATION_RELEASE**, **pReason** MUST hold client-to-server response data conforming to the data format for **AsyncUIMessageBoxReply** (section 2.2.7.4) or **AsyncUICustomUIReply** (section 2.2.7.6). The client sequencing rules defining the conditions under which each response format is sent can be found in section 3.2.3.4.

3.1.3.5 Timer Events

No timer events are required on the server beyond the timers required in the underlying RPC protocol ([MS-RPCE] section 3).

3.1.3.6 Other Local Events

This protocol does not define the set of printing events that cause notification sources to trigger notifications.

3.1.4 Printer Configuration Server Details

The printer configuration notification type allows for a print server-resident notification source to notify a print client of a change in the configuration of a printer on the print server.

The printer configuration notification type MUST use the notification type identifier value **AsyncPrintNotificationType_PrinterConfiguration** (section 2.2.1).

3.1.4.1 Abstract Data Model

No abstract data model is required.

3.1.4.2 Timers

No timer events are required on the client beyond those required in the underlying RPC protocol (see [MS-RPCE] section 3).

3.1.4.3 Initialization

A remote object server (section 3.1.2) and an asynchronous notification server (section 3.1.1) MUST be fully initialized on the server.

3.1.4.4 Message Processing Events and Sequencing Rules

The Print System Asynchronous Notification Protocol MUST specify the notification type identifier **AsyncPrintNotificationType_PrinterConfiguration** when registering for notifications or returning notification data using the methods of the **IRPCAsyncNotify** interface and MUST use the unidirectional communication mode. The sections that follow specify the printer configuration server syntax and behavior for the parameters of those methods.

Methods in RPC Opnum order:

Method	Description
IRPCAsyncNotify_RegisterClient	Printer configuration server parameter details are specified in section 3.1.4.4.1. Opnum: 0
IRPCAsyncNotify_UnregisterClient	There are no printer configuration server parameter details for this method. Opnum: 1
Opnum2NotUsedOnWire	Reserved for local use. Opnum: 2
IRPCAsyncNotify_GetNewChannel	There are no printer configuration server parameter details for this method. Opnum: 3
IRPCAsyncNotify_GetNotificationSendResponse	There are no printer configuration server parameter details for this method. Opnum: 4
IRPCAsyncNotify_GetNotification	Printer configuration server parameter details are specified in section 3.1.4.4.2. Opnum: 5

Method	Description
IRPCAsyncNotify_CloseChannel	There are no printer configuration server parameter details for this method. Opnum: 6

The specific notification and response formats referenced are defined in section 2.2.7. The behavior of methods reserved for local use is specified in section 3.1.1.4.

There is no printer configuration server syntax or behavior for methods of the **IRPCRemoteObject** interface (section 3.2).

3.1.4.4.1 IRPCAsyncNotify_RegisterClient (Opnum 0)

The IRPCAsyncNotify_RegisterClient method is specified in section 3.1.1.4.1. Additional printer configuration-specific server parameter details are defined here.

pInNotificationType: MUST hold the notification type identifier value **AsyncPrintNotificationType_PrinterConfiguration** as specified in section 2.2.1).

conversationStyle: MUST be the conversation style value **kUniDirectional** (see section 2.2.3).

3.1.4.4.2 IRPCAsyncNotify_GetNotification (Opnum 5)

The IRPCAsyncNotify_GetNotification method is specified in section 3.1.1.4.5. Additional printer configuration-specific server parameter details are defined here.

ppOutNotificationType: MUST hold either notification type identifier value **AsyncPrintNotificationType_PrinterConfiguration** or **NOTIFICATION_RELEASE**, as specified in section 2.2.1.

ppOutNotificationData: MUST hold server-to-client notification data that conforms to the data format for a Printer Configuration Notification (section 2.2.8.1).

3.1.4.5 Timer Events

No timer events are required on the server beyond the timers required in the underlying RPC protocol (see [MS-RPCE] section 3).

3.1.4.6 Other Local Events

This protocol does not define the set of printing events that cause notification sources to trigger notifications.

3.2 Client Details

3.2.1 IRPCRemoteObject Client Details

3.2.1.1 Abstract Data Model

No abstract data model is required.

3.2.1.2 Timers

No timers are required beyond those used internally by the RPC Protocol ([MS-RPCE] section 3) to implement resiliency to network outages.

3.2.1.3 Initialization

The client creates an RPC binding handle ([C706] section 2.3), to the server RPC dynamic endpoint when an RPC method is called.

3.2.1.4 Message Processing Events and Sequencing Rules

This protocol MUST direct the RPC Protocol ([MS-RPCE] section 3) runtime to do the following:

- Perform a strict NDR data consistency check at target level 6.0.
- Reject a NULL unique or full pointer with a non-zero conforming value.

Remote object clients MUST manage the lifetime of the remote objects. Specifically, clients MUST call `IRPCRemoteObject_Delete` (section 3.1.2.4) for each successful call to `IRPCRemoteObject_Create` (section 3.1.2.4). These methods are specified in section 3.1.2.4.

3.2.1.5 Timer Events

No protocol timer events are required on the client beyond the timers required in the underlying RPC Protocol ([MS-RPCE] section 3).

3.2.1.6 Other Local Events

A client's invocation of each method is typically the result of local application activity. No other higher-layer triggered events are processed.

3.2.2 IRPCAsyncNotify Client Details

Unidirectional message passing mode is illustrated by the following client state diagram. This diagram represents a client that is registering and receiving notifications of a predetermined notification type and user filter in the `IRPCAsyncNotify_RegisterClient` parameters.

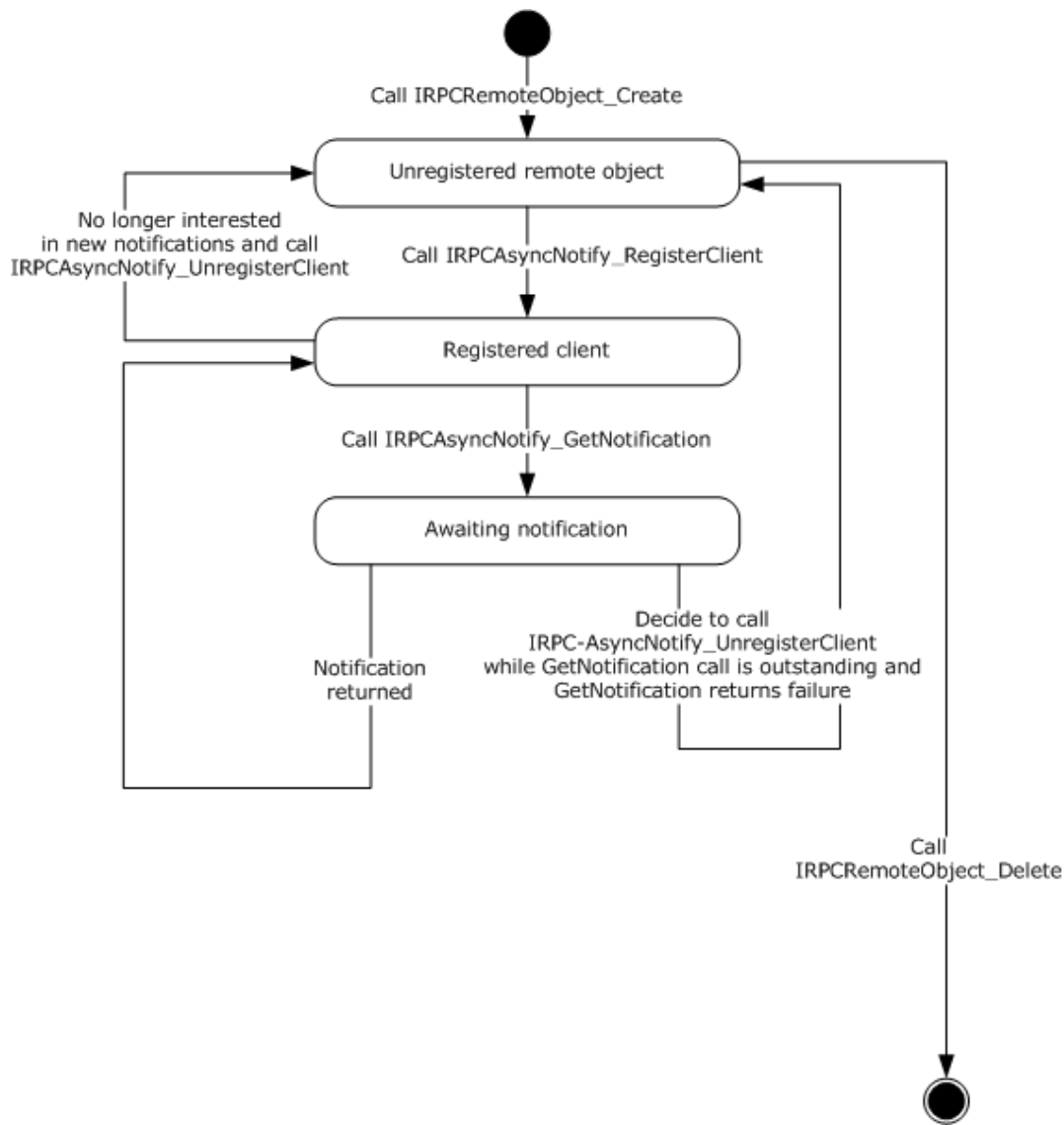


Figure 8: Client registering and receiving notifications of a predetermined notification type

Bidirectional message passing mode is illustrated by the following two client state diagrams. The first diagram illustrates remote object creation and deletion, client registration, and the opening of notification channels. The second diagram provides the details of the processing of an open channel, including its eventual closure.

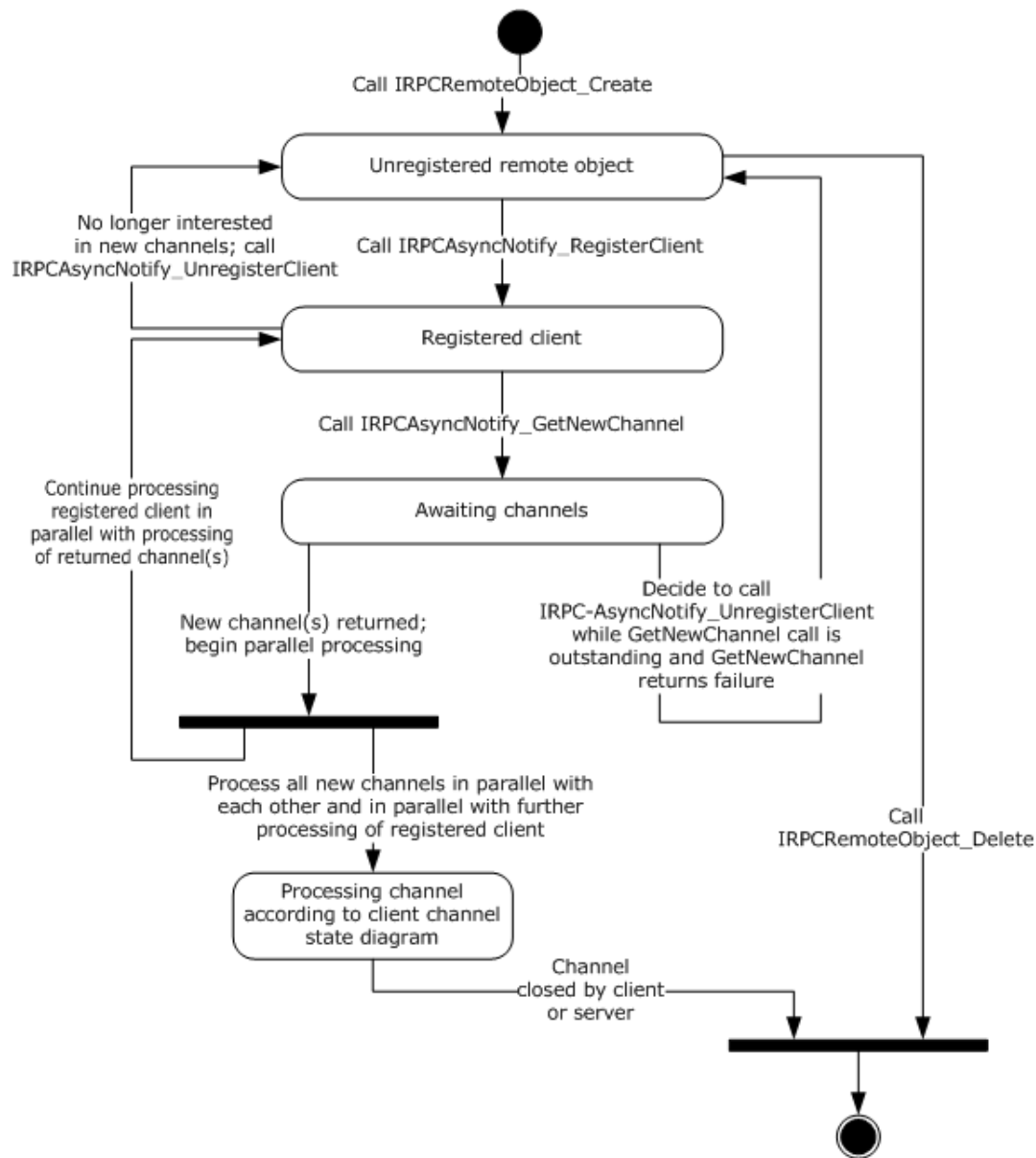


Figure 9: Remote object creation and deletion, client registration, and opening of notification channels

The following diagram illustrates the processing of a single open channel.

IRPCAsyncNotify_GetNewChannel (section 3.1.1.4.3) , and IRPCAsyncNotify_GetNotification (section 3.1.1.4.5) specify the use of a decaying time interval to separate retries until the connection is reestablished or the client unregisters the remote object.

3.2.2.3 Initialization

The client MUST create a RPC binding handle to the server RPC dynamic endpoint when an RPC method is called ([C706] section 2.3).

3.2.2.4 Message Processing Events and Sequencing Rules

This protocol MUST direct the RPC ([MS-RPCE] section 3) runtime to do the following:

- Perform a strict NDR data consistency check at target level 6.0.
- Reject a NULL unique or full pointer with a non-zero conforming value.

Clients MUST manage registrations throughout their lifetimes. Specifically, clients MUST call IRPCAsyncNotify_UnregisterClient for each successful call to IRPCAsyncNotify_RegisterClient.

When either IRPCAsyncNotify_GetNewChannel or IRPCAsyncNotify_GetNotification returns with a success code, the client SHOULD issue the next call of the same kind as soon as possible in order to minimize the amount of buffering and risk of event loss on the server.

The syntax and behavior for the methods of the IRPCAsyncNotify interface are fully specified in section 3.1.1.4.

3.2.2.5 Timer Events

No timer events are required on the client except the timers that are required in the underlying RPC Protocol ([MS-RPCE] section 3).

3.2.2.6 Other Local Events

A client's registration is typically the result of printing activity.

3.2.3 AsyncUI Client Details

The AsyncUI notification type MUST use the notification type identifier value **AsyncPrintNotificationType_AsyncUI** (section 2.2.1).

The AsyncUI notification type includes some notifications that are sent in unidirectional communication mode and others that are sent in bidirectional communication mode. In bidirectional communication mode, the type of notification received by a client determines the required response type. A client of the AsyncUI notification type that uses the Print System Asynchronous Notification Protocol to process notification in bidirectional communication mode has the following state diagram when dealing with a single communication channel.

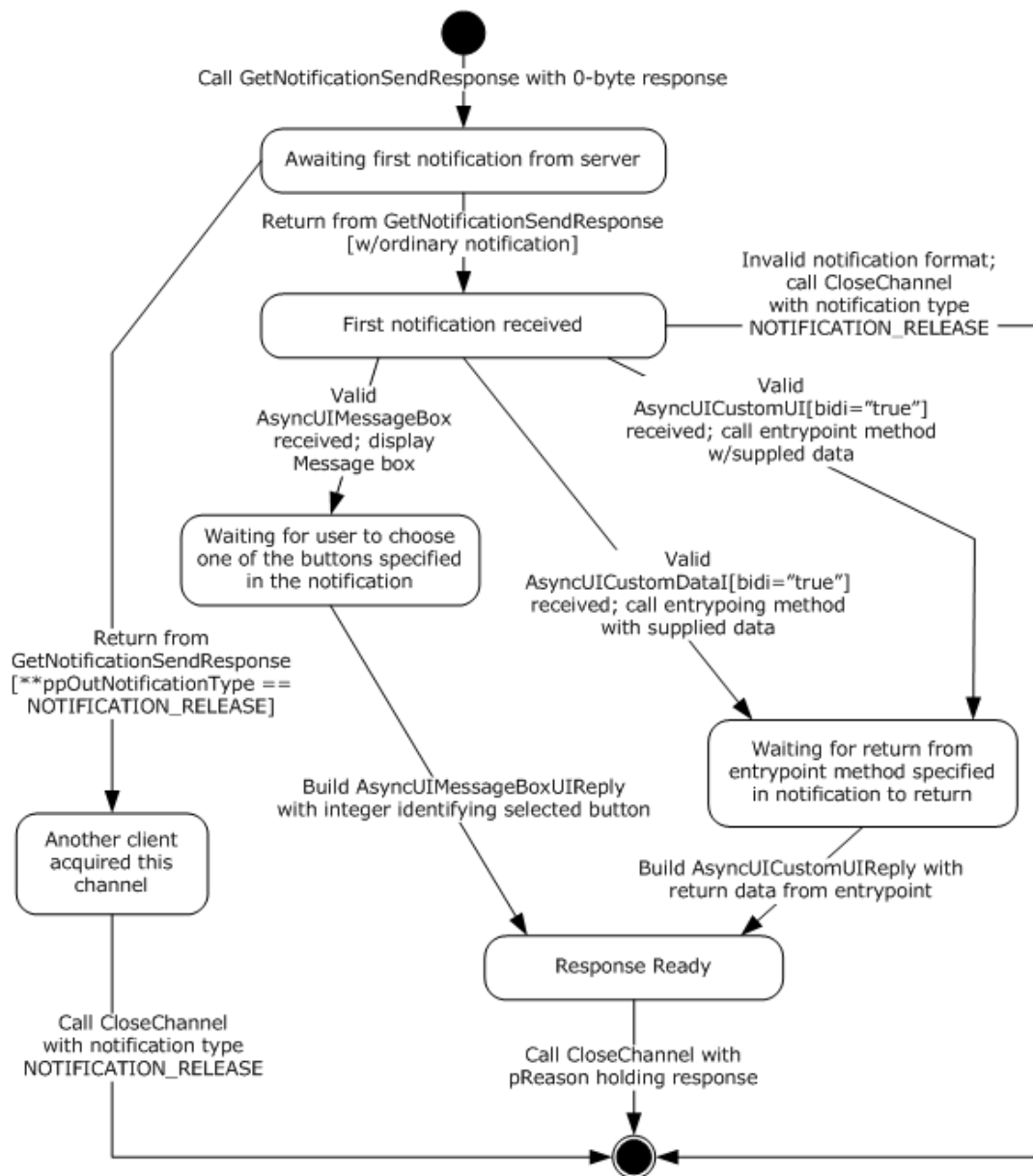


Figure 11: Client state diagram when dealing with a single communication channel

3.2.3.1 Abstract Data Model

No abstract data model is required.

3.2.3.2 Timers

No timer events are required on the client outside of the timers required in the underlying RPC protocol ([MS-RPCE] section 3).

3.2.3.3 Initialization

A remote object client (section 3.2.1) and an asynchronous notification client (section 3.2.2) MUST be fully initialized on the client.

3.2.3.4 Message Processing Events and Sequencing Rules

An AsyncUI client MUST specify a notification type identifier value **AsyncPrintNotificationType_AsyncUI** (section 2.2.1) when registering for, requesting, or responding to notifications or response data, using the methods of the Print System Asynchronous Notification Protocol.

The AsyncUI-specific syntax and behavior for each method specified in section 3.1.3.4.

There is no AsyncUI-specific syntax or behavior for the **IRPCRemoteObject** interface methods described in section 3.1.2.4.

The sections that follow specify the processing of AsyncUI notifications that are delivered to a client from a printer driver using this protocol.

3.2.3.4.1 AsyncUIBalloon Notification

The AsyncUIBalloon notification MUST use unidirectional communication mode and MUST be delivered by way of an output parameter of an **IRPCAsyncNotify_GetNotification** call.

Before acting on a notification, the client SHOULD verify that the notification complies with the requirements for the AsyncUIBalloon type, but SHOULD accept as compliant the following inconsistencies with the AsyncUIBalloon specification:

- Clients SHOULD accept XML-element names that differ in ASCII case from those specified in the XML schema.
- Clients SHOULD accept values of the **bidi** and **buttonID** attributes that differ in ASCII case from those specified in the XML schema.
- Where the XML schema specifies an ordering for sibling elements, clients SHOULD accept as compliant those elements in any order.
- Clients SHOULD ignore and consider as compliant **XML** attributes with unrecognized names.
- Where this specification calls for an integer to be encoded as a string, clients SHOULD accept any string as compliant, and SHOULD interpret the string as follows:
 - If leading, contiguous non-white-space characters of the string can be decoded as an integer, clients SHOULD accept the integer and discard remaining characters.
 - If no leading characters can be decoded as an integer, clients SHOULD treat the string as if it held the value "0".
- Clients SHOULD accept as compliant any string for the value of the **bidi** attribute, and treat any value other than "true" as if it were "false".
- Clients SHOULD accept as compliant a "messageBoxUI" or "balloonUI" element that lacks the required "body" element.

If a compliance error is detected, the client MUST NOT take any further action based on the notification data, but rather MUST continue with a subsequent call to **IRPCAsyncNotify_GetNotification**.

After validating the notification, an AsyncUI client MUST process the request as follows:

- The client SHOULD format a display by using AsyncUI "title", "body", and "parameter" elements, as well as **iconID** and **resourceDII** attributes from the "balloonUI" element (sections 2.2.7.1.3, 2.2.7.1.4, and 2.2.7.1.5).
- If an "action" element is specified, the client MUST call the method identified by the **entrypoint** and **dII** attributes of that element (section 2.2.7.1). If the method entry point cannot be called successfully for any reason, the client MUST ignore the error and continue with a subsequent call to IRPCAsyncNotify_GetNotification.

3.2.3.4.2 AsyncUIMessageBox Notification

The AsyncUIMessageBox notification MUST use bidirectional communication mode and MUST be delivered by way of an output parameter of an IRPCAsyncNotify_GetNotificationSendResponse call. Once the notification has been processed, a client MUST NOT make an additional call to IRPCAsyncNotify_GetNotificationSendResponse by using the same **pChannel** parameter and MUST send a response using a call to IRPCAsyncNotify_CloseChannel.

Before acting on a notification, a client SHOULD verify that the notification complies with the requirements specified for AsyncUIMessageBox (section 2.2.7.3), but SHOULD accept as compliant any of the inconsistencies described in section 3.2.3.4.1.

If a compliance error is detected, the client MUST NOT send any further response on the same notification channel and MUST close the channel by calling IRPCAsyncNotify_CloseChannel with its **pInNotificationType** parameter holding NOTIFICATION_RELEASE.

After successfully validating the notification:

- The client SHOULD format a display by using AsyncUI title, body, parameter, button, and bitmap elements and wait for the user to select one of the buttons.
- The client MUST:
 - Identify a selected button.
 - Construct an AsyncUIMessageBoxReply string. The buttonID element MUST specify the **buttonID** attribute of the button element that was selected (section 2.2.7.3).
 - Send the AsyncUIMessageBoxReply to the server in the **pReason** parameter of an IRPCAsyncNotify_CloseChannel call.

3.2.3.4.3 AsyncUICustomUI Notification

The AsyncUICustomUI notification can be sent by using either unidirectional communication mode or bidirectional communication mode.

A notification sent by using unidirectional communication mode MUST be delivered by way of an output parameter of an IRPCAsyncNotify_GetNotification call.

A notification sent by using bidirectional communication mode MUST be delivered by way of an output parameter of an IRPCAsyncNotify_GetNotificationSendResponse call.

Once a bidirectional notification has been processed, the client MUST NOT make an additional call to IRPCAsyncNotify_GetNotificationSendResponse using the same **pChannel** parameter and MUST send a response using IRPCAsyncNotify_CloseChannel.

Before acting on a notification, the client SHOULD verify that the notification complies with the requirements specified for AsyncUICustomUI (section 2.2.7.5), but SHOULD accept as compliant any of the inconsistencies described in section 3.2.3.4.1.

If a compliance error is detected, the client MUST NOT take any further action based on the notification data. If the invalid notification was sent in unidirectional communication mode, the client MUST continue with a subsequent call to `IRPCAsyncNotify_GetNotification`. If the invalid notification was sent in bidirectional communication mode, the client MUST NOT send any further response on the same notification channel and MUST close the channel by calling `IRPCAsyncNotify_CloseChannel` with its **`pInNotificationType`** parameter holding **`NOTIFICATION_RELEASE`**.

After successfully validating the notification:

- The client MUST call the executable method identified by the **`entrypoint`** and **`dll`** attributes of the customUI element.
- If the **`entrypoint`** cannot be successfully called for any reason:
 - If the **`bidi`** attribute is "false", the client MUST ignore the error and MUST continue with a subsequent call to `IRPCAsyncNotify_GetNotification`.
 - If the **`bidi`** attribute is "true":
 - The client MUST stop further processing of this notification.
 - The client MUST NOT send any further response on the same notification channel.
 - The client MUST close the notification channel by calling `IRPCAsyncNotify_CloseChannel` with its **`pInNotificationType`** parameter holding **`NOTIFICATION_RELEASE`**.
- Otherwise, if the **`entrypoint`** is successful and the **`bidi`** attribute is "true":
 - The client MUST construct an `AsyncUICustomUIReply` string. The CustomUI element MUST contain a string that is returned by the called method.
 - The client MUST send the `AsyncUICustomUIReply` to the server in the **`pReason`** parameter of an `IRPCAsyncNotify_CloseChannel` call.

3.2.3.4.4 AsyncUICustomData Notification

The `AsyncUICustomData` notification can be sent using either unidirectional communication mode or bidirectional communication mode.

A notification that is sent using unidirectional communication mode MUST be delivered by an output parameter from `IRPCAsyncNotify_GetNotification`.

A notification that is sent using bidirectional communication mode MUST be delivered by an output parameter from `IRPCAsyncNotify_GetNotificationSendResponse`.

After a bidirectional notification has been processed, the client MUST NOT make an additional call to `IRPCAsyncNotify_GetNotificationSendResponse` using the same `pChannel` parameter. The client MUST send a response using `IRPCAsyncNotify_CloseChannel`.

Before acting on a notification, the client SHOULD verify that the notification complies with the requirements specified for `AsyncUICustomData` (section 2.2.7.7), but SHOULD accept as compliant the following inconsistencies with the `AsyncUIBalloon` specification.

If a compliance error is detected, the client MUST NOT take any further action based on the notification data. If the invalid notification was sent in unidirectional communication mode, the client MUST continue with a subsequent call to `IRPCAsyncNotify_GetNotification`. If the invalid notification was sent in bidirectional communication mode, the client MUST NOT send any further response on the same notification channel and MUST close the channel by calling `IRPCAsyncNotify_CloseChannel` with its `pInNotificationType` parameter set to **`NOTIFICATION_RELEASE`**.

After successfully validating the notification, the following actions MUST be taken:

- The client MUST call the executable method identified by the **entrypoint** and **dll** attributes of the **customData** element (section 2.2.7.7.1).
- If the **entrypoint** cannot be successfully called for any reason, the following actions MUST be taken:
 - If the **bidi** attribute is "false", the client MUST ignore the error and MUST continue with a subsequent call to `IRPCAsyncNotify_GetNotification`.
 - If the **bidi** attribute is "true", the following actions MUST be taken:
 - The client MUST stop further processing of this notification.
 - The client MUST NOT send any further response on the same notification channel.
 - The client MUST close the notification channel by calling `IRPCAsyncNotify_CloseChannel` with its *pInNotificationType* parameter set to **NOTIFICATION_RELEASE**.
- Otherwise, if the **entrypoint** is successful and the **bidi** attribute is "true", the following action MUST be taken:
 - The client MUST construct an `AsyncUICustomUIReply` string. The **CustomUI** element (section 2.2.7.6.1) MUST contain a string that is returned by the called method.
 - The client MUST send the `AsyncUICustomUIReply` string to the server in the *pReason* parameter of an `IRPCAsyncNotify_CloseChannel` call.

3.2.3.5 Timer Events

No timer events are required on the client beyond the timers required in the underlying RPC protocol ([MS-RPCE] section 3).

3.2.3.6 Other Local Events

There are no AsyncUI-specific local events.

3.2.4 Printer Configuration Client Details

The printer configuration notification client MUST use the notification type identifier value **AsyncPrintNotificationType_PrinterConfiguration** as specified in section 2.2.1.

The printer configuration notification type includes only notifications that are sent in unidirectional communication mode.

3.2.4.1 Abstract Data Model

No abstract data model is required.

3.2.4.2 Timers

No timer events are required on the client beyond the timers required in the underlying RPC protocol ((see [MS-RPCE] section 3).

3.2.4.3 Initialization

A remote object client (section 3.2.1) and an asynchronous notification client (section 3.2.2) MUST be fully initialized on the client.

3.2.4.4 Message Processing Events and Sequencing Rules

An AsyncUI client MUST specify a notification type identifier value **AsyncPrintNotificationType_PrinterConfiguration** (section 2.2.1) when registering for, requesting, or responding to notifications or response data, using the methods of the Print System Asynchronous Notification Protocol.

The printer configuration-specific syntax and behavior for each method is specified in section 3.1.4.4.

There is no printer configuration-specific syntax or behavior for the **IRPCRemoteObject** interface methods described in section 3.1.2.4.

The sections that follow specify the processing of printer configuration notifications that are delivered to a client from a print server using this protocol.

3.2.4.4.1 Printer Configuration Notification

The printer configuration notification MUST use unidirectional communication mode and MUST be delivered by way of an output parameter of an IRPCAsyncNotify_GetNotification (section 3.1.4.4.2) call.

Before acting on a notification, the client SHOULD verify that the notification complies with the requirements for the printer configuration notification type.

If a compliance error is detected, the client MUST NOT take any further action based on the notification data, but rather MUST continue with a subsequent call to IRPCAsyncNotify_GetNotification.

3.2.4.5 Timer Events

No timer events are required on the client beyond the timers required in the underlying RPC protocol (see [MS-RPCE] section 3).

3.2.4.6 Other Local Events

There are no printer configuration-specific local events.

4 Protocol Examples

4.1 Unidirectional Communication Mode

This section presents an example of unidirectional communication mode, which illustrates a single-server to single-client scenario. If multiple clients register with matching parameters, including notification type identifier and user privileges, then each registered client would receive a copy of the notification.

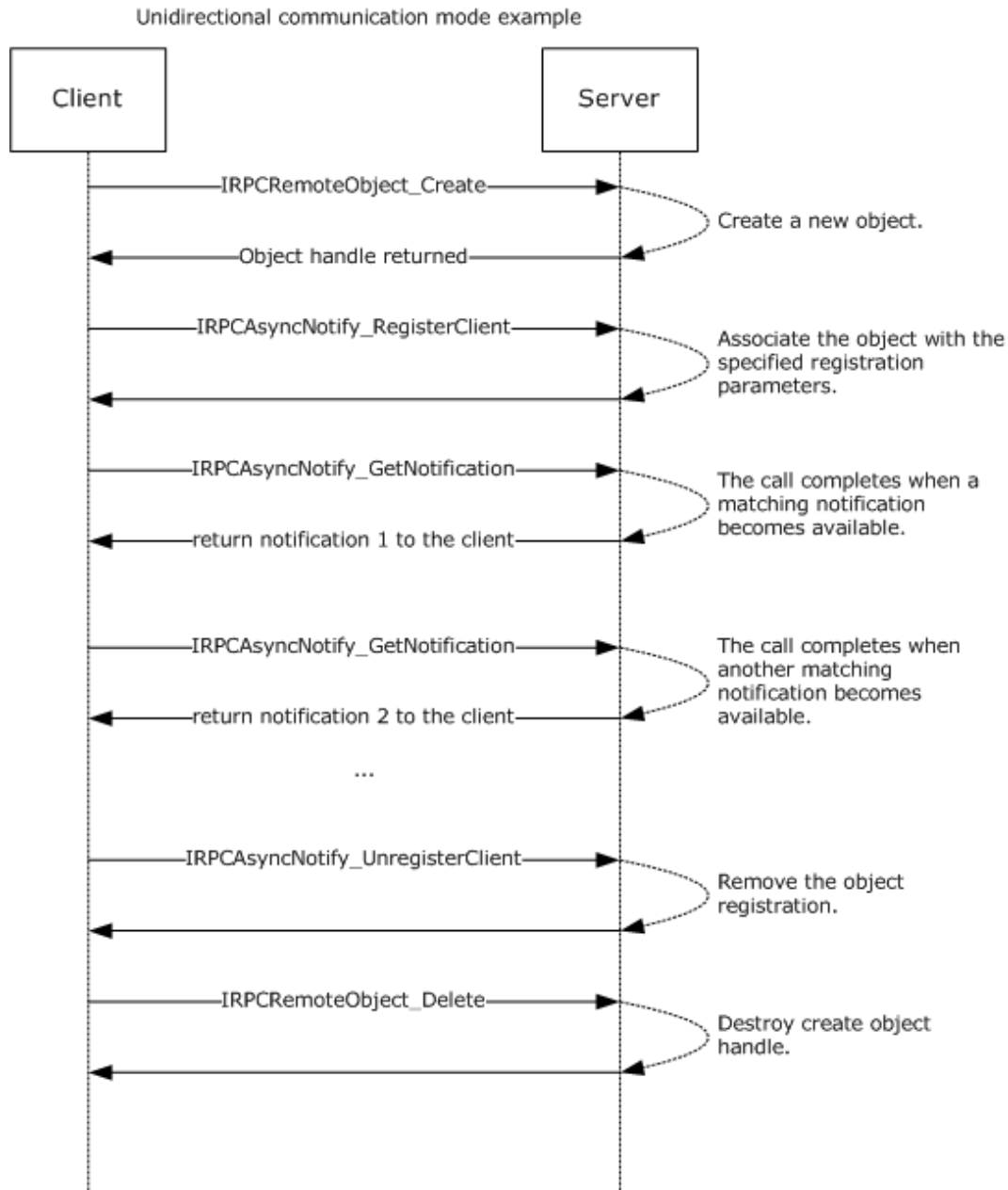


Figure 12: Unidirectional communication mode: single-server to single-client

4.2 AsyncUI Notification in Unidirectional Communication Mode

The following diagram illustrates the processing of an AsyncUI notification in unidirectional communication mode. In this example, the printer driver uses the notification type identifier value **AsyncPrintNotificationType_AsyncUI** (section 2.2.1) to request the client to display an informative message to the user without requesting any response to that message.

All text within the message box is identified by using references to a string resource contained within a client-resident resource file.

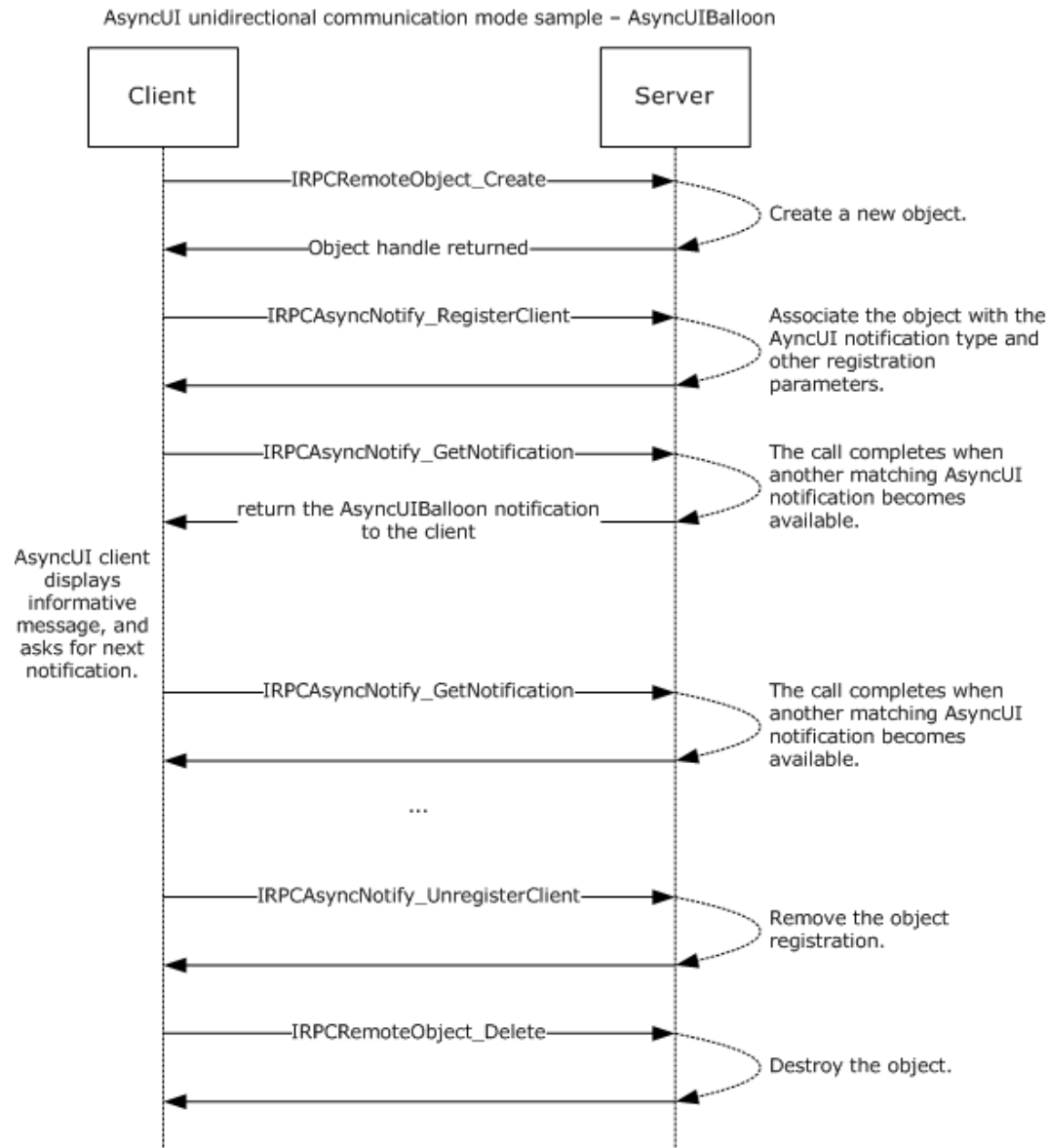


Figure 13: Processing an AsyncUI notification in unidirectional communication mode

The following is a sample notification.

```

<?xml version="1.0" ?>
<asyncPrintUIRequest xmlns=
"http://schemas.microsoft.com/2003/print/asyncui/v1/request">

```

```

<v1>
  <requestOpen>
    <balloonUI iconID="1" resourceDll="IHV.dll">
      <title stringID="1234" resourceDll="IHV.dll" />
      <body stringID="100" resourceDll="IHV.dll" />
    </balloonUI>
  </requestOpen>
</v1>
</asyncPrintUIRequest>

```

4.3 Bidirectional Communication Mode

This section presents an example of bidirectional communication mode, in which only the first notification is sent to all clients registered with matching parameters, including notification type identifier and user privileges. After the first notification, the first client to send a response to that notification acquires the notification channel. All other clients are notified that the notification channel was acquired by another client.

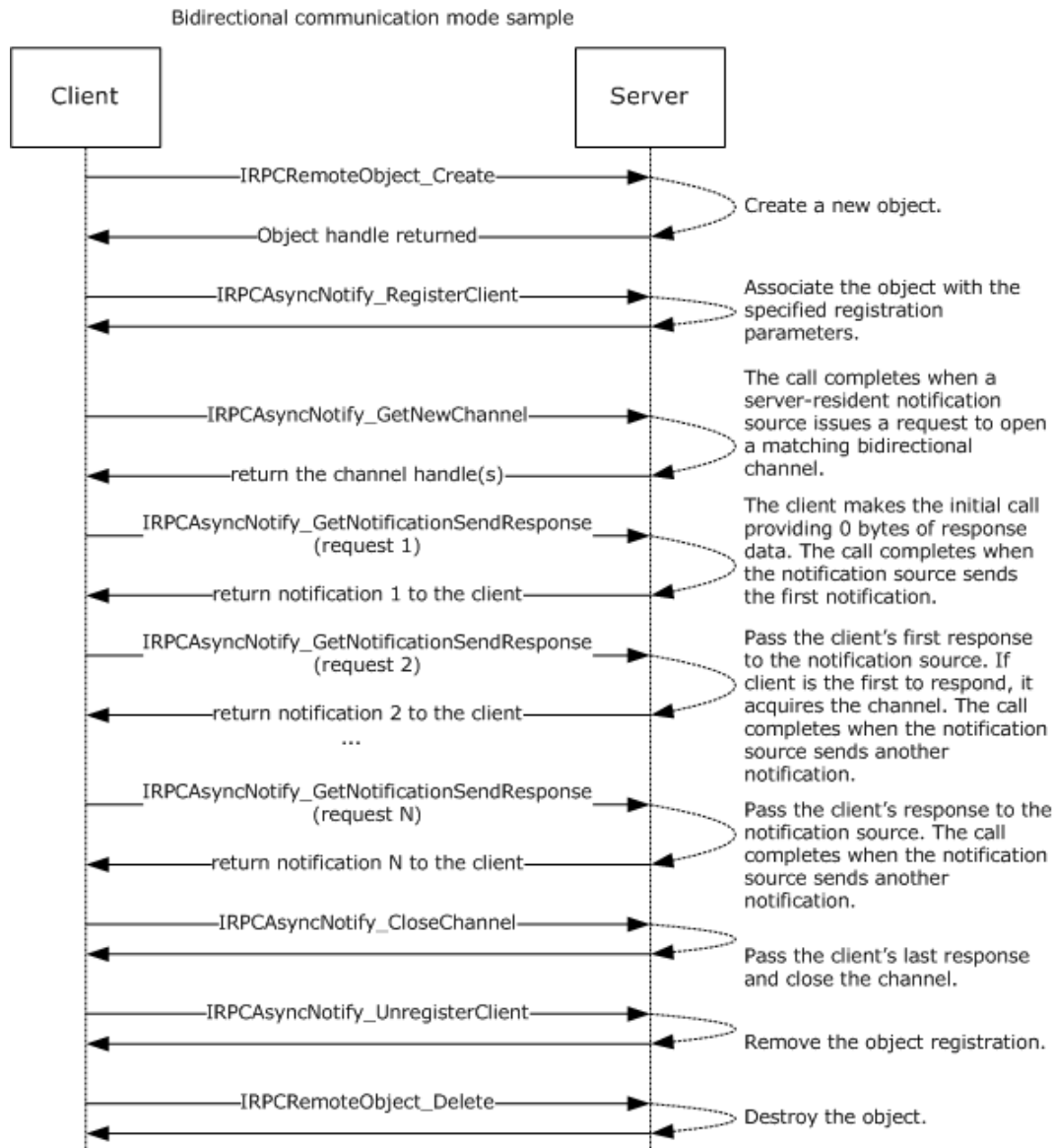


Figure 14: Bidirectional communication mode

4.4 AsyncUI Notification in Bidirectional Communication Mode

This section presents an example of processing an AsyncUI notification in bidirectional communication mode. In this example, a printer driver uses the notification type identifier value **AsyncPrintNotificationType_AsyncUI** (section 2.2.1) to request the client to display a message box containing multiple buttons. The client then sends back a response identifying the selected button.

All text within the message box is identified by using references to a string resource contained within a client-resident resource file.

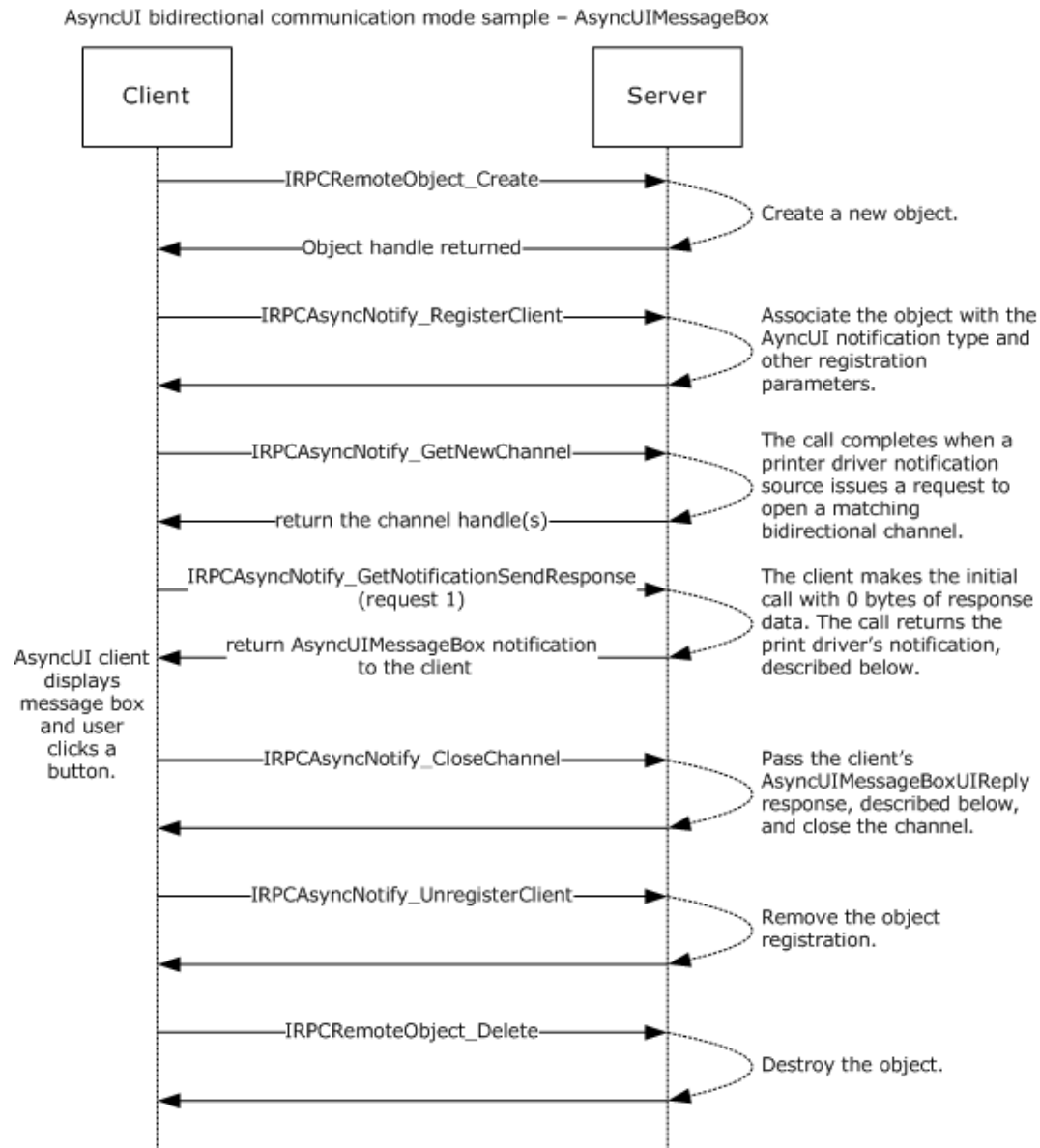


Figure 15: Processing an AsyncUI notification in bidirectional communication mode

Sample notification:

```
<asyncPrintUIRequest xmlns=
"http://schemas.microsoft.com/2003/print/asyncui/v1/request">
  <v1>
    <requestOpen>
      <messageBoxUI>
        <title stringID="100" resourceDll="IHV.dll" />
        <body stringID="101" resourceDll="IHV.dll" />
        <buttons>
          <button stringID="102" resourceDll="IHV.dll" buttonID="3"/>
          <button stringID="103" resourceDll="IHV.dll" buttonID="4"/>
        </buttons>
      </messageBoxUI>
    </requestOpen>
  </v1>
</asyncPrintUIRequest>
```

Sample response:

```
<asyncPrintUIResponse xmlns=
"http://schemas.microsoft.com/2003/print/asyncui/v1/response">
  <v1>
    <requestClose>
      <messageBoxUI>
        <buttonID>4</buttonID>
      </messageBoxUI >
    </requestClose>
  </v1>
</asyncPrintUIResponse>
```


5 Security

5.1 Security Considerations for Implementers

The Print System Asynchronous Notification Protocol treats the print server and print queues as securable resources in its security model. See section 2.1 for relevant security specifications; basic concepts of the security model are described in [MS-WPO] section 9; and security considerations for implementers of print clients that use authenticated RPC are specified in [MS-RPCE] section 3.

The print server and print queues each has an associated security descriptor that contains the security information for that printing resource. The security descriptor identifies the owner of the resource, and it contains a discretionary access control list (DACL). The DACL contains access control entries (ACEs) that specify the security identifier (SID) of a user or group of users and whether access rights are to be allowed, denied, or audited. For resources on a print server, the ACEs specify operations including printing, managing printers, and managing documents in a print queue.

Each RPC client has an associated access token that contains the SID of the user making the RPC call. The print server checks the client's access to resources by comparing the security information of the caller against the security descriptor of the resource. Prior to allowing a user to monitor and receive notifications, security and privacy contexts are considered.

IRPCAsyncNotify_RegisterClient (section 3.1.1.4.1) specifies the security and privacy checks performed by the server before it allows the registration of the client to succeed.

There is the risk of an AsyncUI client being used to execute arbitrary client-resident code, as identified by an **entrypoint** attribute within an executable driver file that is identified by a **dll** attribute (sections 2.2.7.2.1, 2.2.7.5.1, and 2.2.7.7.1). By enforcing the character restrictions specified for the **entrypoint** attribute, the client can ensure that the driver-file name refers to a constituent file of a printer driver. An AsyncUI client can further reduce risk of execution of arbitrary code by minimizing the active permissions when calling an **entrypoint**.

5.2 Index of Security Parameters

There are no security parameters associated with this protocol.

6 Appendix A: Full IDL

For ease of implementation, the following sections provide the full IDL for this protocol.

IDL name	Section
ms-pan_IRPCAsyncNotify	6.1
ms-pan_IRPCRemoteObject	6.2

6.1 Appendix A.1: IRPCAsyncNotify.IDL

This IDL uses definitions from the IRPCRemoteObject interface (section 6.2) and RPC extensions defined in [MS-RPCE].

```
import "ms-pan_irpcremoteobject.idl";

[
    uuid(0b6edbfa-4a24-4fc6-8a23-942bleca65d1),
    version(1.0),
    pointer_default(unique)
]
interface IRPCAsyncNotify {

    // [MS-PAN] enumerations
    typedef [v1_enum] enum {
        kBiDirectional = 0,
        kUniDirectional = 1,
    } PrintAsyncNotifyConversationStyle;

    typedef [v1_enum] enum {
        kPerUser = 0,
        kAllUsers = 1,
    } PrintAsyncNotifyUserFilter;

    // [MS-PAN] data types
    typedef GUID PrintAsyncNotificationType;
    typedef [context_handle] void* PNOTIFYOBJECT;

    // [MS-PAN] methods
    HRESULT
    IRPCAsyncNotify_RegisterClient(
        [in] PRPCREMOTEOBJECT pRegistrationObj,
        [in,string,unique] const wchar_t* pName,
        [in] PrintAsyncNotificationType* pInNotificationType,
        [in] PrintAsyncNotifyUserFilter NotifyFilter,
        [in] PrintAsyncNotifyConversationStyle conversationStyle,
        [out, string] wchar_t** ppRmtServerReferral
    );

    HRESULT
    IRPCAsyncNotify_UnregisterClient(
        [in] PRPCREMOTEOBJECT pRegistrationObj
    );

    void Opnum2NotUsedOnWire(void);

    HRESULT
    IRPCAsyncNotify_GetNewChannel(
        [in] PRPCREMOTEOBJECT pRemoteObj,
        [out] unsigned long* pNoOfChannels,
        [out,size_is( , *pNoOfChannels)] PNOTIFYOBJECT** ppChannelCtxt
```

```

);

HRESULT
IRPCAsyncNotify_GetNotificationSendResponse(
    [in, out] PNOTIFYOBJECT* pChannel,
    [in, unique] PrintAsyncNotificationType* pInNotificationType,
    [in] unsigned long InSize,
    [in, size_is(InSize), unique] byte* pInNotificationData,
    [out] PrintAsyncNotificationType** ppOutNotificationType,
    [out] unsigned long* pOutSize,
    [out, size_is( , *pOutSize)] byte** ppOutNotificationData
);

HRESULT
IRPCAsyncNotify_GetNotification(
    [in] PRPCREMOTEOBJECT pRemoteObj,
    [out] PrintAsyncNotificationType** ppOutNotificationType,
    [out] unsigned long* pOutSize,
    [out, size_is( , *pOutSize)] byte** ppOutNotificationData
);

HRESULT
IRPCAsyncNotify_CloseChannel(
    [in, out] PNOTIFYOBJECT* pChannel,
    [in] PrintAsyncNotificationType* pInNotificationType,
    [in] unsigned long InSize,
    [in, size_is(InSize), unique] byte* pReason
);
}

```

6.2 Appendix A.2: IRPCRemoteObject.IDL

This IDL uses definitions from the full IDL in [MS-DTYP] and RPC extensions defined in [MS-RPCE].

```

import "ms-dtyp.idl";

[
    uuid(ae33069b-a2a8-46ee-a235-ddfd339be281),
    version(1.0),
    pointer_default(unique)
]

interface IRPCRemoteObject
{
    // [MS-PAN] data types
    typedef [context_handle] void* PRPCREMOTEOBJECT;

    // [MS-PAN] methods
    HRESULT
    IRPCRemoteObject_Create(
        [in] handle_t hRemoteBinding,
        [out] PRPCREMOTEOBJECT* ppRemoteObj
    );

    void
    IRPCRemoteObject_Delete(
        [in,out] PRPCREMOTEOBJECT* ppRemoteObj
    );
}

```

7 (Updated Section) Appendix B: Product Behavior

The information in this specification is applicable to the following Microsoft products or supplemental software. References to product versions include updates to those products.

- Windows XP operating system
- Windows Server 2003 operating system
- Windows Vista operating system
- Windows Server 2008 operating system
- Windows 7 operating system
- Windows Server 2008 R2 operating system
- Windows 8 operating system
- Windows Server 2012 operating system
- Windows 8.1 operating system
- Windows Server 2012 R2 operating system
- Windows 10 operating system
- Windows Server 2016 operating system
- Windows Server operating system
- Windows Server 2019 operating system
- Windows Server 2022 operating system

▪ Windows 11 operating system

Exceptions, if any, are noted in this section. If an update version, service pack or Knowledge Base (KB) number appears with a product name, the behavior changed in that update. The new behavior also applies to subsequent updates unless otherwise specified. If a product edition appears with the product version, behavior is different in that product edition.

Unless otherwise specified, any statement of optional behavior in this specification that is prescribed using the terms "SHOULD" or "SHOULD NOT" implies product behavior in accordance with the SHOULD or SHOULD NOT prescription. Unless otherwise specified, the term "MAY" implies that the product does not follow the prescription.

<1> Section 2.2.7.2: For print queues using a printer driver with a driver version of 0x00000004 (see *cVersion* in [MS-RPRN] section 2.2.1.3.1), Windows print servers use AsyncUIBalloon messages to send details about configuration status changes to client UI components. In these messages, the balloonUI element contains exactly one action element (section 2.2.7.2.1). The action element contains the **dll** attribute "PrintConfig.dll" and the **entrypoint** attribute "NotifyEntry". The text data in the action element is an XML fragment of the following form:

```
<Envelope printer="..." reason="{23bb1328-63de-4293-915b-a6a23d929acb}" detail="...">
  <Schema ... />
  ...
</Envelope>
```

The Envelope element contains the following attributes:

printer: A string containing the name of the print queue whose configuration has changed.

reason: The GUID {23bb1328-63de-4293-915b-a6a23d929acb}.

detail: A GUID provided by the printer driver excluding the GUID {ec8f261f-267c-469f-b5d6-3933023c29cc} which is reserved.

The Envelope element contains one or more Schema elements (section 2.2.8.1.2), each of which represents one of the configuration changes.

<2> Section 2.2.7.2.1: For all Windows versions, the function signature of the method specified by the **entrypoint** attribute is as follows.

```
void entrypoint(void * data);
```

data: The data from the action element.

Windows clients load the file indicated by the **dll** attribute as a dynamic linked library and call the method in the library indicated by the **entrypoint** attribute, passing in data by using the *data* parameter.

<3> Section 2.2.7.5.1: For all Windows versions, the function signature of the method specified by the **entrypoint** attribute varies depending on the **bidirectional** attribute value, as shown in the following table.

bidirectional value	Method prototype
"true"	void * entrypoint (void * data);
"false"	void entrypoint (void * data);

data: The data from the customUI element.

Windows clients load the file indicated by the **dll** attribute as a dynamic linked library and call the method in the library indicated by the **entrypoint** attribute, passing in data by using the *data* parameter.

<4> Section 2.2.7.7.1: For all Windows versions, the function signature of the method specified by the **entrypoint** attribute depends on the **bidirectional** attribute value as shown in the following table.

bidirectional value	Method prototype
"true"	void * entrypoint (void * <i>data</i>)
"false"	void entrypoint (void * <i>data</i>)

data: The data from the customData element.

Windows clients load the file indicated by the **dll** attribute as a dynamic linked library and call the method in the library indicated by the **entrypoint** attribute, passing in data by using the *data* parameter.

<5> Section 2.2.8.1.2: In Windows, these attributes correspond to printer attributes in the bidirectional communications schema. This schema is a hierarchy of printer attributes, some of which are properties, and the rest are values or value entries. Bidirectional communications interfaces are implemented by printer-specific components. A detailed description of printer drivers and the bidirectional communications schema can be found in [MSDN-MPD] and [MSDN-BIDI].

<6> Section 2.2.8.1.10: In Windows, these attributes correspond to printer attributes in the bidirectional communications schema. This schema is a hierarchy of printer attributes, some of which

are properties, and the rest are values or value entries. Bidirectional communications interfaces are implemented by printer-specific components. A detailed description of printer drivers and the bidirectional communications schema can be found in [MSDN-MPD] and [MSDN-BIDI].

<7> Section 3.1.1.4: Opnums reserved for local use apply to Windows as follows.

opnum	Description
2	Not used by Windows.

<8> Section 3.1.1.4.3: When a local client directly calls the local API equivalent of IRPCAsyncNotify_GetNewChannel (CreatePrintAsyncNotifyChannel as described in [MSDN-ASYNC]) without a prior successful call to IRPCAsyncNotify_RegisterClient using the same PRPCREMOTEOBJECT value, the local server fails the call immediately and returns the HRESULT error value ([MS-ERREF] section 2.1.1) 0x8004000D. This action is not supported on Windows XP or Windows Server 2003.

<9> Section 3.1.1.4.3: When a local client directly calls the local API equivalent of IRPCAsyncNotify_GetNewChannel (CreatePrintAsyncNotifyChannel as described in [MSDN-ASYNC]) following a prior call to IRPCAsyncNotify_UnregisterClient using the same PRPCREMOTEOBJECT value, the server fails the call immediately and returns the HRESULT error value ([MS-ERREF] section 2.1.1) 0x8004000E. This action is not supported on Windows XP or Windows Server 2003.

<10> Section 3.1.1.4.5: For all Windows versions, the server by default limits the number of buffered unidirectional notifications to 100.

The default limit of 100 can be changed by creating a REG_DWORD value in the registry at HKEY_LOCAL_MACHINE\Software\Policies\Microsoft\Windows NT\Printers\InternalQueueSizeForUniDiChannel and setting this value to the desired limit for the number of buffered unidirectional notifications. This action is not supported on Windows XP, Windows Server 2003, Windows Vista, or Windows Server 2008.

<11> Section 3.1.1.4.6: When a local client directly calls the local API equivalent of IRPCAsyncNotify_CloseChannel (IPrintAsyncNotifyChannel::CloseChannel as described in [MSDN-ASYNC]) following a successful return from IRPCAsyncNotify_GetNotificationSendResponse with a NULL value returned for the *pChannel* parameter, or following a prior successful return from IRPCAsyncNotify_CloseChannel, the server fails the call immediately and returns the HRESULT error value ([MS-ERREF] section 2.1.1) 0x80040008. This action is not supported on Windows XP or Windows Server 2003.

8 Change Tracking

This section identifies changes that were made to this document since the last release. Changes are classified as Major, Minor, or None.

The revision class **Major** means that the technical content in the document was significantly revised. Major changes affect protocol interoperability or implementation. Examples of major changes are:

- A document revision that incorporates changes to interoperability requirements.
- A document revision that captures changes to protocol functionality.

The revision class **Minor** means that the meaning of the technical content was clarified. Minor changes do not affect protocol interoperability or implementation. Examples of minor changes are updates to clarify ambiguity at the sentence, paragraph, or table level.

The revision class **None** means that no new technical changes were introduced. Minor editorial and formatting changes may have been made, but the relevant technical content is identical to the last released version.

The changes made to this document are listed in the following table. For more information, please contact dochelp@microsoft.com.

Section	Description	Revision class
7 Appendix B: Product Behavior	Updated for this version of Windows Client.	Major

9 Index

A

- Abstract data model
 - client
 - AsyncUI 70
 - IRPCAsyncNotify 68
 - IRPCRemoteObject 64
 - printer configuration 74
 - server
 - AsyncUI 60
 - IRPCAsyncNotify 45
 - IRPCRemoteObject 59
 - printer configuration 63
- Applicability 16
- AsyncUI
 - default resource file string resources 20
 - elements - common 25
 - interface
 - client 69
 - server 60
 - notification
 - bidirectional communication mode example 79
 - unidirectional communication mode example 77
 - XML notification and response formats
 - elements - common 25
 - overview 24
- Asyncui notification in bidirectional communication mode example 79
- Asyncui notification in unidirectional communication mode example 77
- AsyncUIBalloon Notification method 71
- AsyncUIBalloon string 30
- AsyncUICustomData Notification method 73
- AsyncUICustomData string 38
- AsyncUICustomUI Notification method 72
- AsyncUICustomUI string 36
- AsyncUICustomUIReply string 37
- AsyncUIMessageBox Notification method 72
- AsyncUIMessageBox string 32
- AsyncUIMessageBoxUIReply string 35

B

- Bidirectional communication mode example 78

C

- Capability negotiation 16
- Change tracking 87
- Client
 - AsyncUI
 - abstract data model 70
 - initialization 71
 - interface 69
 - local events 74
 - message processing 71
 - overview 69
 - sequencing rules 71
 - timer events 74
 - timers 70
 - AsyncUIBalloon Notification method 71
 - AsyncUICustomData Notification method 73
 - AsyncUICustomUI Notification method 72

- AsyncUIMessageBox Notification method 72
- IRPCAsyncNotify
 - abstract data model 68
 - initialization 69
 - interface 65
 - local events 69
 - message processing 69
 - overview 65
 - sequencing rules 69
 - timer events 69
 - timers 68
- IRPCRemoteObject
 - abstract data model 64
 - initialization 65
 - local events 65
 - message processing 65
 - sequencing rules 65
 - timer events 65
 - timers 65
- printer configuration
 - abstract data model 74
 - initialization 74
 - local events 75
 - message processing 75
 - overview 74
 - sequencing rules 75
 - timer events 75
 - timers 74
- printer configuration interface 74
- Printer Configuration Notification method 75
- Common data types 18

D

- Data model - abstract
 - client
 - AsyncUI 70
 - IRPCAsyncNotify 68
 - IRPCRemoteObject 64
 - printer configuration 74
 - server
 - AsyncUI 60
 - IRPCAsyncNotify 45
 - IRPCRemoteObject 59
 - printer configuration 63
- Data types
 - common 18
 - common - overview 18
 - PNOTIFYOBJECT 20
 - PrintAsyncNotificationType 18
 - PRPCREMOTEOBJECT 19

E

- Enumerations
 - PrintAsyncNotifyConversationStyle 19
 - PrintAsyncNotifyUserFilter 19
- Events
 - local
 - client
 - AsyncUI 74
 - IRPCAsyncNotify 69
 - IRPCRemoteObject 65
 - printer configuration 75
 - server

- AsyncUI 62
 - IRPCAsyncNotify 57
 - IRPCRemoteObject 60
 - printer configuration 64
- timer
 - client
 - AsyncUI 74
 - IRPCAsyncNotify 69
 - IRPCRemoteObject 65
 - printer configuration 75
 - server
 - AsyncUI 62
 - IRPCAsyncNotify 57
 - IRPCRemoteObject 60
 - printer configuration 64
- Examples
 - AsyncUI notification
 - bidirectional communication mode 79
 - unidirectional communication mode 77
 - asyncai notification in bidirectional communication mode 79
 - asyncai notification in unidirectional communication mode 77
 - bidirectional communication mode 78
 - unidirectional communication mode 76

F

- Fields - vendor-extensible 16
- Full IDL 82

G

- Glossary 8

I

- IDL 82
- Implementer - security considerations 81
- Index of security parameters 81
- Informative references 13
- Initialization
 - client
 - AsyncUI 71
 - IRPCAsyncNotify 69
 - IRPCRemoteObject 65
 - printer configuration 74
 - server
 - AsyncUI 61
 - IRPCAsyncNotify 46
 - IRPCRemoteObject 59
 - printer configuration 63
- Interfaces
 - client
 - AsyncUI 69
 - IRPCAsyncNotify 65
 - printer configuration 74
 - server
 - AsyncUI 60
 - printer configuration 63
- Introduction 8
- IRPCAsyncNotify interface
 - client 65
- IRPCAsyncNotify_CloseChannel (Opnum 6) method (section 3.1.1.4.6 56, section 3.1.3.4.4 62)
- IRPCAsyncNotify_CloseChannel method 56
- IRPCAsyncNotify_GetNewChannel (Opnum 3) method 50
- IRPCAsyncNotify_GetNewChannel method 50

IRPCAsyncNotify_GetNotification (Opnum 5) method (section 3.1.1.4.5 54, section 3.1.3.4.3 62, section 3.1.4.4.2 64)
IRPCAsyncNotify_GetNotification method 54
IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4) method (section 3.1.1.4.4 52, section 3.1.3.4.2 61)
IRPCAsyncNotify_GetNotificationSendResponse method 52
IRPCAsyncNotify_RegisterClient (Opnum 0) method (section 3.1.1.4.1 47, section 3.1.3.4.1 61, section 3.1.4.4.1 64)
IRPCAsyncNotify_RegisterClient method 47
IRPCAsyncNotify_UnregisterClient (Opnum 1) method 50
IRPCAsyncNotify_UnregisterClient method 50
IRPCRemoteObject_Create (Opnum 0) method 59
IRPCRemoteObject_Create method 59
IRPCRemoteObject_Delete (Opnum 1) method 60
IRPCRemoteObject_Delete method 60

L

Local events

client

- AsyncUI 74
- IRPCAsyncNotify 69
- IRPCRemoteObject 65
- printer configuration 75

server

- AsyncUI 62
- IRPCAsyncNotify 57
- IRPCRemoteObject 60
- printer configuration 64

M

Message processing

client

- AsyncUI 71
- IRPCAsyncNotify 69
- IRPCRemoteObject 65
- printer configuration 75

server

- AsyncUI 61
- IRPCAsyncNotify 47
- IRPCRemoteObject 59
- printer configuration 63

Messages

AsyncUI

- default resource file string resources 20
- elements - common 25
- XML notification and response formats 24

AsyncUIBalloon string 30

AsyncUICustomData string 38

AsyncUICustomUI string 36

AsyncUICustomUIReply string 37

AsyncUIMessageBox string 32

AsyncUIMessageBoxUIReply string 35

common data types 18

PNOTIFYOBJECT data type 20

PrintAsyncNotificationType data type 18

PrintAsyncNotifyConversationStyle enumeration 19

PrintAsyncNotifyUserFilter enumeration 19

PRPCREMOTEOBJECT data type 19

transport 18

Methods

AsyncUIBalloon Notification 71

AsyncUICustomData Notification 73

AsyncUICustomUI Notification 72

AsyncUIMessageBox Notification 72

- IRPCAsyncNotify_CloseChannel (Opnum 6) (section 3.1.1.4.6 56, section 3.1.3.4.4 62)
- IRPCAsyncNotify_GetNewChannel (Opnum 3) 50
- IRPCAsyncNotify_GetNotification (Opnum 5) (section 3.1.1.4.5 54, section 3.1.3.4.3 62, section 3.1.4.4.2 64)
- IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4) (section 3.1.1.4.4 52, section 3.1.3.4.2 61)
- IRPCAsyncNotify_RegisterClient (Opnum 0) (section 3.1.1.4.1 47, section 3.1.3.4.1 61, section 3.1.4.4.1 64)
- IRPCAsyncNotify_UnregisterClient (Opnum 1) 50
- IRPCRemoteObject_Create (Opnum 0) 59
- IRPCRemoteObject_Delete (Opnum 1) 60
- Printer Configuration Notification 75

N

- Normative references 12
- Notification and response formats - AsyncUI XML - overview 24

O

- Overview (synopsis) 13

P

- Parameters - security index 81
- PNOTIFYOBJECT data type 20
- Preconditions 15
- Prerequisites 15
- PrintAsyncNotificationType data type 18
- PrintAsyncNotifyConversationStyle enumeration 19
- PrintAsyncNotifyUserFilter enumeration 19
- Printer configuration interface
 - client 74
 - server 63
- Printer Configuration Notification method 75
- Product behavior 84
- Protocol Details
 - overview 43
- PRPCREMOTEOBJECT data type 19

R

- References 12
 - informative 13
 - normative 12
- Relationship to other protocols 15

S

- Security
 - implementer considerations 81
 - parameter index 81
- Sequencing rules
 - client
 - AsyncUI 71
 - IRPCAsyncNotify 69
 - IRPCRemoteObject 65
 - printer configuration 75
 - server
 - AsyncUI 61
 - IRPCAsyncNotify 47
 - IRPCRemoteObject 59
 - printer configuration 63
- Server
 - AsyncUI
 - abstract data model 60
 - initialization 61

- interface 60
- local events 62
- message processing 61
- overview 60
- sequencing rules 61
- timer events 62
- timers 60
- IRPCAsyncNotify
 - abstract data model 45
 - initialization 46
 - local events 57
 - message processing 47
 - sequencing rules 47
 - timer events 57
 - timers 46
- IRPCAsyncNotify_CloseChannel (Opnum 6) method (section 3.1.1.4.6 56, section 3.1.3.4.4 62)
- IRPCAsyncNotify_GetNewChannel (Opnum 3) method 50
- IRPCAsyncNotify_GetNotification (Opnum 5) method (section 3.1.1.4.5 54, section 3.1.3.4.3 62, section 3.1.4.4.2 64)
- IRPCAsyncNotify_GetNotificationSendResponse (Opnum 4) method (section 3.1.1.4.4 52, section 3.1.3.4.2 61)
- IRPCAsyncNotify_RegisterClient (Opnum 0) method (section 3.1.1.4.1 47, section 3.1.3.4.1 61, section 3.1.4.4.1 64)
- IRPCAsyncNotify_UnregisterClient (Opnum 1) method 50
- IRPCRemoteObject
 - abstract data model 59
 - initialization 59
 - local events 60
 - message processing 59
 - sequencing rules 59
 - timer events 60
 - timers 59
- IRPCRemoteObject_Create (Opnum 0) method 59
- IRPCRemoteObject_Delete (Opnum 1) method 60
- printer configuration
 - abstract data model 63
 - initialization 63
 - interface 63
 - local events 64
 - message processing 63
 - overview 63
 - sequencing rules 63
 - timer events 64
 - timers 63
- Standards assignments 17
- Strings
 - AsyncUIBalloon 30
 - AsyncUICustomData 38
 - AsyncUICustomUI 36
 - AsyncUICustomUIReply 37
 - AsyncUIMessageBox 32
 - AsyncUIMessageBoxUIReply 35
 - resources - AsyncUI default resource file 20

T

- Timer events
 - client
 - AsyncUI 74
 - IRPCAsyncNotify 69
 - IRPCRemoteObject 65
 - printer configuration 75
 - server
 - AsyncUI 62
 - IRPCAsyncNotify 57
 - IRPCRemoteObject 60

- printer configuration 64
- Timers
 - client
 - AsyncUI 70
 - IRPCAsyncNotify 68
 - IRPCRemoteObject 65
 - printer configuration 74
 - server
 - AsyncUI 60
 - IRPCAsyncNotify 46
 - IRPCRemoteObject 59
 - printer configuration 63
- Tracking changes 87
- Transport 18

U

- Unidirectional communication mode example 76

V

- Vendor-extensible fields 16
- Versioning 16