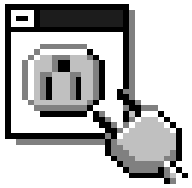
Windows Sockets 2 Application Programming Interface

An Interface for Transparent Network Programming
Under Microsoft Windows™

Revision 2.0.6
February 1, 1995



Winsock 2

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1. Introduction

The Windows Sockets 2 specification is a superset of the widely deployed Windows Sockets 1.1 interface. While maintaining full backwards compatibility it extends the Winsock interface in a number of areas including

- Access to protocols other than TCP/IP: Winsock 2 allows an application to use the familiar socket interface to achieve simultaneous access to any number of installed transport protocols.
- Protocol-independent name resolution facilities: Winsock 2 includes a standardized set of APIs for querying and working with the myriad of name resolution domains that exist today (e.g. DNS, SAP, X.500, etc.)
- Overlapped I/O: following the model established in Win32 environments, Winsock 2 incorporates the overlapped paradigm for socket I/O.
- Quality of service: Winsock 2 establishes conventions for applications to negotiate required service levels for parameters such as bandwidth and latency. Other QOS-related enhancements include socket grouping and prioritization, and mechanisms for network-specific QOS extensions.
- Other frequently requested extensions: shared sockets, conditional acceptance, exchange of user data at connection setup/teardown time, protocol-specific extension mechanisms.

1.1 Intended Audience

This document is targeted at persons who are familiar with the sockets network programming paradigm in general and, to a lesser degree, the Windows Sockets version 1.1 interface in particular. Please see appendix B for an introduction to Winsock programming.

Persons who are interested in developing applications that will take advantage of Winsock 2's capabilities will be primarily interested in this API specification. Persons who are interested in making a particular transport protocol available under the Winsock 2 interface will need to be familiar with the Winsock 2 Service Provider Interface Specification as well. That document exists under separate cover.

1.2 Status of This Specification

This document comprises only the API portion of the Winsock 2 specification. The Winsock Forum's Generic API Extensions group, chaired by David Andersen of the Intel Architecture Labs has responsibility for producing and updating this document. The companion SPI specification is being produced by the Operating Framework group, chaired by Keith Moore of Microsoft Corporation. Constructive comments and feedback on this material are being actively solicited and should be directed towards the principle authors as shown below:

API Specification
David B. Andersen
Intel Architecture Labs
david_b_andersen@ccm.jf.intel.com

SPI Specification
Keith Moore
Microsoft Corporation
keithmo@microsoft.com

At the time of this writing, there are a number of open issues that have not been resolved. These are summarized in Appendix C.

1.3 Document Version Conventions

Starting with this release, the API and SPI documents have adopted a 3-part revision identification system. Each revision of the document will be clearly labelled with a release date and a revision identifier such as *X.Y.Z* where:

X is the *major version* of the Winsock specification (currently version 2)

Y is a *major revision* identifier that is incremented each time changes are made that impact binary compatibility with the previous spec revision (e.g. changes in a function's parameter list or new functions being added)

Z is a *minor revision* indicator that is incremented when wording changes or clarifications have been made which do not impact binary compatability with a previous revision.

Note that the draft versions of the API and SPI specs distributed at the Dec 12, 1994 Winsock meeting did **not** follow these numbering conventions. Also note that gaps in the minor revision indicator (*Z*) between successive releases of a document are not unusal, especially during the early stages of a document's life when many changes are occuring.

Until such time as the API and SPI specifications have stabilized to the point where the Winsock community is ready to undertake implementations of compliant applications and transport providers, successive releases of the specifications will only increment the *minor revision* indicator, even though this will often involve changes which **would** impact binary compatability if the specification were fully implemented.

1.4 New And/Or Different in Version 2.0.6

As a result of feedback received on the previous specification release, and in keeping with what appears to be consensus positions emerging from discussions on the mailing lists, version 2.0.6 incorporates the following changes:

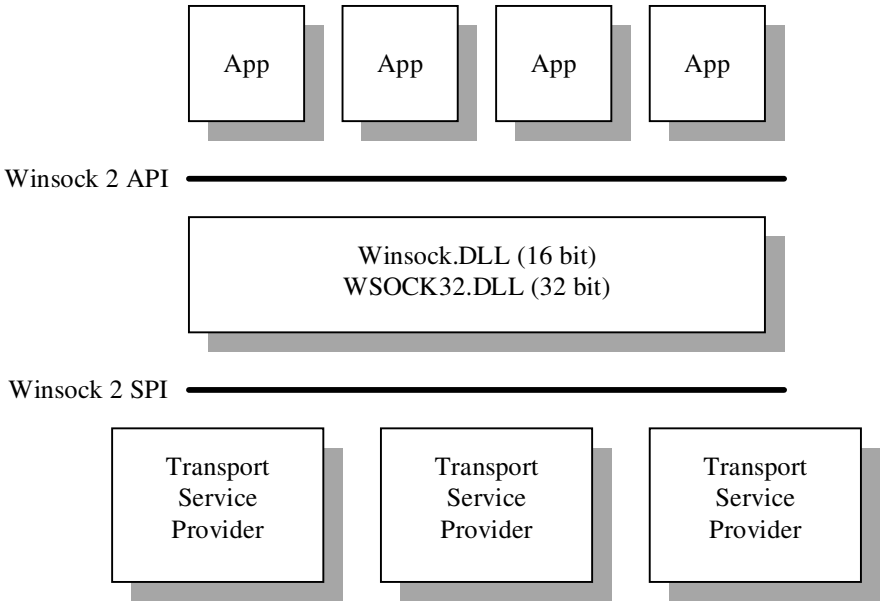
1. Scatter/Gather I/O is now available through **WSASend(), WSASendTo(), WSARecv()** and **WSARecvFrom().**
2. Clarified a number of points regarding overlapped I/O functionality.
3. Added an overlapped-capable ioctl function: **WSAIoctl()**.
4. Clarified the definition of a constrained socket group: members must be connected to the same address on the same host.
5. Changed the semantics of the FD_QOS and FD_GROUP_QOS indications from level to edge triggered.
6. Moved the creation of socket groups from the WSAConnect() function to the WSASocket() function so that grouping can be applied to both connection-oriented and connectionless sockets.
7. Revised and updated the quality of service (QOS) description.
8. Introduced four WSAIoctl() opcodes for quality of service, retired socket options SO_QOS and SO_GROUP_QOS.
9. Indicated that the MSG_PARTIAL flag can be received when using **WSARecv()** and **WSARecvFrom()**.
10. Corrected numerous typos and grammatical errors (and probably created at least as many new ones).
11. Updated the Open Issues list in appendix C.

2. Summary of New Concepts, Additions and Changes

The paragraphs that follow summarize the major changes and additions in going from Winsock 1.1 to Winsock 2. For detailed information about how to use a specific function or feature, please refer to the appropriate API description(s) in section 3.

2.1 Simultaneous Access to Multiple Transport Protocols

Winsock 2 provides simultaneous access to multiple transport protocols by changing the Winsock architecture. With Winsock 1.1, the DLL which implements the Winsock interface is supplied by the vendor of the TCP/IP protocol stack. The interface between the Winsock DLL and the underlying stack was both unique and proprietary. Winsock 2 changes the model by defining a standard interface between the Winsock DLL and protocol stacks. This makes it possible for multiple stacks from multiple vendors to be accessed simultaneously from a single Winsock DLL. Furthermore, Winsock 2 support is not limited to TCP/IP protocol stacks as is the case for Winsock 1.1. The Winsock 2 architecture (which is WOSA compliant) is illustrated as follows:



Note: 16 bit applications utilize Winsock.DLL, 32 bit applications use WSOCK32., but hereafter, for simplicity's sake both will be referred to simply as Winsock.DLL. This is reasonable since there are **no** syntactic differences between the two.

With the above architecture, it is no longer necessary (or even desirable) for each stack vendor to supply their own implementation of Winsock.DLL, since a single Winsock.DLL must work across all stacks. The Winsock DLL should thus be viewed in the same light as an operating system component. Microsoft has committed to create a Winsock.DLL for Winsock 2 which will be freely available for both Windows 95 and Windows NT operating systems. Intel Corporation has expressed a willingness to produce a Winsock 2 compliant Winsock.DLL for Windows 3.1 and Windows 3.11 environments, provided that sufficient demand is evidenced. Please refer to Appendix C for a discussion of open issues surrounding the development and source control of these DLLs.

2.2 Backwards Compatibility For Winsock 1.1 Applications

Even though the underlying Winsock architecture has changed, this will be invisible to existing applications that use Winsock 1.1. Version 2 of Winsock.DLL will be completely backwards compatible

with version 1.1, assuming that at least one TCP/IP stack has been installed on the system and registered with Winsock 2. In the WSAStartup() sequence, a Winsock 1.1 app will ask for version 1.1. The Winsock 2 compliant DLL will cheerfully agree since all of the Winsock 1.1 semantics are retained in Winsock 2. The new Winsock DLL does not need to modify its behavior (other than returning the desired version number in the WSAData structure) regardless of whether version 1.1 or version 2 is requested by an application, as only Winsock 2 applications will know how to make use of the added functionality that is present.

Winsock 1.1 applications currently use certain elements from the **WSAData** structure (obtained via a call to **WSAStartup()**) to obtain information about the underlying TCP/IP stack.. These include: *iMaxSockets, iMaxUdpDg,* and *lpVendorInfo*. While Winsock 2 applications will know to ignore these values (since they cannot uniformly apply to all available protocol stacks), meaningful values must of course still be supplied to avoid breaking Winsock 1.1 applications. The information supplied will be obtained from (and hence only be applicable to) the "default" TCP/IP stack. The method for designating the default TCP/IP stack is TBD.

2.3 Making Transport Protocols Available To Winsock

In order for a transport protocol to be accessible via Winsock it must be properly installed on the system and registered with Winsock. The version 2 Winsock.DLL will export a set of APIs which perform the registration process. These include creating a new registration and removing an existing one. When new registrations are created the caller (presumed to be the stack vendor's installation script) supplies one or more filled in PROTOCOL_INFO structs which contain a complete set of information about the protocol. Please refer to the SPI document for details on how this is accomplished. Note that transport stacks that are thus installed are considered to be Winsock service providers, and in this document are frequently referred to as such

2.3.1 Using Multiple Protocols

An application may use **WSAEnumProtocols()** to discover which transport protocols are present and obtain information about each as contained in the associated PROTOCOL_INFO struct. In most instances, there will be a single PROTOCOL_INFO struct for each protocol. Some protocols however, are able to exhibit multiple behaviors. For example the SPX protocol is message-oriented (i.e. the sender's message boundaries are preserved by the network), but the receiving end may choose to ignore these message boundaries and treat the socket as a byte stream. Thus there could reasonably be two different PROTOCOL_INFO struct entries for SPX, one for each of these behaviors.

Whereas in Winsock 1 there is a single address family (AF_INET) comprising a small number of well-known socket types and protocol identifiers, the focus will shift for Winsock 2. The existing address family, socket type and protocol identifiers will be retained for compatibility reasons, but many new address family, socket type and protocol values are expected to appear which are unique but not necessarily well known. Not being well known need not pose a problem since applications that desire to be protocol-independent are encouraged to select protocols for use on the basis of their suitability rather than the particular values assigned to their *socket_type* or *protocol* fields. Protocol suitability is indicated by the communications attributes (e.g. message vs. byte-stream oriented, reliable vs. unreliable, etc.) contained within the protocol's PROTOCOL_INFO struct. Selecting protocols on the basis of suitability as opposed to well-known protocol names and socket types allows protocol-independent applications to take advantage of new transport protocols and their associated media types as they become available.

In terms of the well-known client/server paradigm, the server half of a client/server application will benefit by establishing listening sockets on all suitable transport protocols. The client, then, may establish its connection using any suitable protocol. This would enable, for example, a client application to be unmodified whether it was running on a desktop system connected via LAN or on a laptop using a wireless network.

It is planned that a Winsock 2 clearinghouse be established for protocol stack vendors to obtain unique identifiers for new address families, socket types and protocols. FTP and world-wide web servers will supply current identifier/value mappings, and an email procedure will be used to request allocation of new ones.

2.3.2 Multiple Provider Restrictions on select()

In Winsock 2 the FD_SET supplied to the select() function will be constrained to contain sockets associated with a single service provider. This does not in any way restrict an application from having multiple sockets open using multiple providers. When non-blocking operations are preferred the WSAAsyncSelect() function is the solution. Since it takes a socket descriptor as an input parameter, it doesn't matter what provider is associated with the socket. When an application needs to use blocking semantics on a set of sockets that spans multiple providers, the recommended solution is to use **WSAWaitForMultipleEvents()**. The application may also choose to take advantage of the **WSAEventSelect()** function which allows the FD_XXX network events to be associated with an event object and handled from within the event object paradigm (described below).

2.4 Protocol Independent Name Resolution

Winsock 2 will include APIs that standardize the way applications access and use the various network naming services. Thus an application will not need to be cognizant of the widely differing interfaces associated with name services such as DNS, NIS, X.500, SAP, etc. Details on these APIs are not included in this specification at this time, and will be supplied at a later date by the Winsock Forum's Name Resolution functionality group.

2.5 Overlapped I/O and Event Objects

Winsock 2 introduces overlapped (or asynchronous) I/O and requires that all transport providers support this capability. Overlapped I/O can be performed only on sockets that were created via the **WSASocket()** function with the WSA_FLAG_OVERLAPPED flag set, and will follow the model established in Win32.

For receiving, applications use **WSARecv()** or **WSARecvFrom()** to supply buffers into which data is to be received. If one or more buffers are posted prior to the time when data has been received by the network, it is possible that data will be placed into the user's buffers immediately as it arrives and thereby avoid the copy operation that would otherwise occur at the time the **recv()** or **recvfrom()** function is invoked. If data is already present when receive buffers are posted, it is copied immediately into the user's buffers. If data arrives when no receive buffers have been posted by the application, the network resorts to the familiar synchronous style of operation where the incoming data is buffered internally until such time as the application issues a receive call and thereby supplies a buffer into which the data may be copied. An exception to this would be if the application used setsockopt() to set the size of the receive buffer to zero. In this instance, reliable protocols would only allow data to be received when application buffers had been posted, and data on unreliable protocols would be lost.

On the sending side, applications use **WSASend()** or **WSASendTo()** to supply pointers to filled buffers and then agree to not disturb the buffers in any way until such time as the network has consumed the buffer's contents.

Overlapped send and receive calls return immediately. A return value of zero indicates that the I/O operation completed immediately and that the corresponding completion indication has already occurred. A return value of SOCKET_ERROR coupled with an error code of WSA_IO_PENDING indicates that the overlapped operation has been successfully initiated and that a subsequent indication will be provided when send buffers have been consumed or when receive buffers are full. Any other error code

indicates that the overlapped operation was not successfully initiated and that no completion indication will be forthcoming.

Both send and receive operations can be overlapped. The receive functions may be invoked multiple times to post receive buffers in preparation for incoming data, and the send functions may be invoked multiple times to queue up multiple buffers to be sent. Note that while the application can rely upon a series of overlapped send buffers being sent in the order supplied, the corresponding completion indications may occur in a different order. Likewise, on the receiving side, buffers will be filled in the order they are supplied but the completion indications may occur in a different order.

2.5.1 Event Objects as an Underpinning for Completion Indication

Introducing overlapped I/O requires a mechanism for applications to unambiguously associate send and receive requests with their subsequent completion indications. In Winsock 2 this is accomplished via event objects which are modeled after Win32 events. Applications use **WSACreateEvent ()** to obtain an event object handle which may then be supplied as a required parameter to the overlapped versions of send and receive calls (**WSASend(), WSASendTo(), WSARecv(), WSARecvFrom()**). The event object, which is cleared when first created, is set by the network when the associated overlapped I/O operation has completed (either successfully or with errors).

In order to provide applications with appropriate levels of flexibility, several options are available for receiving completion indications. These include: waiting on (i.e. blocking on) event objects, polling event objects, and socket I/O completion routines.

Blocking and waiting for Completion Indication -
Applications may also choose to block while waiting for one or more event objects to become set using **WSAWaitForMultipleEvents()**. In Win16 implementations, this will utilize a blocking hook as is currently provided for standard blocking socket operations. In Win32 implementations, the process or thread will be truly blocked. Since Winsock 2 event objects are implemented as Win32 events, the native Win32 function **WaitForMultipleObjects()** may also be used for this purpose. This is especially useful if the thread needs to wait on both socket and non-socket events.
Polling for Completion Indication -
Applications that prefer not to block may use **WSAGetOverlappedResults()** to poll for the completion status associated with any particular event object. This function indicates whether or not the overlapped operation has completed, and, if completed, arranges for **WSAGetLastError()** to retrieve the error status of the overlapped operation.

Using socket I/O completion routines -
The functions used to initiate overlapped I/O (**WSASend, WSASendTo, WSARecv, WSARecvFrom**) all take *lpCompletionRoutine* as an input parameter. This is a pointer to an application-specified function that is called when the overlapped I/O operation has completed (successfully or otherwise).

In Win16 environments, callback functions may be invoked in a preemptive VMM context which is sometimes referred to as an interrupt context. Applications transmitting time-sensitive data (e.g. video and audio) benefit by being able to receive such indications in this low latency, preemptive manner, but must be aware that in this special context a very limited set of runtime and Windows library functions can be safely made. As a rule, an application should confine itself to the same set of runtime functions that the Windows documentation indicates may safely be called during a multimedia timer callback function.

In Windows 95 and NT, the completion function follows the same rules as stipulated for Win32 file I/O completion routines. The completion function will not be invoked until the thread is in an alertable wait state such as can occur when the function **WSAWaitForMultipleEvents()** is invoked.

In all environments, transports do allow an application to invoke send and receive operations from within the context of the socket I/O completion function, and guarantee that, for a given socket, I/O completion functions will not be nested. This permits time-sensitive data transmissions to occur entirely within a preemptive context.

2.5.2 WSAOVERLAPPED Details

The **WSAOVERLAPPED** structure provides a communication medium between the initation of an overlapped I/O operation and its subsequent completion. The **WSAOVERLAPPED** structure is designed to be compatible with the Win32 **OVERLAPPED** structure:

```
typedef struct _WSAOVERLAPPED {
      DWORD       Internal;          // reserved
      DWORD       InternalHigh;      // reserved
      DWORD       Offset;            // ignored
      DWORD       OffsetHigh;        // ignored
      WSAEVENT    hEvent;
} WSAOVERLAPPED, LPWSAOVERLAPPED;
```

Internal — This reserved field is used internally by the entity that implements overlapped I/O. For service providers that create sockets as “real” file handles, this field is used by the underlying operating system. Other service providers (those that create pseudo handles) are free to use this field as necessary.

InternalHigh — This reserved field is used internally by the entity that implements overlapped I/O. For service providers that create sockets as “real” file handles, this field is used by the underlying operating system. Other service providers (those that create pseudo handles) are free to use this field as necessary.

Offset — Since sockets do not have the concept of a file offset, applications are free to use this field as necessary.

OffsetHigh — Since sockets do not have the concept of a file offset, applications are free to use this field as necessary.

hEvent — If an overlapped I/O operation is issued without an I/O completion routine (*lpCompletionRoutine* is NULL), then this field must contain a valid handle to a **WSAEVENT** object. Otherwise (*lpCompletionRoutine* is non-NULL) then applications are free to use this field as necessary.

2.6 Quality of Service

The basic QOS mechanism in Winsock 2 descends from the flow specification (or "flow spec") as described by Craig Partridge in RFC 1363, dated September 1992. A brief overview of this concept is as follows:

Flow specs describe a set of characteristics about a proposed unidirectional flow through the network. An application may associate a pair of flowspecs with a socket at any time using **WSAIoctl**() or at the time a connection request is made using **WSAConnect**(). Flowspecs indicate parametrically what level of

service is required. For connectionless protocols, **WSAIoctl**() is used to stipulate the initial QOS request, and any subsequent QOS renegotiations. For connection-oriented protocols, when a connection request is made, the application can use the QOS currently associated with the socket (either the default QOS defined below, or the QOS set by the latest **WSAIoctl**()), or override it by specifying QOS in **WSAConnect**(). After the connection has been setup, **WSAIoctl**() can also be used for QOS renegotiations. If the service requested is not available, the application may close the socket or take whatever action is appropriate (e.g. scale back and ask for a lower quality of service, try again later, notify the user and exit, etc.)

Even after a flow is established, conditions in the network may change or one of the communicating parties may invoke a QOS renegotiation which results in a reduction (or increase) in the available service level. A notification mechanism is included which utilizes the usual Winsock2 notification techniques (FD_QOS and FD_GROUP_QOS events) to indicate to the application that QOS levels have changed. The application should use **WSAIoctl()** with SIO_GET_QOS and/or SIO_GET_GROUP_QOS to retrieve the corresponding flow specs and examine them in order to discover what aspect of the service level has changed. If the updated level of service is not acceptable, the application may adjust itself to accommodate it, attempt to renogotiate QOS, or close the socket.

The flow specs proposed for Winsock 2 divide QoS characteristics into the following general areas:

1. Source Traffic Description - The manner in which the application's traffic will be injected into the network. This includes specifications for the token rate, the token bucket size, and the peak bandwidth. Note that the bandwidth requirement is expressed in terms of a token rate does not mean that hosts must implement token buckets. Any traffic management scheme that yields equivalent behavior is permitted.

2. Latency - Upper limits on the amount of delay and delay variation that are acceptable.

3. Level of service guarantee - Whether or not an absolute guarantee is required as opposed to best effort. Note that providers which have no feasible way to provide the level of service requested are expected to fail the connection attempt.

4. Cost - This is a place holder for a future time when a meaningful cost metric can be determined.

5. Provider-specific parameters - The flowspec itself can be extended in ways that are particular to specific providers.

2.6.1 The Flow Spec Structures

The Winsock 2 QOS structure is defined in Winsock.h and is reproduced here.

```
typedef enum
{
    BestEffortService,
    PredictiveService,
    GuaranteedService
} GUARANTEE;

typedef struct _flowspec
{
    int32       TokenRate;          // In Bytes/sec
    int32       TokenSize;          // In Bytes
    int32       PeakBandwidth;      // In Bytes/sec
    int32       Latency;            // In microseconds
    int32       DelayVariation;     // In microseconds
```

```
    GUARANTEE   LevelOfGuarantee;       // Guaranteed, Predictive or Best Effort
    int32       CostOfCall;             // Reserved for future use, must be set to 0 now
} FLOWSPEC, FAR *LPFLOWSPEC;

typedef struct _QualityOfService
{
    WSABUF      SendingFlowspec;        // the flow spec for data sending
    WSABUF      ReceivingFlowspec;      // the flow spec for data receiving
} QOS, FAR * LPQOS;
```

Note that the first part of the memory block pointed by *SendingFlowspec.buf* or *ReceivingFlowspec.buf* is the FLOWSPEC structure, optionally followed by any service provider specific portion. Thus, *SendingFlowspec.len* and *ReceivingFlowspec.len* must be larger than or equal to sizeof(FLOWSPEC). In the case of RSVP, the service specific portion is expected to include a structure containing the following information at minimum:

```
struct {
    IpAddress source_address;
    IpAddress dest_address;
    uint16 next_level_protocol;
    udpPort source_port;
    udpPort dest_port;
} ip_params;
```

Definitions:

LevelOfGuarantee This is the level of service being negotiated for. Three levels of service are defined: Guaranteed, Predictive, and Best Effort.

The reason for defining both predictive and guaranteed service is that predictive services may achieve substantially better performance given the same level of network resource usage, while guaranteed service provides the mathematical level of certainty needed by selected applications. Specific providers may implement none, one, or both of these services.

Best effort service is just a hint to the service provider and should be always supported.

GuaranteedService A service provider supporting guaranteed service implements a queuing algorithm which isolates the flow from the effects of other flows as much as possible, and guarantees the flow the ability to propagate data at least TokenRate for the duration of the connection. If the sender sends faster than that rate, the network may delay or discard the excess traffic. If the sender does not exceed TokenRate over time, then latency is also guaranteed. This service is designed for applications which require a precisely known quality of service but would not benefit from better service, such as real-time control systems.

PredictiveService A service provider supporting predictive service guarantees the flow the ability to propagate data at least TokenRate for the duration of the connection. If the sender sends faster than that rate, the network may

delay or discard the excess traffic. The delay limit is not guaranteed (occasional packets may take longer than specified), but is generally highly reliable. This service is designed for applications that can accommodate or adapt to some variation in service quality, such as video service.

BestEffortService — A service provider supporting best effort service, at minimum, takes the flow spec as a guideline and makes reasonable efforts to maintain the level of service requested, however without making any guarantees whatsoever.

TokenRate/TokenSize — A *Token bucket model* is used to specify the rate at which permission to send traffic accrues. The value zero (0) in these variables indicates that no rate limiting is in force. Negative values are reserved for future use. The *TokenRate* is expressed in bytes per second, and the *TokenSize* in bytes.

The concept of the token bucket is a bucket which has a maximum volume (token size) and continuously fills at certain rate (token rate). If the "bucket" contains sufficient credit, the application may send data; if it does, it reduces the available credit by that amount. If sufficient credits are not available, the application must wait or discard the extra traffic.

If an application has been sending at a low rate for a period of time, it clearly may send a large burst of data all at once until it runs out of credit. Having done so, it must limit itself to sending at TokenRate until its data burst is exhausted. Equally clearly, if it transmits at a rate below TokenRate for a period of time, it accrues the right to send a burst of data.

In video applications, the token Rate is typically the average bit rate peak to peak, and the token size is the largest typical frame size. In constant rate applications, the token rate is the average data rate, and the token size is chosen to accommodate small variations.

PeakBandwidth — This field, expressed in bytes/second, limits how fast packets may be sent back to back from the application. Some intermediate systems can take advantage of this information resulting in a more efficient resource allocation.

Latency — Latency is the maximum acceptable delay between transmission of a bit by the sender and its receipt by the intended receiver(s). The precise interpretation of this number depends on the level of guarantee specified in the QoS request.

DelayVariation — This field is the difference, in microseconds, between the maximum and minimum possible delay that a packet will experience. This value is used by applications to determine the amount of buffer space needed at the receiving side in order to restore the original data transmission pattern.

CostOfCall	This is just a place holder for now and should always be set to 0 until we can come up with a meaningful cost metric.

2.6.2 Default Values

A default flow spec is associated with each eligible socket at the time it is created. Field values for this default flow spec are indicated below. In all cases these values indicate that no particular flow characteristics are being requested from the network. Applications only need to modify values for those fields which they are interested in, but must be aware that there exists some coupling between fields such as TokenRate and TokenSize.

TokenRate =	-1, not specified
TokenSize =	-1, not specified
PeakBandwidth=	-1, not specified
Latency =	-1, not specified
DelayVariation =	-1, not specified
LevelOfGuarantee =	BestEffortService
CostOfCall =	0, reserved for future use

2.7 Socket Groups

Winsock 2 introduces the notion of a socket group as a means for an application (or cooperating set of applications) to indicate to an underlying service provider that a particular set of sockets are related and that the group thus formed has certain attributes. Group attributes include relative priorities of the individual sockets within the group and a group quality of service specification.

Applications needing to exchange multimedia streams over the network are benefited by being able to establish a specific relationship among the set of sockets being utilized. As a minimum this might include a hint to the service provider about the relative priorities of the media streams being carried. For example, a conferencing application would want to have the socket used for carrying the audio stream be given higher priority than that of the socket used for the video stream. Furthermore, there are transport providers (e.g. digital telephony and ATM) which can utilize a group quality of service specification to determine the appropriate characteristics for the underlying call or circuit connection. The sockets within a group are then multiplexed in the usual manner over this call. By allowing the application to identify the sockets that make up a group and to specify the required group attributes, such service providers can operate with maximum effectiveness.

WSASocket() and **WSAAccept()** are two new functions used to explicitly create and/or join a socket group coincident with creating a new socket. Socket group IDs can be retrieved by using **getsockopt()** with option SO_GROUP_ID. Relative priority can be accessed by using **get/setsockopt()** with option SO_GROUP_PRIORITY.

2.8 Shared Sockets

WSADuplicateSocket() is introduced to enable socket sharing across processes by creating an additional socket descriptor to an underlying socket which thus becomes shared. The function takes as input both the local socket descriptor and a handle to the target process. It returns a new descriptor for the socket which is only valid in the context of the target process (which is not precluded from being the same as the original process). This mechanism is designed to be appropriate for both single-threaded version of Windows (such as Windows 3.1) and preemptive multithreaded versions of Windows (such as Windows 95 and NT). Note however, that sockets may be shared amongst threads in a given process without using the WSADuplicateSocket() function, since a socket descriptor is valid in all of a process' threads.

The two (or more) descriptors that reference a shared socket may be used independently as far as I/O is concerned. However, the Winsock interface does not implement any type of access control, so it is up to the processes involved to coordinate their operations on a shared socket. A typical use for shared sockets is to have one process reading and a different process writing.

Since what is duplicated are the socket descriptors and not the underlying socket, all of the state associated with a socket is held in common across all the descriptors. For example a **setsockopt()** operation performed using one descriptor is subsequently visible using a **getsockopt()** from any or all descriptors. A process may call **closesocket()** on a duplicated socket and the descriptor will become deallocated. The underlying socket, however, will remain open until **closesocket()** is called by the last remaining descriptor.

The manner in which event notification is handled on shared sockets is currently under discussion. Two proposals have been made. In the first, the notification properties are associated completely with each descriptor and are thus entirely independent from one another. Assume processes A, B and C all have descriptors to a shared socket. It would be allowed for process A to register interest in FD_READ and FD_CLOSE, process B to register for FD_CLOSE and FD_WRITE, and process C to register for FD_READ and FD_WRITE. When data was available to be read on the socket, both process A and C would receive notification. Likewise, if the socket were closed by the remote end, both process A and B would be notified.

In the second proposal, any particular FD_XXX network event may be delivered only to a single process. Thus if process A registered for FD_READ and FD_CLOSE, process B would be precluded from registering for FD_CLOSE as well.

2.9 Enhanced Functionality During Connection Setup

WSAAccept () allows an application to obtain caller information before deciding whether or not to accept an incoming connection request. This is done via a callback to an application-supplied condition function.
User-to-user data specified via parameters in **WSAConnect()** and/or the condition function of **WSAAccept()** may be transferred to the peer during connection establishment, provided this feature is supported by the service provider.

2.10 Extended Byte Order Conversion Routines

Winsock 2 does not assume that the network byte order for all protocols is the same. Therefore a set of conversion routines are supplied for converting 16 and 32 bit quantities to and from network byte order. These routines take as in input parameter a boolean which specifies whether the desired network byte order is “big-endian” or “little-endian”. Also, the PROTOCOL_INFO struct for each protocol includes a flag to indicate the byte ordering to be used for the protocol.

2.11 Support for Scatter/Gather I/O

The **WSASend(), WSASendTo(), WSARecv(),** and **WSARecvFrom()** routines all take an array of application buffers as input parameters and thus may be used for scatter/gather (or vectored) I/O. This can be very useful in instances where portions of each message being transmitted consist of one or more fixed length “header” components in addition to message body. Such header components need not be concatenated by the application into a single contiguous buffer prior to sending. Likewise on receiving, the header components can be automatically split off into separate buffers, leaving the message body “pure”.
When receiving into multiple buffers, completion occurs as data arrives from the network, regardless of whether all of the supplied buffers are utilized.

2.12 Summary of New Socket Options

The new socket options proposed for Winsock2 are summarized in the following table. More detailed information is provided in section 3 under **getsockopt()** and/or **setsockopt()**.

Value	Type	Meaning	Default	Note
SO_MAX_MSG_SIZE	int	Maximum size of a message for message-oriented socket types. Has no meaning for stream-oriented sockets.	Implementation dependent	get only
SO_GROUP_ID	GROUP	The identifier of the group to which this socket belongs.	NULL	get only
SO_GROUP_PRIORITY	int	The relative priority for sockets that are part of a socket group.	0	
SO_PROTOCOL_INFO	struct PROTOCOL_ INFO	Description of protocol info for protocol that is bound to this socket.	protocol dependent	get only
PVD_CONFIG	char FAR *	An opaque data structure object containing configuration information of the service provider.	Implementation dependent	

2.13 Summary of New Socket Ioctl Opcodes

The new socket ioctl opcodes proposed for Winsock2 are summarized in the following table. More detailed information is provided in section 3 under **WSAIoctl()**

Opcode	Input Type	Output Type	Meaning
SIO_GET_QOS	<not used>	QOS	Retrieve current flow spec(s) for the socket.
SIO_SET_QOS	QOS	<not used>	Establish new flow spec(s) for the socket.
SIO_GET_GROUP_QOS	<not used>	QOS	Retrieve current group flow spec(s) for the group this socket belongs to.
SIO_SET_GROUP_QOS	QOS	<not used>	Establish new group flow spec(s) for the group this socket belongs to.

2.14 Summary of New Functions

The new API functions proposed for Winsock2 are summarized in the following table.

WSAAccept() *	An extended version of accept() which allows for conditional acceptance and socket grouping.
WSACloseEvent()	Destroys an event object.
WSAConnect()	An extended version of connect() which allows for exchange of connect data and QOS specification.
WSACreateEvent()	Creates an event object.
WSADuplicateSocket()	Allow an underlying socket to be shared by creating a virtual socket.
WSAEnumNetworkEvents()	Discover occurrences of network events.
WSAEnumProtocols()	Retrieve information about each available protocol.
WSAEventSelect()	Associate network events with an event object.
WSAGetOverlappedResult()	Get completion status of overlapped operation.
WSAGetQOSByName()	Supply QOS parameters based on a well-known service name.
WSAHtonl()	Extended version of htonl()
WSAHtons()	Extended version of htons()
WSAIoctl()	Overlapped-capable version of ioctl()
WSANtohl()	Extended version of ntohl()
WSANtohs()	Extended version of ntohs()
WSARecv()	An extended version of recv() which accommodates scatter/gather I/O, overlapped sockets and provides the *flags* parameter as IN OUT
WSARecvfrom()	An extended version of recvfrom() which accommodates scatter/gather I/O, overlapped sockets and provides the *flags* parameter as IN OUT
WSAResetEvent()	Resets an event object.
WSASend()	An extended version of send() which accommodates scatter/gather I/O and overlapped sockets
WSASendto()	An extended version of sendto() which accommodates scatter/gather I/O and overlapped sockets
WSASetEvent()	Sets an event object.
WSASocket()	An extended version of socket() which takes a PROTOCOL_INFO struct as input and allows overlapped sockets to be created. Also allows socket groups to be formed.
WSAWaitForMultipleEvents()	Blocks on multiple event objects.

3. SOCKET LIBRARY REFERENCE

This chapter presents the socket library routines in alphabetical order, and describes each routine in detail.

In each routine it is indicated that the header file **winsock.h** must be included. Appendix A.2 lists the Berkeley-compatible header files which are supported. These are provided for compatibility purposes only, and each of them will simply include **winsock.h**. The Windows header file **windows.h** is also needed, but **winsock.h** will include it if necessary.

3.1 accept()

Description Accept a connection on a socket.

#include <winsock.h>

SOCKET WSAAPI accept (SOCKET *s***, struct sockaddr FAR *** *addr,*
int FAR * *addrlen* **);**

s	A descriptor identifying a socket which is listening for connections after a **listen**().
addr	An optional pointer to a buffer which receives the address of the connecting entity, as known to the communications layer. The exact format of the *addr* argument is determined by the address family established when the socket was created.
addrlen	An optional pointer to an integer which contains the length of the address *addr*.

Remarks This routine extracts the first connection on the queue of pending connections on *s*, creates a new socket with the same properties as *s* and returns a handle to the new socket. If no pending connections are present on the queue, and the socket is not marked as non-blocking, **accept()** blocks the caller until a connection is present. If the socket is marked non-blocking and no pending connections are present on the queue, **accept()** returns an error as described below. The accepted socket may not be used to accept more connections. The original socket remains open.

The argument *addr* is a result parameter that is filled in with the address of the connecting entity, as known to the communications layer. The exact format of the *addr* parameter is determined by the address family in which the communication is occurring. The *addrlen* is a value-result parameter; it should initially contain the amount of space pointed to by *addr*; on return it will contain the actual length (in bytes) of the address returned. This call is used with connection-oriented socket types such as SOCK_STREAM. If *addr* and/or *addrlen* are equal to NULL, then no information about the remote address of the accepted socket is returned.

Return Value If no error occurs, **accept**() returns a value of type SOCKET which is a descriptor for the accepted socket. Otherwise, a value of INVALID_SOCKET is returned, and a specific error code may be retrieved by calling **WSAGetLastError**().

The integer referred to by *addrlen* initially contains the amount of space pointed to by *addr*. On return it will contain the actual length in bytes of the address returned.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	The *addrlen* argument is too small.
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINVAL	**listen()** was not invoked prior to **accept()**.
WSAEMFILE	The queue is non-empty upon entry to **accept()** and there are no descriptors available.
WSAENOBUFS	No buffer space is available.
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	The referenced socket is not a type that supports connection-oriented service.
WSAEWOULDBLOCK	The socket is marked as non-blocking and no connections are present to be accepted.

See Also **bind**(), **connect**(), **listen**(), **select**(), **socket**(), **WSAAsyncSelect(), WSAAccept()**

3.2 bind()

Description Associate a local address with a socket.

#include <winsock.h>

int WSAAPI bind (SOCKET *s*, const struct sockaddr FAR * *name*, int *namelen*);

s A descriptor identifying an unbound socket.

name The address to assign to the socket. The sockaddr structure is defined as follows:

```
struct sockaddr {
      u_short     sa_family;
      char        sa_data[14];
};
```

namelen The length of the *name*.

Remarks This routine is used on an unconnected connectionless or connection-oriented socket, before subsequent **connect**()s or **listen**()s. When a socket is created with **socket**(), it exists in a name space (address family), but it has no name assigned. **bind**() establishes the local association of the socket by assigning a local name to an unnamed socket.

As an example, in the Internet address family, a name consists of three parts: the address family, a host address, and a port number which identifies the application. In Winsock 2, the *name* parameter is not strictly interpreted as a pointer to a "sockaddr" struct. It is cast this way for Windows Sockets compatibility. Service Providers are free to regard it as a pointer to a block of memory of size *namelen*. The first two bytes in this block (corresponding to "sa_family" in the "sockaddr" declaration) must contain the address family that was used to create the socket. Otherwise an error WSAEFAULT will occur.

If an application does not care what local address is assigned to it, it may specify the manifest constant value ADDR_ANY for the sa_data field of the name parameter. This allows the underlying service provider to use any appropriate network address, potentially simplifying application programming in the presence of multi-homed hosts (i.e., hosts that have more than one network interface and address). For TCP/IP, if the port is specified as 0, the service provider will assign a unique port to the application with a value between 1024 and 5000. The application may use **getsockname()** after **bind()** to learn the address that has been assigned to it, but note that **getsockname()** will not necessarily be able to supply the address until the socket is connected, since several addresses may be valid if the host is multi-homed.

Return Value If no error occurs, **bind()** returns 0. Otherwise, it returns SOCKET_ERROR, and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.

WSAEADDRINUSE	The specified address is already in use. (See the SO_REUSEADDR socket option under **setsockopt()**.)
WSAEFAULT	The *namelen* argument is too small, the *name* argument contains incorrect address format for the associated address family, or the first two bytes of the memory block specified by *name* does not match the address family associate with the socket descriptor *s*.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINVAL	The socket is already bound to an address.
WSAENOBUFS	Not enough buffers available, too many connections.
WSAENOTSOCK	The descriptor is not a socket.

See Also **connect()**, **listen()**, **getsockname()**, **setsockopt()**, **socket()**, **WSACancelBlockingCall()**.

3.3 closesocket()

Description Close a socket.

#include <winsock.h>

int WSAAPI closesocket (SOCKET *s* **);**

s A descriptor identifying a socket.

Remarks This function closes a socket. More precisely, it releases the socket descriptor *s*, so that further references to *s* will fail with the error WSAENOTSOCK. If this is the last reference to an underlying socket, the associated naming information and queued data are discarded.

The semantics of **closesocket**() are affected by the socket options SO_LINGER and SO_DONTLINGER as follows:

Option	Interval	Type of close	Wait for close?
SO_DONTLINGER	Don't care	Graceful	No
SO_LINGER	Zero	Hard	No
SO_LINGER	Non-zero	Graceful	Yes

If SO_LINGER is set (i.e. the *l_onoff* field of the linger structure is non-zero; see sections B.3.4 , 3.14 and 3.28) with a zero timeout interval (*l_linger* is zero), **closesocket()** is not blocked even if queued data has not yet been sent or acknowledged. This is called a "hard" or "abortive" close, because the socket's virtual circuit is reset immediately, and any unsent data is lost. Any **recv()** call on the remote side of the circuit will fail with WSAECONNRESET.

If SO_LINGER is set with a non-zero timeout interval, the **closesocket()** call blocks until the remaining data has been sent or until the timeout expires. This is called a graceful disconnect. Note that if the socket is set to non-blocking and SO_LINGER is set to a non-zero timeout, the call to **closesocket()** will fail with an error of WSAEWOULDBLOCK.

If SO_DONTLINGER is set on a stream socket (i.e. the *l_onoff* field of the linger structure is zero; see sections B.3.4 , 3.14 and 3.28), the **closesocket()** call will return immediately. However, any data queued for transmission will be sent if possible before the underlying socket is closed. This is also called a graceful disconnect. Note that in this case the Winsock provider may not release the socket and other resources for an arbitrary period, which may affect applications which expect to use all available sockets.

Return Value If no error occurs, **closesocket()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.

WSAENOTSOCK	The descriptor is not a socket.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEWOULDBLOCK	The socket is marked as nonblocking and SO_LINGER is set to a nonzero timeout value.

See Also **accept()**, **socket()**, **ioctlsocket()**, **setsockopt()**, **WSAAsyncSelect(), WSADuplicateSocket()**.

3.4 connect()

Description Establish a connection to a peer.

#include <winsock.h>

int WSAAPI connect (SOCKET *s***, const struct sockaddr FAR *** *name***,**
int *namelen* **);**

s	A descriptor identifying an unconnected socket.
name	The name of the peer to which the socket is to be connected.
namelen	The length of the *name*.

Remarks This function is used to create a connection to the specified destination. For connection-oriented sockets (e.g., type SOCK_STREAM), an active connection is initiated to the foreign host using *name* (an address in the name space of the socket; for a detailed description, please see **bind()**). When the socket call completes successfully, the socket is ready to send/receive data.

For a connectionless socket (e.g., type SOCK_DGRAM), the operation performed by **connect()** is merely to establish a default destination address which will be used on subsequent **send**() and **recv**() calls.

If the socket, *s*, is unbound, unique values are assigned to the local association by the system, and the socket is marked as bound. Note that if the address field of the *name* structure is all zeroes, **connect()** will return the error WSAEADDRNOTAVAIL.

Comments When connected sockets break (i.e. become closed for whatever reason), they should be discarded and recreated. It is safest to assume that when things go awry for any reason on a connected socket, the application must discard and recreate the needed sockets in order to return to a stable point.

Return Value If no error occurs, **connect()** returns 0. Otherwise, it returns SOCKET_ERROR, and a specific error code may be retrieved by calling **WSAGetLastError().**

On a blocking socket, the return value indicates success or failure of the connection attempt.

On a non-blocking socket, if the return value is SOCKET_ERROR an application should call **WSAGetLastError().** If this indicates an error code of WSAEWOULDBLOCK, then your application can either:

1. Use **select()** to determine the completion of the connection request by checking if the socket is writeable, or

2. If your application is using **WSAAsyncSelect()** to indicate interest in connection events, then your application will receive an FD_CONNECT notification when the connect operation is complete.

3. If your applicationis using **WSAEventSelect()** to indicate interest in connection events, then the associated event object will be signaled when the connect operation is complete.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEADDRINUSE	The specified address is already in use.
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEADDRNOTAVAIL	The specified address is not available from the local machine.
WSAEAFNOSUPPORT	Addresses in the specified family cannot be used with this socket.
WSAECONNREFUSED	The attempt to connect was forcefully rejected.
WSAEDESTADDREQ	A destination address is required.
WSAEFAULT	The *namelen* argument is incorrect, or the *name* argument contains incorrect address format for the associated address family.
WSAEINVAL	The parameter *s* is a listening socket.
WSAEISCONN	The socket is already connected.
WSAEMFILE	No more socket descriptors are available.
WSAENETUNREACH	The network can't be reached from this host at this time.
WSAENOBUFS	No buffer space is available. The socket cannot be connected.
WSAENOTSOCK	The descriptor is not a socket.
WSAETIMEDOUT	Attempt to connect timed out without establishing a connection
WSAEWOULDBLOCK	The socket is marked as non-blocking and the connection cannot be completed immediately. It is possible to **select()** the socket while it is connecting by **select()**ing it for writing.

See Also **accept(), bind(), getsockname(), socket(), select(), WSAAsyncSelect(), WSAConnect().**

3.5 gethostbyaddr()

Description Get host information corresponding to an address.

#include <winsock.h>

struct hostent FAR * WSAAPI gethostbyaddr (const char FAR * *addr*, **int** *len*, **int** *type* **);**

addr	A pointer to an address in network byte order.
len	The length of the address.
type	The type of the address.

Remarks **gethostbyaddr**() returns a pointer to the following structure which contains the name(s) and address which correspond to the given address.

```
struct hostent {
      char FAR *  h_name;
      char FAR * FAR *  h_aliases;
      short h_addrtype;
      short h_length;
      char FAR * FAR *  h_addr_list;
};
```

The members of this structure are:

Element	Usage
h_name	Official name of the host (PC).
h_aliases	A NULL-terminated array of alternate names.
h_addrtype	The type of address being returned.
h_length	The length, in bytes, of each address.
h_addr_list	A NULL-terminated list of addresses for the host. Addresses are returned in network byte order.

The macro h_addr is defined to be h_addr_list[0] for compatibility with older software.

The pointer which is returned points to a structure which is allocated by Winsock . The application must never attempt to modify this structure or to free any of its components. Furthermore, only one copy of this structure is allocated per thread, and so the application should copy any information which it needs before issuing any other Winsock API calls.

Return Value If no error occurs, **gethostbyaddr()** returns a pointer to the hostent structure described above. Otherwise it returns a NULL pointer and a specific error number may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.

WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**

See Also **WSAAsyncGetHostByAddr()**, **gethostbyname**(),

3.6 gethostbyname()

Description Get host information corresponding to a hostname.

#include <winsock.h>

struct hostent FAR * WSAAPI gethostbyname (const char FAR * *name* **);**

name A pointer to the name of the host.

Remarks **gethostbyname**() returns a pointer to a hostent structure as described under **gethostbyaddr**(). The contents of this structure correspond to the hostname *name*.

The pointer which is returned points to a structure which is allocated by Winsock. The application must never attempt to modify this structure or to free any of its components. Furthermore, only one copy of this structure is allocated per thread, and so the application should copy any information which it needs before issuing any other Winsock API calls.

A **gethostbyname()** implementation must not resolve IP address strings passed to it. Such a request should be treated exactly as if an unknown host name were passed. An application with an IP address string to resolve should use **inet_addr()** to convert the string to an IP address, then **gethostbyaddr()** to obtain the hostent structure.

Return Value If no error occurs, **gethostbyname()** returns a pointer to the hostent structure described above. Otherwise it returns a NULL pointer and a specific error number may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**

See Also **WSAAsyncGetHostByName()**, **gethostbyaddr()**

3.7 gethostname()

Description Return the standard host name for the local machine.

#include <winsock.h>

int WSAAPI gethostname (char FAR * *name***, int** *namelen* **);**

name	A pointer to a buffer that will receive the host name.
namelen	The length of the buffer.

Remarks This routine returns the name of the local host into the buffer specified by the *name* parameter. The host name is returned as a null-terminated string. The form of the host name is dependent on the Winsock provider--it may be a simple host name, or it may be a fully qualified domain name. However, it is guaranteed that the name returned will be successfully parsed by **gethostbyname()** and **WSAAsyncGetHostByName().**

Return Value If no error occurs, **gethostname()** returns 0, otherwise it returns SOCKET_ERROR and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSAEFAULT	The *namelen* parameter is too small
WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).

See Also **gethostbyname(), WSAAsyncGetHostByName().**

3.8 getprotobyname()

Description Get protocol information corresponding to a protocol name.

#include <winsock.h>

struct protoent FAR * WSAAPI getprotobyname (const char FAR * *name* **);**

name A pointer to a protocol name.

Remarks **getprotobyname**() returns a pointer to the following structure which contains the name(s) and protocol number which correspond to the given protocol *name*.

```
struct protoent {
      char FAR *  p_name;
      char FAR * FAR *  p_aliases;
      short p_proto;
};
```

The members of this structure are:

Element	Usage
p_name	Official name of the protocol.
p_aliases	A NULL-terminated array of alternate names.
p_proto	The protocol number, in host byte order.

The pointer which is returned points to a structure which is allocated by the Winsock library. The application must never attempt to modify this structure or to free any of its components. Furthermore only one copy of this structure is allocated per thread, and so the application should copy any information which it needs before issuing any other Winsock API calls.

Return Value If no error occurs, **getprotobyname()** returns a pointer to the protoent structure described above. Otherwise it returns a NULL pointer and a specific error number may be retrieved by calling **WSAGetLastError**().

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**

See Also **WSAAsyncGetProtoByName()**, **getprotobynumber()**

3.9 getprotobynumber()

Description Get protocol information corresponding to a protocol number.

#include <winsock.h>

struct protoent FAR * WSAAPI getprotobynumber (int *number* **);**

number A protocol number, in host byte order.

Remarks This function returns a pointer to a protoent structure as described above in **getprotobyname()**. The contents of the structure correspond to the given protocol number.

The pointer which is returned points to a structure which is allocated by Winsock. The application must never attempt to modify this structure or to free any of its components. Furthermore, only one copy of this structure is allocated per thread, and so the application should copy any information which it needs before issuing any other Winsock API calls.

Return Value If no error occurs, **getprotobynumber()** returns a pointer to the protoent structure described above. Otherwise it returns a NULL pointer and a specific error number may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**

See Also **WSAAsyncGetProtoByNumber()**, **getprotobyname()**

3.10 getservbyname()

Description Get service information corresponding to a service name and protocol.

#include <winsock.h>

struct servent FAR * WSAAPI getservbyname (const char FAR * *name*, **const char FAR *** *proto* **);**

name	A pointer to a service name.
proto	An optional pointer to a protocol name. If this is NULL, **getservbyname()** returns the first service entry for which the *name* matches the s_name or one of the s_aliases. Otherwise **getservbyname()** matches both the *name* and the *proto*.

Remarks **getservbyname()** returns a pointer to the following structure which contains the name(s) and service number which correspond to the given service *name*.

```
struct servent {
      char FAR *  s_name;
      char FAR * FAR *  s_aliases;
      short s_port;
      char FAR *  s_proto;
};
```

The members of this structure are:

Element	Usage
s_name	Official name of the service.
s_aliases	A NULL-terminated array of alternate names.
s_port	The port number at which the service may be contacted. Port numbers are returned in network byte order.
s_proto	The name of the protocol to use when contacting the service.

The pointer which is returned points to a structure which is allocated by the Winsock library. The application must never attempt to modify this structure or to free any of its components. Furthermore only one copy of this structure is allocated per thread, and so the application should copy any information which it needs before issuing any other Winsock API calls.

Return Value If no error occurs, **getservbyname()** returns a pointer to the servent structure described above. Otherwise it returns a NULL pointer and a specific error number may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.

WSANO_DATA	Valid name, no data record of requested type.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**

See Also **WSAAsyncGetServByName()**, **getservbyport()**

3.11 getservbyport()

Description Get service information corresponding to a port and protocol.

#include <winsock.h>

struct servent FAR * WSAAPI getservbyport (int *port***, const char FAR *** *proto* **);**

port	The port for a service, in network byte order.
proto	An optional pointer to a protocol name. If this is NULL, **getservbyport()** returns the first service entry for which the *port* matches the s_port. Otherwise **getservbyport()** matches both the *port* and the *proto*.

Remarks **getservbyport()** returns a pointer a servent structure as described above for **getservbyname()**.

The pointer which is returned points to a structure which is allocated by Winsock. The application must never attempt to modify this structure or to free any of its components. Furthermore, only one copy of this structure is allocated per thread, and so the application should copy any information which it needs before issuing any other Winsock API calls.

Return Value If no error occurs, **getservbyport()** returns a pointer to the servent structure described above. Otherwise it returns a NULL pointer and a specific error number may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**

See Also **WSAAsyncGetServByPort()**, **getservbyname()**

3.12 getpeername()

Description Get the address of the peer to which a socket is connected.

#include <winsock.h>

int WSAAPI getpeername (SOCKET *s***, struct sockaddr FAR *** *name***, int FAR *** *namelen* **);**

s	A descriptor identifying a connected socket.
name	The structure which is to receive the name of the peer.
namelen	A pointer to the size of the *name* structure.

Remarks **getpeername()** retrieves the name of the peer connected to the socket *s* and stores it in the struct sockaddr identified by *name*. It is used on a connected socket.

On return, the *namelen* argument contains the actual size of the name returned in bytes.

Return Value If no error occurs, **getpeername()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	The namelen argument is not large enough.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAENOTCONN	The socket is not connected.
WSAENOTSOCK	The descriptor is not a socket.

See Also **bind**(), **socket**(), **getsockname**().

3.13 getsockname()

Description Get the local name for a socket.

#include <winsock.h>

int WSAAPI getsockname (SOCKET s**, struct sockaddr FAR *** *name*,
int FAR * *namelen* **);**

s	A descriptor identifying a bound socket.
name	Receives the address (name) of the socket.
namelen	The size of the *name* buffer.

Remarks **getsockname()** retrieves the current name for the specified socket descriptor in *name*. It is used on a bound and/or connected socket specified by the *s* parameter. The local association is returned. This call is especially useful when a **connect()** call has been made without doing a **bind()** first; this call provides the only means by which you can determine the local association which has been set by the system.

On return, the *namelen* argument contains the actual size of the name returned in bytes.

If a socket was bound to an unspecified address (e.g., ADDR_ANY), indicating that any of the host's addresses within the specified address family should be used for the socket, **getsockname()** will not necessarily return information about the host address, unless the socket has been connected with **connect()** or **accept().** A Winsock application must not assume that the address will be specified unless the socket is connected. This is because for a multi-homed host the address that will be used for the socket is unknown unless the socket is connected.

Return Value If no error occurs, **getsockname()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	The *namelen* argument is not large enough, or the *name* or *namelen* argument is not part of the user address space.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAENOTSOCK	The descriptor is not a socket.
WSAEINVAL	The socket has not been bound to an address with **bind().**

See Also **bind**(), **socket**(), **getpeername**().

3.14 getsockopt()

Description Retrieve a socket option.

#include <winsock.h>

int WSAAPI getsockopt (SOCKET *s*, **int** *level*, **int** *optname*,
char FAR * *optval*, **int** FAR * *optlen* **);**

s	A descriptor identifying a socket.
level	The level at which the option is defined; the only supported *levels* are SOL_SOCKET and SOL_PROVIDER. (SOL_PROVIDER is defined to be an alias for IPPROTO_TCP for the sake of compatibility with Windows Sockets specification 1.1.)
optname	The socket option for which the value is to be retrieved.
optval	A pointer to the buffer in which the value for the requested option is to be returned.
optlen	A pointer to the size of the *optval* buffer.

Remarks **getsockopt()** retrieves the current value for a socket option associated with a socket of any type, in any state, and stores the result in *optval*. Options may exist at multiple protocol levels, but they are always present at the uppermost "socket" level. Options affect socket operations, such as the routing of packets, out-of-band data transfer, etc.

The value associated with the selected option is returned in the buffer *optval*. The integer pointed to by *optlen* should originally contain the size of this buffer; on return, it will be set to the size of the value returned. For SO_LINGER, this will be the size of a struct linger; for most other options it will be the size of an integer.

The application is responsible for allocating any memory space pointed to directly or indirectly by any of the parameters it specified.

If the option was never set with **setsockopt(),** then **getsockopt()** returns the default value for the option.

The following options are supported for **getsockopt()**. The Type identifies the type of data addressed by *optval*.

***level* = SOL_SOCKET**		
Value	Type	Meaning
SO_ACCEPTCONN	BOOL	Socket is **listen()**ing.
SO_BROADCAST	BOOL	Socket is configured for the transmission of broadcast messages.
SO_DEBUG	BOOL	Debugging is enabled.
SO_DONTLINGER	BOOL	If true, the SO_LINGER option is disabled.
SO_DONTROUTE	BOOL	Routing is disabled.
SO_ERROR	int	Retrieve error status and clear.

SO_GROUP_ID	GROUP	The identifier of the group to which this socket belongs.
SO_GROUP_PRIORITY	int	The relative priority for sockets that are part of a socket group.
SO_KEEPALIVE	BOOL	Keepalives are being sent.
SO_LINGER	struct linger	Returns the current linger options.
SO_MAX_MSG_SIZE	unsigned int	Maximum size of a message for message-oriented socket types (e.g., SO_DGRAM). Has no meaning for stream-oriented sockets.
SO_OOBINLINE	BOOL	Out-of-band data is being received in the normal data stream.
SO_PROTOCOL_INFO	PROTOCOL _INFO	Description of protocol info for protocol that is bound to this socket.
SO_RCVBUF	int	Buffer size for receives
SO_REUSEADDR	BOOL	The socket may be bound to an address which is already in use.
SO_SNDBUF	int	Buffer size for sends
SO_TYPE	int	The type of the socket (e.g. SOCK_STREAM).

***level* = SOL_PROVIDER (also aliased to IPPROTO_TCP)**		
PVD_CONFIG	Service Provider Dependent	An "opaque" data structure object from the service provider associated with socket *s*. This object stores the current configuration information of the service provider. The exact format of this data structure is service provider specific.
TCP_NODELAY	BOOL	Disables the Nagle algorithm for send coalescing.

BSD options not supported for **getsockopt()** are:

Value	Type	Meaning
SO_RCVLOWAT	int	Receive low water mark
SO_RCVTIMEO	int	Receive timeout
SO_SNDLOWAT	int	Send low water mark
SO_SNDTIMEO	int	Send timeout
IP_OPTIONS		Get options in IP header.
TCP_MAXSEG	int	Get TCP maximum segment size.

Calling **getsockopt()** with an unsupported option will result in an error code of WSAENOPROTOOPT being returned from **WSAGetLastError()**.

SO_DEBUG

Winsock service providers are encouraged (but not required) to supply output debug information if the SO_DEBUG option is set by an application. The mechanism for generating the debug information and the form it takes are beyond the scope of this specification.

SO_GROUP_ID

This is a get-only socket option which indicates the identifier of the group this socket belongs to. If this socket is not a group socket, the value is NULL.

SO_GROUP_PRIORITY

Group priority indicates the relative priority of the specified socket relative to other sockets within the socket group. Values are non-negative integers, with zero corresponding to the highest priority. Priority values represent a hint to the underlying service provider about how potentially scarce resources should be allocated. For example, whenever two or more sockets are both ready to transmit data, the highest priority socket (lowest value for SO_GROUP_PRIORITY) should be serviced first, with the remainder serviced in turn according to their relative priorities.

The WSAENOPROTOOPT error code is indicated for non group sockets or for service providers which do not support group sockets.

SO_KEEPALIVE

An application may request that a TCP/IP service provider enable the use of "keep-alive" packets on TCP-connections by turning on the SO_KEEPALIVE socket option. A Winsock provider need not support the use of keep-alives: if it does, the precise semantics are implementation-specific but should conform to section 4.2.3.6 of RFC 1122: *Requirements for Internet Hosts -- Communication Layers*. If a connection is dropped as the result of "keep-alives" the error code WSAENETRESET is returned to any calls in progress on the socket, and any subsequent calls will fail with WSAENOTCONN.

SO_LINGER

SO_LINGER controls the action taken when unsent data is queued on a socket and a **closesocket()** is performed. See **closesocket()** for a description of the way in which the SO_LINGER settings affect the semantics of **closesocket()**. The application sets the desired behavior by creating a *struct linger* (pointed to by the *optval* argument) with the following elements:

```
struct linger {
      int   l_onoff;
      int   l_linger;
}
```

SO_MAX_MSG_SIZE

This is a get-only socket option which indicates the maximum size of a message for message-oriented socket types (e.g., SO_DGRAM) as implemented by a particular service provider. It has no meaning for byte stream oriented sockets

SO_REUSEADDR

By default, a socket may not be bound (see **bind()**) to a local address which is already in use. On occasions, however, it may be desirable to "re-use" an address in this way. Since every connection is uniquely identified by the combination of local and remote addresses, there is no problem with having two sockets bound to the same local address as long as the remote addresses are different. To inform the Winsock provider that a **bind()** on a socket should not be disallowed because the desired address is already in use by another socket, the application should set the SO_REUSEADDR socket option for the socket before issuing the **bind()**. Note that the option is interpreted only at the time of the **bind()**: it is therefore unnecessary (but harmless) to set the option on a

socket which is not to be bound to an existing address, and setting or resetting the option after the **bind()** has no effect on this or any other socket.

PVD_CONFIG

This option retrieves an "opaque" data structure object from the service provider associated with socket *s*. This object stores the current configuration information of the service provider. The exact format of this data structure is service provider specific.

TCP_NODELAY

The TCP_NODELAY option disables the Nagle algorithm. The Nagle algorithm is used to reduce the number of small packets sent by a host by buffering unacknowledged send data until a full-size packet can be sent. However, for some applications this algorithm can impede performance, and TCP_NODELAY may be used to turn it off. Application writers should not set TCP_NODELAY unless the impact of doing so is well-understood and desired, since setting TCP_NODELAY can have a significant negative impact of network performance.

Return Value

If no error occurs, **getsockopt()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	The *optlen* argument was invalid.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINVAL	No value available for *optname* at the moment.
WSAENOPROTOOPT	The option is unknown or unsupported by the indicated protocol family.
WSAENOTSOCK	The descriptor is not a socket.

See Also

setsockopt(), **socket(), WSAAsyncSelect(), WSAConnect**().

3.15 htonl()

Description Convert a **u_long** from host to network byte order.

#include <winsock.h>

u_long WSAAPI htonl (u_long *hostlong* **);**

hostlong A 32-bit number in host byte order.

Remarks This routine takes a 32-bit number in host byte order and returns a 32-bit number in network byte order.

Return Value **htonl()** returns the value in network byte order.

See Also **htons()**, **ntohl()**, **ntohs()**.

3.16 htons()

Description Convert a **u_short** from host to network byte order.

#include <winsock.h>

u_short WSAAPI htons (u_short *hostshort* **);**

hostshort A 16-bit number in host byte order.

Remarks This routine takes a 16-bit number in host byte order and returns a 16-bit number in network byte order.

Return Value **htons()** returns the value in network byte order.

See Also **htonl()**, **ntohl()**, **ntohs()**.

3.17 inet_addr()

Description Convert a string containing a dotted address into an **in_addr**.

#include <winsock.h>

unsigned long WSAAPI inet_addr (const char FAR * *cp* **);**

cp A character string representing a number expressed in the Internet standard "." notation.

Remarks This function interprets the character string specified by the *cp* parameter. This string represents a numeric Internet address expressed in the Internet standard "." notation. The value returned is a number suitable for use as an Internet address. All Internet addresses are returned in network order (bytes ordered from left to right).

Internet Addresses

Values specified using the "." notation take one of the following forms:

a.b.c.d a.b.c a.b a

When four parts are specified, each is interpreted as a byte of data and assigned, from left to right, to the four bytes of an Internet address. Note that when an Internet address is viewed as a 32-bit integer quantity on the Intel architecture, the bytes referred to above appear as "d.c.b.a". That is, the bytes on an Intel processor are ordered from right to left.

Note: The following notations are only used by Berkeley, and nowhere else on the Internet. In the interests of compatibility with their software, they are supported as specified.

When a three part address is specified, the last part is interpreted as a 16-bit quantity and placed in the right most two bytes of the network address. This makes the three part address format convenient for specifying Class B network addresses as "128.net.host".

When a two part address is specified, the last part is interpreted as a 24-bit quantity and placed in the right most three bytes of the network address. This makes the two part address format convenient for specifying Class A network addresses as "net.host".

When only one part is given, the value is stored directly in the network address without any byte rearrangement.

Return Value If no error occurs, **inet_addr()** returns an unsigned long containing a suitable binary representation of the Internet address given. If the passed-in string does not contain a legitimate Internet address, for example if a portion of an "a.b.c.d" address exceeds 255, **inet_addr()** returns the value INADDR_NONE.

See Also **inet_ntoa()**

3.18 inet_ntoa()

Description Convert a network address into a string in dotted format.

#include <winsock.h>

char FAR * WSAAPI inet_ntoa (struct in_addr *in* **);**

in A structure which represents an Internet host address.

Remarks This function takes an Internet address structure specified by the *in* parameter. It returns an ASCII string representing the address in "." notation as "a.b.c.d". Note that the string returned by **inet_ntoa()** resides in memory which is allocated by Winsock . The application should not make any assumptions about the way in which the memory is allocated. The data is guaranteed to be valid until the next Winsock API call within the same thread, but no longer.

Return Value If no error occurs, **inet_ntoa()** returns a char pointer to a static buffer containing the text address in standard "." notation. Otherwise, it returns NULL. The data should be copied before another Winsock call is made.

See Also **inet_addr()**.

3.19 ioctlsocket()

Description Control the mode of a socket.

#include <winsock.h>

int WSAAPI ioctlsocket (SOCKET *s***, long** *cmd***, u_long FAR *** *argp* **);**

s	A descriptor identifying a socket.
cmd	The command to perform on the socket *s*.
argp	A pointer to a parameter for *cmd*.

Remarks This routine may be used on any socket in any state. It is used to get or retrieve operating parameters associated with the socket, independent of the protocol and communications subsystem. The following commands are supported:

Command	Semantics
FIONBIO	Enable or disable non-blocking mode on socket *s*. *argp* points at an **unsigned long**, which is non-zero if non-blocking mode is to be enabled and zero if it is to be disabled. When a socket is created, it operates in blocking mode (i.e. non-blocking mode is disabled). This is consistent with BSD sockets. The **WSAAsyncSelect()** or **WSAEventSelect()** routine automatically sets a socket to nonblocking mode. If **WSAAsyncSelect()** or **WSAEventSelect()** has been issued on a socket, then any attempt to use **ioctlsocket()** to set the socket back to blocking mode will fail with WSAEINVAL. To set the socket back to blocking mode, an application must first disable **WSAAsyncSelect()** by calling **WSAAsyncSelect()** with the *lEvent* parameter equal to 0, or disable **WSAEventSelect()** by calling **WSAEventSelect()** with the *lNetworkEvents* parameter equal to 0.
FIONREAD	Determine the amount of data which can be read atomically from socket *s*. *argp* points at an **unsigned long** in which **ioctlsocket()** stores the result. If *s* is stream-oriented (e.g., type SOCK_STREAM), FIONREAD returns the total amount of data which may be read in a single **recv()**; this is normally the same as the total amount of data queued on the socket. If *s* is message-oriented (e.g., type SOCK_DGRAM), FIONREAD returns the size of the first datagram (message) queued on the socket.
SIOCATMARK	Determine whether or not all out-of-band data has been read. This applies only to a socket of stream style (e.g., type SOCK_STREAM) which has been configured for in-line reception of any out-of-band data (SO_OOBINLINE). If no out-of-band data is waiting to be read, the operation returns TRUE. Otherwise it returns FALSE, and the next **recv()** or **recvfrom()** performed on the socket will retrieve some or all of the data preceding the "mark"; the application should use the

SIOCATMARK operation to determine whether any remains. If there is any normal data preceding the "urgent" (out of band) data, it will be received in order. (Note that a **recv()** or **recvfrom()** will never mix out-of-band and normal data in the same call.) *argp* points at a **BOOL** in which **ioctlsocket()** stores the result.

Compatibility

This function is a subset of **ioctl()** as used in Berkeley sockets. In particular, there is no command which is equivalent to FIOASYNC, while SIOCATMARK is the only socket-level command which is supported.

Return Value

Upon successful completion, the **ioctlsocket()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	*cmd* is not a valid command, or *argp* is not an acceptable parameter for *cmd*, or the command is not applicable to the type of socket supplied
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAENOTSOCK	The descriptor *s* is not a socket.

See Also

socket(), **setsockopt()**, **getsockopt()**, **WSAAsyncSelect(), WSAEventSelect().**

3.20 listen()

Description Establish a socket to listen for incoming connection.

#include <winsock.h>

int WSAAPI listen (SOCKET *s***, int** *backlog* **);**

s	A descriptor identifying a bound, unconnected socket.
backlog	The maximum length to which the queue of pending connections may grow. If this value is SOMAXCONN, then the underlying service provider responsible for socket *s* will set the backlog to a maximum "reasonable" value.

Remarks To accept connections, a socket is first created with **socket**(), a backlog for incoming connections is specified with **listen**(), and then the connections are accepted with **accept**(). **listen**() applies only to sockets that are connection-oriented , e.g., those of type SOCK_STREAM. The socket *s* is put into "passive" mode where incoming connections are acknowledged and queued pending acceptance by the process.

This function is typically used by servers that could have more than one connection request at a time: if a connection request arrives with the queue full, the client will receive an error with an indication of WSAECONNREFUSED.

Compatibility *backlog* is limited (silently) to a reasonable value as determined by the underlying service provider. Illegal values are replaced by the nearest legal value..

Return Value If no error occurs, **listen()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError**().

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEADDRINUSE	An attempt has been made to **listen()** on an address in use.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINVAL	The socket has not been bound with **bind**().
WSAEISCONN	The socket is already connected.
WSAEMFILE	No more socket descriptors are available.
WSAENOBUFS	No buffer space is available.
WSAENOTSOCK	The descriptor is not a socket.

WSAEOPNOTSUPP	The referenced socket is not of a type that supports the **listen()** operation.

See Also **accept**(), **connect**(), **socket**().

3.21 ntohl()

Description Convert a **u_long** from network to host byte order.

#include <winsock.h>

u_long WSAAPI ntohl (u_long *netlong* **);**

netlong A 32-bit number in network byte order.

Remarks This routine takes a 32-bit number in network byte order and returns a 32-bit number in host byte order.

Return Value **ntohl()** returns the value in host byte order.

See Also **htonl()**, **htons()**, **ntohs()**.

3.22 ntohs()

Description Convert a **u_short** from network to host byte order.

#include <winsock.h>

u_short WSAAPI ntohs (u_short *netshort* **);**

netshort A 16-bit number in network byte order.

Remarks This routine takes a 16-bit number in network byte order and returns a 16-bit number in host byte order.

Return Value **ntohs()** returns the value in host byte order.

See Also **htonl()**, **htons()**, **ntohl()**.

3.23 recv()

Description Receive data from a socket.

#include <winsock.h>

int WSAAPI recv (SOCKET *s*, **char FAR *** *buf*, **int** *len*, **int** *flags* **);**

s	A descriptor identifying a connected socket.
buf	A buffer for the incoming data.
len	The length of *buf*.
flags	Specifies the way in which the call is made.

Remarks This function is used on connected connectionless or connection-oriented sockets specified by the *s* parameter and is used to read incoming data.

For sockets of stream style (e.g., type SOCK_STREAM), as much information as is currently available up to the size of the buffer supplied is returned. If the socket has been configured for in-line reception of out-of-band data (socket option SO_OOBINLINE) and out-of-band data is unread, only out-of-band data will be returned. The application may use the **ioctlsocket()** SIOCATMARK to determine whether any more out-of-band data remains to be read.

For message-oriented sockets (e.g., type SOCK_DGRAM), data is extracted from the first enqueued datagram (message), up to the size of the buffer supplied. If the datagram is larger than the buffer supplied, the buffer is filled with the first part of the datagram, the excess data is lost, and **recv()** returns the error WSAEMSGSIZE.

If no incoming data is available at the socket, the **recv()** call waits for data to arrive unless the socket is non-blocking. In this case a value of SOCKET_ERROR is returned with the error code set to WSAEWOULDBLOCK. The **select**(), **WSAAsyncSelect**(), or **WSAEventSelect**() calls may be used to determine when more data arrives.

If the socket is connection-oriented and the remote side has shut down the connection gracefully, a **recv()** will complete immediately with 0 bytes received. If the connection has been reset, a **recv()** will fail with the error WSAECONNRESET.

Flags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *flags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_PEEK	Peek at the incoming data. The data is copied into the buffer but is not removed from the input queue.
MSG_OOB	Process out-of-band data (See section B.3.2.3 for a discussion of this topic.)

Return Value If no error occurs, **recv()** returns the number of bytes received. If the connection has been gracefully closed, the return value is 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	The *buf* argument is not in a valid part of the user address space.
WSAENOTCONN	The socket is not connected.
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAENETRESET	The connection must be reset because the Winsock implementation dropped it.
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	MSG_OOB was specified, but the socket is not stream style such as type SOCK_STREAM, out-of-band data is not supported in the communication domain associated with this socket, or the socket is unidirectional and supports only send operations.
WSAESHUTDOWN	The socket has been shutdown; it is not possible to **recv()** on a socket after **shutdown()** has been invoked with *how* set to SD_RECEIVE or SD_BOTH.
WSAEWOULDBLOCK	The socket is marked as non-blocking and the receive operation would block.
WSAEMSGSIZE	The message was too large to fit into the specified buffer and was truncated.
WSAEINVAL	The socket has not been bound with **bind().**
WSAECONNABORTED	The virtual circuit was aborted due to timeout or other failure. . The application should close the socket as it is no longer useable.

WSAECONNRESET	The virtual circuit was reset by the remote side executing a “hard” or “abortive” close. The application should close the socket as it is no longer useable.

See Also **recvfrom**(), **send**(), **select**(), **socket**(), **WSAAsyncSelect().**

3.24 recvfrom()

Description Receive a datagram and store the source address.

#include <winsock.h>

int WSAAPI recvfrom (SOCKET *s*, **char FAR *** *buf*, **int** *len*, **int** *flags*,
struct sockaddr FAR * *from*, **int FAR *** *fromlen* **);**

s	A descriptor identifying a bound socket.
buf	A buffer for the incoming data.
len	The length of *buf*.
flags	Specifies the way in which the call is made.
from	An optional pointer to a buffer which will hold the source address upon return.
fromlen	An optional pointer to the size of the *from* buffer.

Remarks This function is used to read incoming data on a (possibly connected) socket and capture the address from which the data was sent.

For stream-oriented sockets such as those of type SOCK_STREAM, as much information as is currently available up to the size of the buffer supplied is returned. If the socket has been configured for in-line reception of out-of-band data (socket option SO_OOBINLINE) and out-of-band data is unread, only out-of-band data will be returned. The application may use the **ioctlsocket**() SIOCATMARK to determine whether any more out-of-band data remains to be read. The from and fromlen parameters are ignored for connection-oriented sockets.

For message-oriented sockets, data is extracted from the first enqueued message, up to the size of the buffer supplied. If the message is larger than the buffer supplied, the buffer is filled with the first part of the message, the excess data is lost, and **recvfrom()** returns the error code WSAEMSGSIZE.

If *from* is non-zero, and the socket is not connection-oriented (e.g., type SOCK_DGRAM), the network address of the peer which sent the data is copied to the corresponding struct sockaddr. The value pointed to by *fromlen* is initialized to the size of this structure, and is modified on return to indicate the actual size of the address stored there.

If no incoming data is available at the socket, the **recvfrom()** call waits for data to arrive unless the socket is non-blocking. In this case a value of SOCKET_ERROR is returned with the error code set to WSAEWOULDBLOCK. The **select**(), **WSAAsyncSelect**(), or **WSAEventSelect**() may be used to determine when more data arrives.

If the socket is connection-oriented and the remote side has shut down the connection gracefully, a **recvfrom()** will complete immediately with 0 bytes received. If the connection has been reset **recvfrom()** will fail with the error WSAECONNRESET.

Flags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *flags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_PEEK	Peek at the incoming data. The data is copied into the buffer but is not removed from the input queue.
MSG_OOB	Process out-of-band data (See section B.3.2.3 for a discussion of this topic.)

Return Value

If no error occurs, **recvfrom()** returns the number of bytes received. If the connection has been gracefully closed, the return value is 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	The *buf* or *from* parameters are not part of the user address space, or the *fromlen* argument is too small to accommodate the peer address.
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINVAL	The socket has not been bound with **bind()**.
WSAENETRESET	The connection must be reset because the Winsock provider dropped it.
WSAENOTCONN	The socket is not connected (connection-oriented sockets only).
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	MSG_OOB was specified, but the socket is not stream style such as type SOCK_STREAM, out-of-band data is not supported in the communication domain associated with this socket, or the socket is unidirectional and supports only send operations.

WSAESHUTDOWN	The socket has been shutdown; it is not possible to **recvfrom()** on a socket after **shutdown()** has been invoked with *how* set to SD_RECEIVE or SD_BOTH.
WSAEWOULDBLOCK	The socket is marked as non-blocking and the **recvfrom()** operation would block.
WSAEMSGSIZE	The message was too large to fit into the specified buffer and was truncated.
WSAECONNABORTED	The virtual circuit was aborted due to timeout or other failure. The application should close the socket as it is no longer useable.
WSAECONNRESET	The virtual circuit was reset by the remote side executing a “hard” or “abortive” close. The application should close the socket as it is no longer useable.

See Also **recv**(), **send**(), **socket**(), **WSAAsyncSelect(), WSAEventSelect().**

3.25 select()

Description Determine the status of one or more sockets, waiting if necessary.

#include <winsock.h>

int WSAAPI select (int *nfds***, fd_set FAR *** *readfds***, fd_set FAR *** *writefds***, fd_set FAR *** *exceptfds***, const struct timeval FAR *** *timeout* **);**

nfds	This argument is ignored and included only for the sake of compatibility.
readfds	An optional pointer to a set of sockets to be checked for readability.
writefds	An optional pointer to a set of sockets to be checked for writability
exceptfds	An optional pointer to a set of sockets to be checked for errors.
timeout	The maximum time for **select()** to wait, or NULL for blocking operation.

Remarks This function is used to determine the status of one or more sockets. For each socket, the caller may request information on read, write or error status. The set of sockets for which a given status is requested is indicated by an fd_set structure. The sockets contained within the fd_set structures must be associated with a single service provider. Upon return, the structure is updated to reflect the subset of these sockets which meet the specified condition, and **select()** returns the number of sockets meeting the conditions. A set of macros is provided for manipulating an fd_set. These macros are compatible with those used in the Berkeley software, but the underlying representation is completely different.

The parameter *readfds* identifies those sockets which are to be checked for readability. If the socket is currently **listen()**ing, it will be marked as readable if an incoming connection request has been received, so that an **accept()** is guaranteed to complete without blocking. For other sockets, readability means that queued data is available for reading or, for connection-oriented sockets, that the virtual circuit corresponding to the socket has been closed, so that a **recv()** or **recvfrom()** is guaranteed to complete without blocking. If the virtual circuit was closed gracefully, then a **recv()** will return immediately with 0 bytes read; if the virtual circuit was reset, then a **recv()** will complete immediately with the error code WSAECONNRESET. The presence of out-of-band data will be checked if the socket option SO_OOBINLINE has been enabled (see **setsockopt()**).

The parameter *writefds* identifies those sockets which are to be checked for writability. If a socket is **connect()**ing (non-blocking), writability means that the connection establishment successfully completed. If the socket is not in the process of **connect()**ing, writability means that a **send()** or **sendto()** will complete without blocking. [It is not specified how long this guarantee can be assumed to be valid, particularly in a multithreaded environment.]

The parameter *exceptfds* identifies those sockets which are to be checked for the presence of out-of-band data or any exceptional error conditions. Note that out-of-band

data will only be reported in this way if the option SO_OOBINLINE is FALSE. For a connection-oriented socket, the breaking of the connection by the peer or due to KEEPALIVE failure will be indicated as an exception. This specification does not define which other errors will be included. If a socket is **connect()**ing (non-blocking), failure of the connect attempt is indicated in *exceptfds.*

Any of *readfds*, *writefds*, or *exceptfds* may be given as NULL if no descriptors are of interest.

Four macros are defined in the header file **winsock.h** for manipulating the descriptor sets. The variable FD_SETSIZE determines the maximum number of descriptors in a set. (The default value of FD_SETSIZE is 64, which may be modified by #defining FD_SETSIZE to another value before #including **winsock.h**.) Internally, an fd_set is represented as an array of SOCKETs; the last valid entry is followed by an element set to INVALID_SOCKET. The macros are:

FD_CLR(*s***, ****set***)**	Removes the descriptor *s* from *set*.
FD_ISSET(*s***, ****set***)**	Nonzero if *s* is a member of the *set*, zero otherwise.
FD_SET(*s***, ****set***)**	Adds descriptor *s* to *set*.
FD_ZERO(**set***)**	Initializes the *set* to the NULL set.

The parameter *timeout* controls how long the **select()** may take to complete. If *timeout* is a null pointer, **select()** will block indefinitely until at least one descriptor meets the specified criteria. Otherwise, *timeout* points to a struct timeval which specifies the maximum time that **select()** should wait before returning. If the timeval is initialized to {0, 0}, **select()** will return immediately; this is used to "poll" the state of the selected sockets. If this is the case, then the **select()** call is considered nonblocking and the standard assumptions for nonblocking calls apply. For example, the blocking hook will not be called, and Winsock will not yield.

Return Value

select() returns the total number of descriptors which are ready and contained in the fd_set structures, 0 if the time limit expired, or SOCKET_ERROR if an error occurred. If the return value is SOCKET_ERROR, **WSAGetLastError()** may be used to retrieve a specific error code.

Comments

select() has no effect on the persistance of socket events registered with **WSAAsyncSelect()** or **WSAEventSelect()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAEFAULT	The Winsock implementation was unable to allocated needed resources for its internal operations, or the *readfds*, *writefds*, or *exceptfds* parameters are not part of the user address space.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	The *timeout* value is not valid.

WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAENOTSOCK	One of the descriptor sets contains an entry which is not a socket.

See Also **accept()**, **connect()**, **recv()**, **recvfrom()**, **send(), WSAAsyncSelect(), WSAEventSelect()**

3.26 send()

Description Send data on a connected socket.

#include <winsock.h>

int WSAAPI send (SOCKET *s*, **const char FAR *** *buf*, **int** *len*, **int** *flags* **);**

s	A descriptor identifying a connected socket.
buf	A buffer containing the data to be transmitted.
len	The length of the data in *buf*.
flags	Specifies the way in which the call is made.

Remarks **send**() is used to write outgoing data on a connected socket. For message-oriented sockets, care must be taken not to exceed the maximum packet size of the underlying provider, which can be obtained by getting the value of socket option **SO_MAX_MSG_SIZE**. If the data is too long to pass atomically through the underlying protocol the error WSAEMSGSIZE is returned, and no data is transmitted.

Note that the successful completion of a **send()** does not indicate that the data was successfully delivered.

If no buffer space is available within the transport system to hold the data to be transmitted, **send**() will block unless the socket has been placed in a non-blocking I/O mode. On non-blocking stream-oriented sockets, the number of bytes written may be between 1 and the requested length, depending on buffer availability on both the local and foreign hosts. The **select**(), **WSAAsyncSelect**() or **WSAEventSelect**() call may be used to determine when it is possible to send more data.

Flags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *flags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_DONTROUTE	Specifies that the data should not be subject to routing. A Winsock service provider may choose to ignore this flag; see also the discussion of the SO_DONTROUTE option in section B.3.4 .
MSG_OOB	Send out-of-band data (stream style socket such as SOCK_STREAM only; see also section B.3.2.3)

Return Value If no error occurs, **send()** returns the total number of characters sent. (Note that this may be less than the number indicated by *len*.) Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEACCES	The requested address is a broadcast address, but the appropriate flag was not set.
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEFAULT	The *buf* argument is not in a valid part of the user address space.
WSAENETRESET	The connection must be reset because the Winsock provider dropped it.
WSAENOBUFS	The Winsock provider reports a buffer deadlock.
WSAENOTCONN	The socket is not connected.
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	MSG_OOB was specified, but the socket is not stream style such as type SOCK_STREAM, out-of-band data is not supported in the communication domain associated with this socket, or the socket is unidirectional and supports only receive operations.
WSAESHUTDOWN	The socket has been shutdown; it is not possible to **send()** on a socket after **shutdown()** has been invoked with how set to SD_SEND or SD_BOTH.
WSAEWOULDBLOCK	The socket is marked as non-blocking and the requested operation would block.
WSAEMSGSIZE	The socket is message-oriented, and the message is larger than the maximum supported by the underlying transport.
WSAEINVAL	The socket has not been bound with **bind().**
WSAECONNABORTED	The virtual circuit was aborted due to timeout or other failure. . The application should close the socket as it is no longer useable.

WSAECONNRESET	The virtual circuit was reset by the remote side executing a “hard” or “abortive” close. The application should close the socket as it is no longer useable.

See Also **recv**(), **recvfrom**(), **select**(), **socket**(), **sendto**(), **WSAAsyncSelect**(), **WSAEventSelect**().

3.27 sendto()

Description Send data to a specific destination.

#include <winsock.h>

int WSAAPI sendto (SOCKET *s*, **const char FAR *** *buf*, **int** *len*, **int** *flags*, **const struct sockaddr FAR *** *to*, **int** *tolen* **);**

s	A descriptor identifying a socket.
buf	A buffer containing the data to be transmitted.
len	The length of the data in *buf*.
flags	Specifies the way in which the call is made.
to	An optional pointer to the address of the target socket.
tolen	The size of the address in *to*.

Remarks **sendto**() is used to write outgoing data on a socket. For message-oriented sockets, care must be taken not to exceed the maximum packet size of the underlying subnets, which can be obtained by getting the value of socket option SO_MAX_MSG_SIZE. If the data is too long to pass atomically through the underlying protocol the error WSAEMSGSIZE is returned, and no data is transmitted.

Note that the successful completion of a **sendto()** does not indicate that the data was successfully delivered.

sendto() is normally used on a connectionless socket to send a datagram to a specific peer socket identified by the *to* parameter. On a connection-oriented socket, the *to* and *tolen* parameters are ignored; in this case the **sendto()** is equivalent to **send**().

For sockets using IP:
To send a broadcast (on a SOCK_DGRAM only), the address in the *to* parameter should be constructed using the special IP address INADDR_BROADCAST (defined in **winsock.h**) together with the intended port number. It is generally inadvisable for a broadcast datagram to exceed the size at which fragmentation may occur, which implies that the data portion of the datagram (excluding headers) should not exceed 512 bytes.

If no buffer space is available within the transport system to hold the data to be transmitted, **sendto**() will block unless the socket has been placed in a non-blocking I/O mode. On non-blocking stream-oriented sockets, the number of bytes written may be between 1 and the requested length, depending on buffer availability on both the local and foreign hosts. The **select**(), **WSAAsyncSelect**() or **WSAEventSelect**() call may be used to determine when it is possible to send more data.

Flags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *flags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_DONTROUTE	Specifies that the data should not be subject to routing. A Winsock service provider may choose to ignore this flag; see also the discussion of the SO_DONTROUTE option in section B.3.4 .
MSG_OOB	Send out-of-band data (stream style socket such as SOCK_STREAM only; see also section B.3.2.3)

Return Value If no error occurs, **sendto()** returns the total number of characters sent. (Note that this may be less than the number indicated by *len*.) Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEACCES	The requested address is a broadcast address, but the appropriate flag was not set.
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEFAULT	The *buf* or *to* parameters are not part of the user address space, or the *tolen* argument is too small.
WSAENETRESET	The connection must be reset because the Winsock provider dropped it.
WSAENOBUFS	The Winsock provider reports a buffer deadlock.
WSAENOTCONN	The socket is not connected (connection-oriented sockets only)
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	MSG_OOB was specified, but the socket is not stream style such as type SOCK_STREAM, out-of-band data is not supported in the communication domain associated with this socket, or the socket is unidirectional and supports only receive operations.
WSAESHUTDOWN	The socket has been shutdown; it is not possible to **sendto()** on a socket after **shutdown()** has been invoked with how set to SD_SEND or SD_BOTH.

WSAEWOULDBLOCK	The socket is marked as non-blocking and the requested operation would block.
WSAEMSGSIZE	The socket is message-oriented, and the message is larger than the maximum supported by the underlying transport.
WSAECONNABORTED	The virtual circuit was aborted due to timeout or other failure. . The application should close the socket as it is no longer useable.
WSAECONNRESET	The virtual circuit was reset by the remote side executing a “hard” or “abortive” close. The application should close the socket as it is no longer useable.
WSAEADDRNOTAVAIL	The specified address is not available from the local machine.
WSAEAFNOSUPPORT	Addresses in the specified family cannot be used with this socket.
WSAEDESTADDRREQ	A destination address is required.
WSAENETUNREACH	The network can't be reached from this host at this time.

See Also **recv**(), **recvfrom**(), **select**(), **socket**(), **send**(), **WSAAsyncSelect(), WSAEventSelect**().

3.28 setsockopt()

Description Set a socket option.

#include <winsock.h>

int WSAAPI setsockopt (SOCKET *s*, **int** *level*, **int** *optname*,
const char FAR * *optval*, **int** *optlen* **);**

s	A descriptor identifying a socket.
level	The level at which the option is defined; the only supported *level*s are SOL_SOCKET and SOL_PROVIDER. (SOL_PROVIDER is defined to be an alias for IPPROTO_TCP for the sake of compatibility with Windows Sockets specification 1.1.)
optname	The socket option for which the value is to be set.
optval	A pointer to the buffer in which the value for the requested option is supplied.
optlen	The size of the *optval* buffer.

Remarks **setsockopt()** sets the current value for a socket option associated with a socket of any type, in any state. Although options may exist at multiple protocol levels, they are always present at the uppermost "socket" level. Options affect socket operations, such as whether expedited data is received in the normal data stream, whether broadcast messages may be sent on the socket, etc.

There are two types of socket options: Boolean options that enable or disable a feature or behavior, and options which require an integer value or structure. To enable a Boolean option, *optval* points to a nonzero integer. To disable the option *optval* points to an integer equal to zero. *optlen* should be equal to sizeof(int) for Boolean options. For other options, *optval* points to the an integer or structure that contains the desired value for the option, and *optlen* is the length of the integer or structure.

The following options are supported for **setsockopt()**. The Type identifies the type of data addressed by *optval*.

***level* = SOL_SOCKET**		
Value	Type	Meaning
SO_BROADCAST	BOOL	Allow transmission of broadcast messages on the socket.
SO_DEBUG	BOOL	Record debugging information.
SO_DONTLINGER	BOOL	Don't block close waiting for unsent data to be sent. Setting this option is equivalent to setting SO_LINGER with *l_onoff* set to zero.
SO_DONTROUTE	BOOL	Don't route: send directly to interface.
SO_GROUP_PRIORITY	int	Specify the relative priority to be established for sockets that are part of a socket group.
SO_KEEPALIVE	BOOL	Send keepalives
SO_LINGER	struct linger	Linger on close if unsent data is present

SO_OOBINLINE	BOOL	Receive out-of-band data in the normal data stream.
SO_RCVBUF	int	Specify buffer size for receives
SO_REUSEADDR	BOOL	Allow the socket to be bound to an address which is already in use. (See **bind()**.)
SO_SNDBUF	int	Specify buffer size for sends.

***level* = SOL_PROVIDER (aliased to IPPROTO_TCP)**		
PVD_CONFIG	Service Provider Dependent	This object stores the configuration information for the service provider associated with socket *s*. The exact format of this data structure is service provider specific.
TCP_NODELAY	BOOL	Disables the Nagle algorithm for send coalescing.

BSD options not supported for **setsockopt()** are:

Value	Type	Meaning
SO_ACCEPTCONN	BOOL	Socket is listening
SO_RCVLOWAT	int	Receive low water mark
SO_RCVTIMEO	int	Receive timeout
SO_SNDLOWAT	int	Send low water mark
SO_SNDTIMEO	int	Send timeout
SO_TYPE	int	Type of the socket
IP_OPTIONS		Set options field in IP header.

SO_DEBUG

Winsock service providers are encouraged (but not required) to supply output debug information if the SO_DEBUG option is set by an application. The mechanism for generating the debug information and the form it takes are beyond the scope of this specification.

SO_GROUP_PRIORITY

Group priority indicates the relative priority of the specified socket relative to other sockets within the socket group. Values are non-negative integers, with zero corresponding to the highest priority. Priority values represent a hint to the underlying service provider about how potentially scarce resources should be allocated. For example, whenever two or more sockets are both ready to transmit data, the highest priority socket (lowest value for SO_GROUP_PRIORITY) should be serviced first, with the remainder serviced in turn according to their relative priorities.

The WSAENOPROTOOPT error is indicated for non group sockets or for service providers which do not support group sockets.

SO_KEEPALIVE

An application may request that a TCP/IP provider enable the use of "keep-alive" packets on TCP-connections by turning on the SO_KEEPALIVE socket option. A Winsock provider need not support the use of keep-alives: if it does, the precise semantics are implementation-specific but should conform to section 4.2.3.6 of RFC 1122: *Requirements for Internet Hosts -- Communication Layers*. If a connection is dropped as the result of "keep-alives" the error code WSAENETRESET is returned to

any calls in progress on the socket, and any subsequent calls will fail with WSAENOTCONN.

SO_LINGER

SO_LINGER controls the action taken when unsent data is queued on a socket and a **closesocket()** is performed. See **closesocket()** for a description of the way in which the SO_LINGER settings affect the semantics of **closesocket()**. The application sets the desired behavior by creating a *struct linger* (pointed to by the *optval* argument) with the following elements:

```
struct linger {
      int   l_onoff;
      int   l_linger;
}
```

To enable SO_LINGER, the application should set *l_onoff* to a non-zero value, set *l_linger* to 0 or the desired timeout (in seconds), and call **setsockopt()**. To enable SO_DONTLINGER (i.e. disable SO_LINGER) *l_onoff* should be set to zero and **setsockopt()** should be called.

SO_REUSEADDR

By default, a socket may not be bound (see **bind()**) to a local address which is already in use. On occasions, however, it may be desirable to "re-use" an address in this way. Since every connection is uniquely identified by the combination of local and remote addresses, there is no problem with having two sockets bound to the same local address as long as the remote addresses are different. To inform the Winsock provider that a **bind()** on a socket should not be disallowed because the desired address is already in use by another socket, the application should set the SO_REUSEADDR socket option for the socket before issuing the **bind()**. Note that the option is interpreted only at the time of the **bind()**: it is therefore unnecessary (but harmless) to set the option on a socket which is not to be bound to an existing address, and setting or resetting the option after the **bind()** has no effect on this or any other socket.

PVD_CONFIG

This object stores the configuration information for the service provider associated with socket *s*. The exact format of this data structure is service provider specific.

TCP_NODELAY

The TCP_NODELAY option is specific to TCP/IP service providers. It is used to disable the Nagle algorithm. The Nagle algorithm is used to reduce the number of small packets sent by a host by buffering unacknowledged send data until a full-size packet can be sent. However, for some applications this algorithm can impede performance, and TCP_NODELAY may be used to turn it off. Application writers should not set TCP_NODELAY unless the impact of doing so is well-understood and desired, since setting TCP_NODELAY can have a significant negative impact of network performance.

Return Value

If no error occurs, **setsockopt()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	*optval* is not in a valid part of the process address space.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEINVAL	*level* is not valid, or the information in *optval* is not valid.
WSAENETRESET	Connection has timed out when SO_KEEPALIVE is set.
WSAENOPROTOOPT	The option is unknown or unsupported for the specified provider.
WSAENOTCONN	Connection has been reset when SO_KEEPALIVE is set.
WSAENOTSOCK	The descriptor is not a socket.

See Also **bind**(), **getsockopt**(), **ioctlsocket**(), **socket**(), **WSAAsyncSelect**(), **WSAEventSelect**().

3.29 shutdown()

Description Disable sends and/or receives on a socket.

#include <winsock.h>

int WSAAPI shutdown (SOCKET *s*, **int** *how* **);**

s	A descriptor identifying a socket.
how	A flag that describes what types of operation will no longer be allowed.

Remarks **shutdown**() is used on all types of sockets to disable reception, transmission, or both.

If *how* is SD_RECEIVE, subsequent receives on the socket will be disallowed. This has no effect on the lower protocol layers. For TCP, the TCP window is not changed and incoming data will be accepted (but not acknowledged) until the window is exhausted. For UDP, incoming datagrams are accepted and queued. In no case will an ICMP error packet be generated.

If *how* is SD_SEND, subsequent sends are disallowed. For TCP sockets, a FIN will be sent.

Setting *how* to SD_BOTH disables both sends and receives as described above.

Note that **shutdown()** does not close the socket, and resources attached to the socket will not be freed until **closesocket()** is invoked.

Comments **shutdown()** does not block regardless of the SO_LINGER setting on the socket.

An application should not rely on being able to re-use a socket after it has been shut down. In particular, a Winsock provider is not required to support the use of **connect()** on such a socket.

Return Value If no error occurs, **shutdown()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	*how* is not valid, or is not consistent with the socket type, e.g., SD_SEND is used with a UNI_RECV socket type.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).

WSAENOTCONN	The socket is not connected (connection-oriented sockets only).
WSAENOTSOCK	The descriptor is not a socket.

See Also **connect**(), **socket**().

3.30 socket()

Description Create a socket which is bound to a specific service provider.

#include <winsock.h>

SOCKET WSAAPI socket (int *af***, int** *type***, int** *protocol* **);**

af	An address family specification.
type	A type specification for the new socket.
protocol	A particular protocol to be used with the socket, or 0 if the caller does not wish to specify a protocol.

Remarks **socket()** causes a socket descriptor and any related resources to be allocated and bound to a specific transport service provider. Winsock will utilize the first available service provider that supports the requested combination of address family, socket type and protocol parameters.

If a protocol is not specified (i.e., equal to 0), the default for the specified socket type is used. However, the address family may be given as AF_UNSPEC (unspecified), in which case the *protocol* parameter must be specified. The protocol number to use is particular to the "communication domain" in which communication is to take place.

The following are the only two *type* specifications supported for Winsock 1.1:

Type	Explanation
SOCK_STREAM	Provides sequenced, reliable, two-way, connection-based byte streams with an out-of-band data transmission mechanism. Uses TCP for the Internet address family.
SOCK_DGRAM	Supports datagrams, which are connectionless, unreliable buffers of a fixed (typically small) maximum length. Uses UDP for the Internet address family.

In Winsock 2 many new socket types will be introduced. However, since an application can dynamically discover the attributes of each available transport protocol via the **WSAEnumProtocols**() function, the various socket types need not be called out in the API specification. Socket type definitions will appear in Winsock.h which will be periodically updated as new socket types, address families and protocols are defined.

Connection-oriented sockets such as SOCK_STREAM provide full-duplex connections, and must be in a connected state before any data may be sent or received on it. A connection to another socket is created with a **connect**() call. Once connected, data may be transferred using **send**() and **recv**() calls. When a session has been completed, a **closesocket**() must be performed.

The communications protocols used to implement a reliable, connection-oriented socket ensure that data is not lost or duplicated. If data for which the peer protocol has buffer

space cannot be successfully transmitted within a reasonable length of time, the connection is considered broken and subsequent calls will fail with the error code set to WSAETIMEDOUT.

Connectionless, message-oriented sockets allow sending and receiving of datagrams to and from arbitrary peers using **sendto()** and **recvfrom()**. If such a socket is **connect()**ed to a specific peer, datagrams may be send to that peer using **send**() and may be received from (only) this peer using **recv**().

Return Value

If no error occurs, **socket()** returns a descriptor referencing the new socket. Otherwise, a value of INVALID_SOCKET is returned, and a specific error code may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem or the associated service provider has failed.
WSAEAFNOSUPPORT	The specified address family is not supported.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEMFILE	No more socket descriptors are available.
WSAENOBUFS	No buffer space is available. The socket cannot be created.
WSAEPROTONOSUPPORT	The specified protocol is not supported.
WSAEPROTOTYPE	The specified protocol is the wrong type for this socket.
WSAESOCKTNOSUPPORT	The specified socket type is not supported in this address family.

See Also

accept(), **bind()**, **connect()**, **getsockname()**, **getsockopt()**, **setsockopt()**, **listen()**, **recv()**, **recvfrom()**, **select()**, **send()**, **sendto()**, **shutdown()**, **ioctlsocket()**.

3.31 WSAAccept()

Description Conditionally accept a connection based on the return value of a condition function, and optionally create and/or join a socket group.

#include <winsock.h>

SOCKET WSAAPI WSAAccept (SOCKET *s*, **struct sockaddr FAR *** *addr*, **int FAR *** *addrlen*, **LPCONDITIONPROC** *lpfnCondition*, **DWORD** *dwCallbackData* **);**

s	A descriptor identifying a socket which is listening for connections after a **listen**().
addr	An optional pointer to a buffer which receives the address of the connecting entity, as known to the communications layer. The exact format of the *addr* argument is determined by the address family established when the socket was created.
addrlen	An optional pointer to an integer which contains the length of the address *addr*.
lpfnCondition	The procedure instance address of the optional, application-supplied condition function which will make an accept/reject decision based on the caller information passed in as parameters, and optionally create and/or join a socket group by assigning an appropriate value to the result parameter *g* of this function.
dwCallbackData	The callback data passed back to the application as a condition function parameter. This parameter is not interpreted by Winsock.

Remarks This routine extracts the first connection on the queue of pending connections on *s*, and checks it against the condition function, provided the condition function is specified (i.e., not NULL). If the condition function returns CF_ACCEPT, this routine creates a new socket with the same properties as *s* and returns a handle to the new socket, and then optionally creates and/or joins a socket group based on the value of the result parameter *g* in the condition function. If the condition function returns CF_REJECT, this routine rejects the connection request. The condition function runs in the same thread as this routine does, and should return as soon as possible. If the decision cannot be made immediately, the condition function should return CF_DEFER to indicate that no decision has been made, and no action about this connection request should be taken by the service provider. When the application is ready to take action on the connection request, it may invoke **WSAAccept()** again and return either CF_ACCEPT or CF_REJECT as a return value from the condition function.

For synchronous sockets which remain in the (default) blocking mode, if no pending connections are present on the queue, **WSAAccept()** blocks the caller until a connection is present. For synchronous sockets in a non-blocking mode or for overlapped sockets, if this function is called when no pending connections are present on the queue, **WSAAccept()** returns an error as described below. The accepted socket may not be used to accept more connections. The original socket remains open.

The argument *addr* is a result parameter that is filled in with the address of the connecting entity, as known to the communications layer. The exact format of the *addr*

parameter is determined by the address family in which the communication is occurring. The *addrlen* is a value-result parameter; it should initially contain the amount of space pointed to by *addr*. On return, it will contain the actual length (in bytes) of the address returned. This call is used with connection-oriented socket types such as SOCK_STREAM. If *addr* and/or *addrlen* are equal to NULL, then no information about the remote address of the accepted socket is returned. Otherwise, these two parameters will be filled in regardless of whether the condition function is specified or what it returns.

The prototype of the condition function is as follows:

```
int CALLBACK ConditionFunc(
        WSABUF CallerId,
        LPWSABUF lpCallerData,
        LPQOS lpCallerSQOS,
        LPQOS lpCallerGQOS,
        WSABUF CalleeId,
        LPWSABUF lpCalleeData,
        GROUP FAR * g,
        DWORD dwCallbackData );
```

ConditionFunc is a placeholder for the application-supplied function name. In 16-bit Windowns environments, it is invoked in the same thread as **WSAAccept()**, thus no other Winsock functions can be called except **WSAIsBlocking()** and **WSACancelBlockingCall()**. The actual condition function must reside in a DLL or application module and be exported in the module definition file. You must use **MakeProcInstance()** to get a procedure-instance address for the callback function.

The *lpCallerId* and *lpCallerData* are value parameters which contain the address of the connecting entity and any user data that was sent along with the connection request, respectively.

lpCallerSQOS contains two blocks of memory containing the flow specs for socket *s*, one for each direction, specified by the caller. The forward or backward flow spec values will be set to NULL as appropriate for any unidirectional sockets. The first part of each memory block contains the flow parameters common to all providers, optionally followed by any provider specific portion started at *ProviderSpecificParams*. These is no provider specific portion if *SizePSP* is 0. A NULL value for *lpCallerSQOS* indicates no caller supplied QOS.

lpCallerGQOS specifies two blocks of memory containing the flow specs for the socket group the caller is to create, one for each direction. The first part of each memory block contains the flow parameters common to all providers, optionally followed by any provider specific portion started at *ProviderSpecificParams*. These is no provider specific portion if *SizePSP* is 0. A NULL value for *lpCallerGQOS* indicates no caller-supplied group QOS.

The *lpCalleeId* is a value parameter which contains the local address of the connected entity. The *lpCalleeData* is a result parameter used by the condition function to supply user data back to the connecting entity. *lpCalleeData->len* initially contains the length of the buffer allocated by the service provider and pointed to by *lpCalleeData->buf*. A value of zero means passing user data back to the caller is not supported. The condition

function should copy up to *lpCalleeData->len* bytes of data into *lpCalleeData->buf* , and then update *lpCalleeData->len* to indicate the actual number of bytes transferred. If no user data is to be passed back to the caller, the condition function should set *lpCalleeData->len* to zero. The format of all address and user data is specific to the address family to which the socket belongs.

The result parameter g is assigned within the condition function to indicate the following actions:

if *g* is an existing socket group id, add *s* to this group, provided all the requirements set by this group are met; or

if *g* = SG_UNCONSTRAINED_GROUP, create an unconstrained socket group and have *s* as the first member; or

if *g* = SG_CONSTRAINED_GROUP, create a constrained socket group and have *s* as the first member; or

if *g* = NULL, no group operation is performed.

For unconstrained groups, any set of sockets may be grouped together as long as they are supported by a single service provider and are connection-oriented. A constrained socket group may consist only of connection-oriented sockets, and requires that connections on all grouped sockets be to the same address on the same host. For newly created socket groups, the new group id can be retrieved by using **getsockopt()** with option SO_GROUP_ID, if this operation completes successfully.

Return Value

If no error occurs, **WSAAccept**() returns a value of type SOCKET which is a descriptor for the accepted socket. Otherwise, a value of INVALID_SOCKET is returned, and a specific error code may be retrieved by calling **WSAGetLastError**().

The integer referred to by *addrlen* initially contains the amount of space pointed to by *addr*. On return it will contain the actual length in bytes of the address returned.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAECONNREFUSED	The connection request was forcefully rejected as indicated in the return value of the condition function (CF_REJECT).
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	The *addrlen* argument is too small or the *lpfnCondition* is not part of the user address space.
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress.
WSAEINVAL	**listen()** was not invoked prior to **WSAAccept()**, parameter *g* specified in the condition function is not a valid value, the return value of the condition function is not a valid one, or any case where the specified socket is in an invalid state.

WSAEMFILE	The queue is non-empty upon entry to **WSAAccept()** and there are no socket descriptors available.
WSAENOBUFS	No buffer space is available.
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	The referenced socket is not a type that supports connection-oriented service.
WSATRY_AGAIN	The acceptance of the connection request was deferred as indicated in the return value of the condition function (CF_DEFER).
WSAEWOULDBLOCK	The socket is marked as non-blocking and no connections are present to be accepted, or the connection request that was deferred has timed out or been withdrawn.

See Also **accept(), bind(), connect(), getsockopt(), listen(), select(), socket(), WSAAsyncSelect(), WSAConnect().**

3.32 WSAAsyncGetHostByAddr()

Description Get host information corresponding to an address - asynchronous version.

#include <winsock.h>

HANDLE WSAAPI WSAAsyncGetHostByAddr (HWND *hWnd*, **unsigned int** *wMsg*, **const char FAR *** *addr*, **int** *len*, **int** *type*, **char FAR *** *buf*, **int** *buflen* **);**

hWnd	The handle of the window which should receive a message when the asynchronous request completes.
wMsg	The message to be received when the asynchronous request completes.
addr	A pointer to the network address for the host. Host addresses are stored in network byte order.
len	The length of the address.
type	The type of the address
buf	A pointer to the data area to receive the hostent data. Note that this must be larger than the size of a hostent structure. This is because the data area supplied is used by Winsock to contain not only a hostent structure but any and all of the data which is referenced by members of the hostent structure. It is recommended that you supply a buffer of MAXGETHOSTSTRUCT bytes.
buflen	The size of data area *buf* above.

Remarks This function is an asynchronous version of **gethostbyaddr()**, and is used to retrieve host name and address information corresponding to a network address. Winsock initiates the operation and returns to the caller immediately, passing back an asynchronous task handle which the application may use to identify the operation. When the operation is completed, the results (if any) are copied into the buffer provided by the caller and a message is sent to the application's window.

When the asynchronous operation is complete the application's window *hWnd* receives message *wMsg*. The *wParam* argument contains the asynchronous task handle as returned by the original function call. The high 16 bits of *lParam* contain any error code. The error code may be any error as defined in **winsock.h**. An error code of zero indicates successful completion of the asynchronous operation. On successful completion, the buffer supplied to the original function call contains a hostent structure. To access the elements of this structure, the original buffer address should be cast to a hostent structure pointer and accessed as appropriate.

Note that if the error code is WSAENOBUFS, it indicates that the size of the buffer specified by *buflen* in the original call was too small to contain all the resultant information. In this case, the low 16 bits of *lParam* contain the size of buffer required to supply ALL the requisite information. If the application decides that the partial data

is inadequate, it may reissue the **WSAAsyncGetHostByAddr()** function call with a buffer large enough to receive all the desired information (i.e. no smaller than the low 16 bits of *lParam*).

The error code and buffer length should be extracted from the *lParam* using the macros WSAGETASYNCERROR and WSAGETASYNCBUFLEN, defined in **winsock.h** as:

```
#define WSAGETASYNCERROR(lParam)            HIWORD(lParam)
#define WSAGETASYNCBUFLEN(lParam)           LOWORD(lParam)
```

The use of these macros will maximize the portability of the source code for the application.

Return Value

The return value specifies whether or not the asynchronous operation was successfully initiated. Note that it does not imply success or failure of the operation itself.

If the operation was successfully initiated, **WSAAsyncGetHostByAddr()** returns a nonzero value of type HANDLE which is the asynchronous task handle for the request. This value can be used in two ways. It can be used to cancel the operation using **WSACancelAsyncRequest()**. It can also be used to match up asynchronous operations and completion messages, by examining the *wParam* message argument.

If the asynchronous operation could not be initiated, **WSAAsyncGetHostByAddr()** returns a zero value, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments

The buffer supplied to this function is used by Winsock to construct a hostent structure together with the contents of data areas referenced by members of the same hostent structure. To avoid the WSAENOBUFS error noted above, the application should provide a buffer of at least MAXGETHOSTSTRUCT bytes (as defined in **winsock.h**).

Error Codes

The following error codes may be set when an application window receives a message. As described above, they may be extracted from the *lParam* in the reply message using the WSAGETASYNCERROR macro.

WSAENETDOWN	The network subsystem has failed.
WSAENOBUFS	No/insufficient buffer space is available
WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

The following errors may occur at the time of the function call, and indicate that the asynchronous operation could not be initiated.

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEWOULDBLOCK	The asynchronous operation cannot be scheduled at this time due to resource or other constraints within the Winsock implementation.

See Also **gethostbyaddr()**, **WSACancelAsyncRequest()**

3.33 WSAAsyncGetHostByName()

Description Get host information corresponding to a hostname - asynchronous version.

#include <winsock.h>

HANDLE WSAAPI WSAAsyncGetHostByName (HWND *hWnd*,
unsigned int *wMsg*, **const char FAR *** *name*, **char FAR *** *buf*, **int** *buflen* **);**

hWnd	The handle of the window which should receive a message when the asynchronous request completes.
wMsg	The message to be received when the asynchronous request completes.
name	A pointer to the name of the host.
buf	A pointer to the data area to receive the hostent data. Note that this must be larger than the size of a hostent structure. This is because the data area supplied is used by Winsock to contain not only a hostent structure but any and all of the data which is referenced by members of the hostent structure. It is recommended that you supply a buffer of MAXGETHOSTSTRUCT bytes.
buflen	The size of data area *buf* above.

Remarks This function is an asynchronous version of **gethostbyname()**, and is used to retrieve host name and address information corresponding to a hostname. Winsock initiates the operation and returns to the caller immediately, passing back an asynchronous task handle which the application may use to identify the operation. When the operation is completed, the results (if any) are copied into the buffer provided by the caller and a message is sent to the application's window.

When the asynchronous operation is complete the application's window *hWnd* receives message *wMsg*. The *wParam* argument contains the asynchronous task handle as returned by the original function call. The high 16 bits of *lParam* contain any error code. The error code may be any error as defined in **winsock.h**. An error code of zero indicates successful completion of the asynchronous operation. On successful completion, the buffer supplied to the original function call contains a hostent structure. To access the elements of this structure, the original buffer address should be cast to a hostent structure pointer and accessed as appropriate.

Note that if the error code is WSAENOBUFS, it indicates that the size of the buffer specified by *buflen* in the original call was too small to contain all the resultant information. In this case, the low 16 bits of *lParam* contain the size of buffer required to supply ALL the requisite information. If the application decides that the partial data is inadequate, it may reissue the **WSAAsyncGetHostByName()** function call with a buffer large enough to receive all the desired information (i.e. no smaller than the low 16 bits of *lParam*).

The error code and buffer length should be extracted from the *lParam* using the macros WSAGETASYNCERROR and WSAGETASYNCBUFLEN, defined in **winsock.h** as:

```
#define WSAGETASYNCERROR(lParam)              HIWORD(lParam)
#define WSAGETASYNCBUFLEN(lParam)             LOWORD(lParam)
```

The use of these macros will maximize the portability of the source code for the application.

Return Value

The return value specifies whether or not the asynchronous operation was successfully initiated. Note that it does not imply success or failure of the operation itself.

If the operation was successfully initiated, **WSAAsyncGetHostByName()** returns a nonzero value of type HANDLE which is the asynchronous task handle for the request. This value can be used in two ways. It can be used to cancel the operation using **WSACancelAsyncRequest()**. It can also be used to match up asynchronous operations and completion messages, by examining the *wParam* message argument.

If the asynchronous operation could not be initiated, **WSAAsyncGetHostByName()** returns a zero value, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments

The buffer supplied to this function is used by Winsock to construct a hostent structure together with the contents of data areas referenced by members of the same hostent structure. To avoid the WSAENOBUFS error noted above, the application should provide a buffer of at least MAXGETHOSTSTRUCT bytes (as defined in **winsock.h**).

Error Codes

The following error codes may be set when an application window receives a message. As described above, they may be extracted from the *lParam* in the reply message using the WSAGETASYNCERROR macro.

WSAENETDOWN	The network subsystem has failed.
WSAENOBUFS	No/insufficient buffer space is available
WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

The following errors may occur at the time of the function call, and indicate that the asynchronous operation could not be initiated.

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.

WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEWOULDBLOCK	The asynchronous operation cannot be scheduled at this time due to resource or other constraints within the Winsock implementation.

See Also **gethostbyname()**, **WSACancelAsyncRequest()**

3.34 WSAAsyncGetProtoByName()

Description Get protocol information corresponding to a protocol name - asynchronous version.

#include <winsock.h>

HANDLE WSAAPI WSAAsyncGetProtoByName (HWND *hWnd*,
unsigned int *wMsg*, **const char FAR *** *name*, **char FAR *** *buf*, **int** *buflen* **);**

hWnd	The handle of the window which should receive a message when the asynchronous request completes.
wMsg	The message to be received when the asynchronous request completes.
name	A pointer to the protocol name to be resolved.
buf	A pointer to the data area to receive the protoent data. Note that this must be larger than the size of a protoent structure. This is because the data area supplied is used by Winsock to contain not only a protoent structure but any and all of the data which is referenced by members of the protoent structure. It is recommended that you supply a buffer of MAXGETHOSTSTRUCT bytes.
buflen	The size of data area *buf* above.

Remarks This function is an asynchronous version of **getprotobyname()**, and is used to retrieve the protocol name and number corresponding to a protocol name. Winsock initiates the operation and returns to the caller immediately, passing back an asynchronous task handle which the application may use to identify the operation. When the operation is completed, the results (if any) are copied into the buffer provided by the caller and a message is sent to the application's window.

When the asynchronous operation is complete the application's window *hWnd* receives message *wMsg*. The *wParam* argument contains the asynchronous task handle as returned by the original function call. The high 16 bits of *lParam* contain any error code. The error code may be any error as defined in **winsock.h**. An error code of zero indicates successful completion of the asynchronous operation. On successful completion, the buffer supplied to the original function call contains a protoent structure. To access the elements of this structure, the original buffer address should be cast to a protoent structure pointer and accessed as appropriate.

Note that if the error code is WSAENOBUFS, it indicates that the size of the buffer specified by *buflen* in the original call was too small to contain all the resultant information. In this case, the low 16 bits of *lParam* contain the size of buffer required to supply ALL the requisite information. If the application decides that the partial data is inadequate, it may reissue the **WSAAsyncGetProtoByName()** function call with a buffer large enough to receive all the desired information (i.e. no smaller than the low 16 bits of *lParam*).

The error code and buffer length should be extracted from the *lParam* using the macros WSAGETASYNCERROR and WSAGETASYNCBUFLEN, defined in **winsock.h** as:

```
#define WSAGETASYNCERROR(lParam)            HIWORD(lParam)
#define WSAGETASYNCBUFLEN(lParam)           LOWORD(lParam)
```

The use of these macros will maximize the portability of the source code for the application.

Return Value

The return value specifies whether or not the asynchronous operation was successfully initiated. Note that it does not imply success or failure of the operation itself.

If the operation was successfully initiated, **WSAAsyncGetProtoByName()** returns a nonzero value of type HANDLE which is the asynchronous task handle for the request. This value can be used in two ways. It can be used to cancel the operation using **WSACancelAsyncRequest()**. It can also be used to match up asynchronous operations and completion messages, by examining the *wParam* message argument.

If the asynchronous operation could not be initiated, **WSAAsyncGetProtoByName()** returns a zero value, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments

The buffer supplied to this function is used by Winsock to construct a protoent structure together with the contents of data areas referenced by members of the same protoent structure. To avoid the WSAENOBUFS error noted above, the application should provide a buffer of at least MAXGETHOSTSTRUCT bytes (as defined in **winsock.h**).

Error Codes

The following error codes may be set when an application window receives a message. As described above, they may be extracted from the *lParam* in the reply message using the WSAGETASYNCERROR macro.

WSAENETDOWN	The network subsystem has failed.
WSAENOBUFS	No/insufficient buffer space is available
WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

The following errors may occur at the time of the function call, and indicate that the asynchronous operation could not be initiated.

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.

WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEWOULDBLOCK	The asynchronous operation cannot be scheduled at this time due to resource or other constraints within the Winsock implementation.

See Also **getprotobyname**(), **WSACancelAsyncRequest**()

3.35 WSAAsyncGetProtoByNumber()

Description Get protocol information corresponding to a protocol number - asynchronous version.

#include <winsock.h>

HANDLE WSAAPI WSAAsyncGetProtoByNumber (HWND *hWnd*, **unsigned int** *wMsg*, **int** *number*, **char FAR *** *buf*, **int** *buflen* **);**

hWnd	The handle of the window which should receive a message when the asynchronous request completes.
wMsg	The message to be received when the asynchronous request completes.
number	The protocol number to be resolved, in host byte order.
buf	A pointer to the data area to receive the protoent data. Note that this must be larger than the size of a protoent structure. This is because the data area supplied is used by Winsock to contain not only a protoent structure but any and all of the data which is referenced by members of the protoent structure. It is recommended that you supply a buffer of MAXGETHOSTSTRUCT bytes.
buflen	The size of data area *buf* above.

Remarks This function is an asynchronous version of **getprotobynumber()**, and is used to retrieve the protocol name and number corresponding to a protocol number. Winsock initiates the operation and returns to the caller immediately, passing back an asynchronous task handle which the application may use to identify the operation. When the operation is completed, the results (if any) are copied into the buffer provided by the caller and a message is sent to the application's window.

When the asynchronous operation is complete the application's window *hWnd* receives message *wMsg*. The *wParam* argument contains the asynchronous task handle as returned by the original function call. The high 16 bits of *lParam* contain any error code. The error code may be any error as defined in **winsock.h**. An error code of zero indicates successful completion of the asynchronous operation. On successful completion, the buffer supplied to the original function call contains a protoent structure. To access the elements of this structure, the original buffer address should be cast to a protoent structure pointer and accessed as appropriate.

Note that if the error code is WSAENOBUFS, it indicates that the size of the buffer specified by *buflen* in the original call was too small to contain all the resultant information. In this case, the low 16 bits of *lParam* contain the size of buffer required to supply ALL the requisite information. If the application decides that the partial data is inadequate, it may reissue the **WSAAsyncGetProtoByNumber()** function call with a buffer large enough to receive all the desired information (i.e. no smaller than the low 16 bits of *lParam*).

The error code and buffer length should be extracted from the *lParam* using the macros WSAGETASYNCERROR and WSAGETASYNCBUFLEN, defined in **winsock.h** as:

```
#define WSAGETASYNCERROR(lParam)              HIWORD(lParam)
#define WSAGETASYNCBUFLEN(lParam)             LOWORD(lParam)
```

The use of these macros will maximize the portability of the source code for the application.

Return Value The return value specifies whether or not the asynchronous operation was successfully initiated. Note that it does not imply success or failure of the operation itself.

If the operation was successfully initiated, **WSAAsyncGetProtoByNumber()** returns a nonzero value of type HANDLE which is the asynchronous task handle for the request. This value can be used in two ways. It can be used to cancel the operation using **WSACancelAsyncRequest()**. It can also be used to match up asynchronous operations and completion messages, by examining the *wParam* message argument.

If the asynchronous operation could not be initiated, **WSAAsyncGetProtoByNumber()** returns a zero value, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments The buffer supplied to this function is used by Winsock to construct a protoent structure together with the contents of data areas referenced by members of the same protoent structure. To avoid the WSAENOBUFS error noted above, the application should provide a buffer of at least MAXGETHOSTSTRUCT bytes (as defined in **winsock.h**).

Error Codes The following error codes may be set when an application window receives a message. As described above, they may be extracted from the *lParam* in the reply message using the WSAGETASYNCERROR macro.

WSAENETDOWN	The network subsystem has failed.
WSAENOBUFS	No/insufficient buffer space is available
WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

The following errors may occur at the time of the function call, and indicate that the asynchronous operation could not be initiated.

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.

WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEWOULDBLOCK	The asynchronous operation cannot be scheduled at this time due to resource or other constraints within the Winsock implementation.

See Also **getprotobynumber**(), **WSACancelAsyncRequest**()

3.36 WSAAsyncGetServByName()

Description Get service information corresponding to a service name and port - asynchronous version.

#include <winsock.h>

HANDLE WSAAPI WSAAsyncGetServByName (HWND *hWnd*, **unsigned int** *wMsg*, **const char FAR *** *name*, **const char FAR *** *proto*, **char FAR *** *buf*, **int** *buflen* **);**

hWnd	The handle of the window which should receive a message when the asynchronous request completes.
wMsg	The message to be received when the asynchronous request completes.
name	A pointer to a service name.
proto	A pointer to a protocol name. This may be NULL, in which case **WSAAsyncGetServByName()** will search for the first service entry for which *s_name* or one of the *s_aliases* matches the given *name*. Otherwise **WSAAsyncGetServByName()** matches both *name* and *proto*.
buf	A pointer to the data area to receive the servent data. Note that this must be larger than the size of a servent structure. This is because the data area supplied is used by Winsock to contain not only a servent structure but any and all of the data which is referenced by members of the servent structure. It is recommended that you supply a buffer of MAXGETHOSTSTRUCT bytes.
buflen	The size of data area *buf* above.

Remarks This function is an asynchronous version of **getservbyname()**, and is used to retrieve service information corresponding to a service name. Winsock initiates the operation and returns to the caller immediately, passing back an asynchronous task handle which the application may use to identify the operation. When the operation is completed, the results (if any) are copied into the buffer provided by the caller and a message is sent to the application's window.

When the asynchronous operation is complete the application's window *hWnd* receives message *wMsg*. The *wParam* argument contains the asynchronous task handle as returned by the original function call. The high 16 bits of *lParam* contain any error code. The error code may be any error as defined in **winsock.h**. An error code of zero indicates successful completion of the asynchronous operation. On successful completion, the buffer supplied to the original function call contains a servent structure. To access the elements of this structure, the original buffer address should be cast to a servent structure pointer and accessed as appropriate.

Note that if the error code is WSAENOBUFS, it indicates that the size of the buffer specified by *buflen* in the original call was too small to contain all the resultant

information. In this case, the low 16 bits of *lParam* contain the size of buffer required to supply ALL the requisite information. If the application decides that the partial data is inadequate, it may reissue the **WSAAsyncGetServByName()** function call with a buffer large enough to receive all the desired information (i.e. no smaller than the low 16 bits of *lParam*).

The error code and buffer length should be extracted from the *lParam* using the macros WSAGETASYNCERROR and WSAGETASYNCBUFLEN, defined in **winsock.h** as:

```
#define WSAGETASYNCERROR(lParam)            HIWORD(lParam)
#define WSAGETASYNCBUFLEN(lParam)           LOWORD(lParam)
```

The use of these macros will maximize the portability of the source code for the application.

Return Value

The return value specifies whether or not the asynchronous operation was successfully initiated. Note that it does not imply success or failure of the operation itself.

If the operation was successfully initiated, **WSAAsyncGetServByName()** returns a nonzero value of type HANDLE which is the asynchronous task handle for the request. This value can be used in two ways. It can be used to cancel the operation using **WSACancelAsyncRequest()**. It can also be used to match up asynchronous operations and completion messages, by examining the *wParam* message argument.

If the asynchronous operation could not be initiated, **WSAAsyncServByName()** returns a zero value, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments

The buffer supplied to this function is used by Winsock to construct a servent structure together with the contents of data areas referenced by members of the same servent structure. To avoid the WSAENOBUFS error noted above, the application should provide a buffer of at least MAXGETHOSTSTRUCT bytes (as defined in **winsock.h**).

Error Codes

The following error codes may be set when an application window receives a message. As described above, they may be extracted from the *lParam* in the reply message using the WSAGETASYNCERROR macro.

WSAENETDOWN	The network subsystem has failed.
WSAENOBUFS	No/insufficient buffer space is available
WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

The following errors may occur at the time of the function call, and indicate that the asynchronous operation could not be initiated.

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEWOULDBLOCK	The asynchronous operation cannot be scheduled at this time due to resource or other constraints within the Winsock implementation.

See Also **getservbyname**(), **WSACancelAsyncRequest**()

3.37 WSAAsyncGetServByPort()

Description Get service information corresponding to a port and protocol - asynchronous version.

#include <winsock.h>

HANDLE WSAAPI WSAAsyncGetServByPort (HWND *hWnd*, **unsigned int** *wMsg*, **int** *port*, **const char FAR *** *proto*, **char FAR *** *buf*, **int** *buflen* **);**

hWnd	The handle of the window which should receive a message when the asynchronous request completes.
wMsg	The message to be received when the asynchronous request completes.
port	The port for the service, in network byte order.
proto	A pointer to a protocol name. This may be NULL, in which case **WSAAsyncGetServByPort()** will search for the first service entry for which *s_port* match the given *port*. Otherwise **WSAAsyncGetServByPort()** matches both *port* and *proto*.
buf	A pointer to the data area to receive the servent data. Note that this must be larger than the size of a servent structure. This is because the data area supplied is used by Winsock to contain not only a servent structure but any and all of the data which is referenced by members of the servent structure. It is recommended that you supply a buffer of MAXGETHOSTSTRUCT bytes.
buflen	The size of data area *buf* above.

Remarks This function is an asynchronous version of **getservbyport()**, and is used to retrieve service information corresponding to a port number. Winsock initiates the operation and returns to the caller immediately, passing back an asynchronous task handle which the application may use to identify the operation. When the operation is completed, the results (if any) are copied into the buffer provided by the caller and a message is sent to the application's window.

When the asynchronous operation is complete the application's window *hWnd* receives message *wMsg*. The *wParam* argument contains the asynchronous task handle as returned by the original function call. The high 16 bits of *lParam* contain any error code. The error code may be any error as defined in **winsock.h**. An error code of zero indicates successful completion of the asynchronous operation. On successful completion, the buffer supplied to the original function call contains a servent structure. To access the elements of this structure, the original buffer address should be cast to a servent structure pointer and accessed as appropriate.

Note that if the error code is WSAENOBUFS, it indicates that the size of the buffer specified by *buflen* in the original call was too small to contain all the resultant information. In this case, the low 16 bits of *lParam* contain the size of buffer required to supply ALL the requisite information. If the application decides that the partial data is inadequate, it may reissue the **WSAAsyncGetServByPort()** function call with a

buffer large enough to receive all the desired information (i.e. no smaller than the low 16 bits of *lParam*).

The error code and buffer length should be extracted from the *lParam* using the macros WSAGETASYNCERROR and WSAGETASYNCBUFLEN, defined in **winsock.h** as:

```
#define WSAGETASYNCERROR(lParam)            HIWORD(lParam)
#define WSAGETASYNCBUFLEN(lParam)           LOWORD(lParam)
```

The use of these macros will maximize the portability of the source code for the application.

Return Value

The return value specifies whether or not the asynchronous operation was successfully initiated. Note that it does not imply success or failure of the operation itself.

If the operation was successfully initiated, **WSAAsyncGetServByPort()** returns a nonzero value of type HANDLE which is the asynchronous task handle for the request. This value can be used in two ways. It can be used to cancel the operation using **WSACancelAsyncRequest()**. It can also be used to match up asynchronous operations and completion messages, by examining the *wParam* message argument.

If the asynchronous operation could not be initiated, **WSAAsyncGetServByPort()** returns a zero value, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments

The buffer supplied to this function is used by Winsock to construct a servent structure together with the contents of data areas referenced by members of the same servent structure. To avoid the WSAENOBUFS error noted above, the application should provide a buffer of at least MAXGETHOSTSTRUCT bytes (as defined in **winsock.h**).

Error Codes

The following error codes may be set when an application window receives a message. As described above, they may be extracted from the *lParam* in the reply message using the WSAGETASYNCERROR macro.

WSAENETDOWN	The network subsystem has failed.
WSAENOBUFS	No/insufficient buffer space is available
WSAHOST_NOT_FOUND	Authoritative Answer Host not found.
WSATRY_AGAIN	Non-Authoritative Host not found, or SERVERFAIL.
WSANO_RECOVERY	Non recoverable errors, FORMERR, REFUSED, NOTIMP.
WSANO_DATA	Valid name, no data record of requested type.

The following errors may occur at the time of the function call, and indicate that the asynchronous operation could not be initiated.

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEWOULDBLOCK	The asynchronous operation cannot be scheduled at this time due to resource or other constraints within the Winsock implementation.

See Also **getservbyport()**, **WSACancelAsyncRequest()**

3.38 WSAAsyncSelect()

Description Request event notification for a socket.

#include < winsock.h >

int WSAAPI WSAAsyncSelect (SOCKET *s*, **HWND** *hWnd*, **unsigned int** *wMsg*, **long** *lEvent* **);**

s	A descriptor identifying the socket for which event notification is required.
hWnd	A handle identifying the window which should receive a message when a network event occurs.
wMsg	The message to be received when a network event occurs.
lEvent	A bitmask which specifies a combination of network events in which the application is interested.

Remarks This function is used to request that the Winsock DLL should send a message to the window *hWnd* whenever it detects any of the network events specified by the *lEvent* parameter. The message which should be sent is specified by the *wMsg* parameter. The socket for which notification is required is identified by *s*.

This function automatically sets socket *s* to non-blocking mode, regardless of the value of *lEvent*. See **ioctlsocket()** about how to set the non-overlapped socket back to blocking mode.

The *lEvent* parameter is constructed by or'ing any of the values specified in the following list.

Value	Meaning
FD_READ	Want to receive notification of readiness for reading
FD_WRITE	Want to receive notification of readiness for writing
FD_OOB	Want to receive notification of the arrival of out-of-band data
FD_ACCEPT	Want to receive notification of incoming connections
FD_CONNECT	Want to receive notification of completed connection
FD_CLOSE	Want to receive notification of socket closure
FD_QOS	Want to receive notification of socket Quality of Service (QOS) changes
FD_GROUP_QOS	Want to receive notification of socket group Quality of Service (QOS) changes

Issuing a **WSAAsyncSelect()** for a socket cancels any previous **WSAAsyncSelect()** or **WSAEventSelect()** for the same socket. For example, to receive notification for both reading and writing, the application must call **WSAAsyncSelect()** with both FD_READ and FD_WRITE, as follows:

```
rc = WSAAsyncSelect(s, hWnd, wMsg, FD_READ|FD_WRITE);
```

It is not possible to specify different messages for different events. The following code will not work; the second call will cancel the effects of the first, and only FD_WRITE events will be reported with message wMsg2:

```
rc = WSAAsyncSelect(s, hWnd, wMsg1, FD_READ);
rc = WSAAsyncSelect(s, hWnd, wMsg2, FD_WRITE);
```

To cancel all notification – i.e., to indicate that Winsock should send no further messages related to network events on the socket – *lEvent* should be set to zero.

```
rc = WSAAsyncSelect(s, hWnd, 0, 0);
```

Although in this instance **WSAAsyncSelect()** immediately disables event message posting for the socket, it is possible that messages may be waiting in the application's message queue. The application must therefore be prepared to receive network event messages even after cancellation. Closing a socket with **closesocket()** also cancels **WSAAsyncSelect()** message sending, but the same caveat about messages in the queue prior to the **closesocket()** still applies.

Since an **accept()'**ed socket has the same properties as the listening socket used to accept it, any **WSAAsyncSelect()** events set for the listening socket apply to the accepted socket. For example, if a listening socket has **WSAAsyncSelect()** events FD_ACCEPT, FD_READ, and FD_WRITE, then any socket accepted on that listening socket will also have FD_ACCEPT, FD_READ, and FD_WRITE events with the same *wMsg* value used for messages. If a different *wMsg* or events are desired, the application should call **WSAAsyncSelect()**, passing the accepted socket and the desired new information.[1]

When one of the nominated network events occurs on the specified socket *s*, the application's window *hWnd* receives message *wMsg*. The *wParam* argument identifies the socket on which a network event has occurred. The low word of *lParam* specifies the network event that has occurred. The high word of *lParam* contains any error code. The error code be any error as defined in **winsock.h**.

The error and event codes may be extracted from the *lParam* using the macros WSAGETSELECTERROR and WSAGETSELECTEVENT, defined in **winsock.h** as:

```
#define WSAGETSELECTERROR(lParam)             HIWORD(lParam)
#define WSAGETSELECTEVENT(lParam)             LOWORD(lParam)
```

The use of these macros will maximize the portability of the source code for the application.

The possible network event codes which may be returned are as follows:

---

[1]Note that there is a timing window between the **accept()** call and the call to **WSAAsyncSelect()** to change the events or *wMsg*. An application which desires a different *wMsg* for the listening and **accept()**'ed sockets should ask for only FD_ACCEPT events on the listening socket, then set appropriate events after the **accept()**. Since FD_ACCEPT is never sent for a connected socket and FD_READ, FD_WRITE, FD_OOB, and FD_CLOSE are never sent for listening sockets, this will not impose difficulties.

Value	Meaning
FD_READ	Socket *s* ready for reading
FD_WRITE	Socket *s* ready for writing
FD_OOB	Out-of-band data ready for reading on socket s.
FD_ACCEPT	Socket *s* ready for accepting a new incoming connection
FD_CONNECT	Connection initiated on socket *s* completed
FD_CLOSE	Connection identified by socket *s* has been closed
FD_QOS	Quality of Service associated with socket *s* has changed.
FD_GROUP_QOS	Quality of Service associated with the socket group to which *s* belongs has changed.

Return Value The return value is 0 if the application's declaration of interest in the network event set was successful. Otherwise the value SOCKET_ERROR is returned, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments Although **WSAAsyncSelect()** can be called with interest in multiple events, the application window will receive a single message for each network event.

As in the case of the **select()** function, **WSAAsyncSelect()** will frequently be used to determine when a data transfer operation (**send()** or **recv()**) can be issued with the expectation of immediate success. Nevertheless, a robust application must be prepared for the possibility that it may receive a message and issue a Winsock2 call which returns WSAEWOULDBLOCK immediately. For example, the following sequence of events is possible:

(i)	data arrives on socket **s**; Winsock2 posts **WSAAsyncSelect** message
(ii)	application processes some other message
(iii)	while processing, application issues an **ioctlsocket(s, FIONREAD...)** and notices that there is data ready to be read
(iv)	application issues a **recv(s,...)** to read the data
(v)	application loops to process next message, eventually reaching the **WSAAsyncSelect** message indicating that data is ready to read
(vi)	application issues **recv(s,...)**, which fails with the error WSAEWOULDBLOCK.

Other sequences are possible.

TheWinsock DLL will not continually flood an application with messages for a particular network event. Having successfully posted notification of a particular event to an application window, no further message(s) for that network event will be posted to the application window until the application makes the function call which implicitly reenables notification of that network event.

Event	Re-enabling function
FD_READ	**recv()** or **recvfrom()**
FD_WRITE	**send()** or **sendto()**
FD_OOB	**recv()**
FD_ACCEPT	**accept()** or **WSAAcceptEx()** unless the error code returned is WSATRY_AGAIN indicating that the condition function returned CF_DEFER
FD_CONNECT	NONE
FD_CLOSE	NONE

FD_QOS	**WSAIoctl()** with command SIO_GET_QOS
FD_GROUP_QOS	**WSAIoctl()** with command SIO_GET_GROUP_QOS

Any call to the reenabling routine, even one which fails, results in reenabling of message posting for the relevant event.

For FD_READ, FD_OOB, and FD_ACCEPT events, message posting is "level-triggered." This means that if the reenabling routine is called and the relevant event is still valid after the call, a **WSAAsyncSelect()** message is posted to the application. This allows an application to be event-driven and not be concerned with the amount of data that arrives at any one time. Consider the following sequence:

(i)	network transport stack receives 100 bytes of data on socket **s** and causes Winsock2 to post an FD_READ message.
(ii)	The application issues **recv(s, buffptr, 50, 0)** to read 50 bytes.
(iii)	another FD_READ message is posted since there is still data to be read.

With these semantics, an application need not read all available data in response to an FD_READ message--a single **recv()** in response to each FD_READ message is appropriate. If an application issues multiple **recv()** calls in response to a single FD_READ, it may receive multiple FD_READ messages. Such an application may wish to disable FD_READ messages before starting the **recv()** calls by calling **WSAAsyncSelect()** with the FD_READ event not set.

The FD_QOS and FD_GROUP_QOS events are considered edge triggered. A message will be posted exactly once when a QOS change occurs. Further messages will not be forthcoming until either the provider detects a further change in QOS or the application renegotiates the QOS for the socket.

If an event has already happened when the application calls **WSAAsyncSelect()** or when the reenabling function is called, then a message is posted as appropriate. All the events have persistence beyond the occurrence of their respective events. For example, consider the following sequence: 1) an application calls **listen()**, 2) a connect request is received but not yet accepted, 3) the application calls **WSAAsyncSelect()** specifying that it wants to receive FD_ACCEPT messages for the socket. Due to the persistence of events, Winsock2 posts an FD_ACCEPT message immediately.

The FD_WRITE event is handled slightly differently. An FD_WRITE message is posted when a socket is first connected with **connect()/WSAConnect()** or accepted with **accept()/WSAAccept()**, and then after a send operation fails with WSAEWOULDBLOCK and buffer space becomes available. Therefore, an application can assume that sends are possible starting from the first FD_WRITE message and lasting until a send returns WSAEWOULDBLOCK. After such a failure the application will be notified that sends are again possible with an FD_WRITE message.

The FD_OOB event is used only when a socket is configured to receive out-of-band data separately. If the socket is configured to receive out-of-band data in-line, the out-of-band (expedited) data is treated as normal data and the application should register an interest in, and will receive, FD_READ events, not FD_OOB events. An application may set or inspect the way in which out-of-band data is to be handled by using **setsockopt()** or **getsockopt()** for the SO_OOBINLINE option.

The error code in an FD_CLOSE message indicates whether the socket close was graceful or abortive. If the error code is 0, then the close was graceful; if the error code is WSAECONNRESET, then the socket's virtual circuit was reset. This only applies to connection-oriented sockets such as SOCK_STREAM.

The FD_CLOSE message is posted when a close indication is received for the virtual circuit corresponding to the socket. In TCP terms, this means that the FD_CLOSE is posted when the connection goes into the FIN WAIT or CLOSE WAIT states. This results from the remote end performing a **shutdown()** on the send side or a **closesocket().**

Please note your application will receive ONLY an FD_CLOSE message to indicate closure of a virtual circuit, and only when all the received data has been read if this is a graceful close. It will NOT receive an FD_READ message to indicate this condition.

The FD_QOS or FD_GROUP_QOS message is posted when any field in the flow spec associated with socket *s* or the socket group that *s* belongs to has changed, respectively. Applications should use **WSAIoctl()** with command SIO_GET_QOS or SIO_GET_GROUP_QOS to get the current QOS for socket *s* or for the socket group *s* belongs to, respectively.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	Indicates that one of the specified parameters was invalid, or the specified socket is in an invalid state.
WSAEINPROGRESS	A blocking Winsock2 call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAENOTSOCK	The descriptor is not a socket.

Additional error codes may be set when an application window receives a message. This error code is extracted from the *lParam* in the reply message using the WSAGETSELECTERROR macro. Possible error codes for each network event are:

Event: FD_CONNECT

Error Code	Meaning
WSAEADDRINUSE	The specified address is already in use.
WSAEADDRNOTAVAIL	The specified address is not available from the local machine.
WSAEAFNOSUPPORT	Addresses in the specified family cannot be used with this socket.
WSAECONNREFUSED	The attempt to connect was forcefully rejected.
WSAENETUNREACH	The network can't be reached from this host at this time.

WSAENOBUFS	No buffer space is available. The socket cannot be connected.
WSAETIMEDOUT	Attempt to connect timed out without establishing a connection

Event: FD_CLOSE

Error Code	Meaning
WSAENETDOWN	The network subsystem has failed.
WSAECONNRESET	The connection was reset by the remote side.
WSAECONNABORTED	The connection was aborted due to timeout or other failure.

Event: FD_READ
Event: FD_WRITE
Event: FD_OOB
Event: FD_ACCEPT
Event: FD_QOS
Event: FD_GROUP_QOS

Error Code	Meaning
WSAENETDOWN	The network subsystem has failed.

See Also **select(), WSAEventSelect()**

3.39 WSACancelAsyncRequest()

Description Cancel an incomplete asynchronous operation.

#include <winsock.h>

int WSAAPI WSACancelAsyncRequest (HANDLE *hAsyncTaskHandle* **);**

hAsyncTaskHandle Specifies the asynchronous operation to be canceled.

Remarks The **WSACancelAsyncRequest()** function is used to cancel an asynchronous operation which was initiated by one of the **WSAAsyncGetXByY()** functions such as **WSAAsyncGetHostByName()**. The operation to be canceled is identified by the *hAsyncTaskHandle* parameter, which should be set to the asynchronous task handle as returned by the initiating function.

Return Value The value returned by **WSACancelAsyncRequest()** is 0 if the operation was successfully canceled. Otherwise the value SOCKET_ERROR is returned, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments An attempt to cancel an existing asynchronous **WSAAsyncGetXByY()** operation can fail with an error code of WSAEALREADY for two reasons. First, the original operation has already completed and the application has dealt with the resultant message. Second, the original operation has already completed but the resultant message is still waiting in the application window queue.

Note It is unclear whether the application can usefully distinguish between WSAEINVAL and WSAEALREADY, since in both cases the error indicates that there is no asynchronous operation in progress with the indicated handle. [Trivial exception: 0 is always an invalid asynchronous task handle.] The Winsock specification does not prescribe how a conformant Winsock provider should distinguish between the two cases. For maximum portability, a Winsock application should treat the two errors as equivalent.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	Indicates that the specified asynchronous task handle was invalid
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEALREADY	The asynchronous routine being canceled has already completed.

See Also **WSAAsyncGetHostByAddr**(), **WSAAsyncGetHostByName**(), **WSAAsyncGetProtoByNumber**(), **WSAAsyncGetProtoByName**(), **WSAAsyncGetServByPort**(), **WSAAsyncGetServByName**().

3.40 WSACancelBlockingCall()

Description Cancel a blocking call which is currently in progress.

#include <winsock.h>

int WSAAPI WSACancelBlockingCall (void);

Remarks This function cancels any outstanding blocking operation for this task. It is normally used in two situations:

(1) An application is processing a message which has been received while a blocking call is in progress. In this case, **WSAIsBlocking()** will be true.

(2) A blocking call is in progress, and Winsock has called back to the application's "blocking hook" function (as established by **WSASetBlockingHook()**).

In each case, the original blocking call will terminate as soon as possible with the error WSAEINTR. (In (1), the termination will not take place until Windows message scheduling has caused control to revert to the blocking routine in Winsock. In (2), the blocking call will be terminated as soon as the blocking hook function completes.)

In the case of a blocking **connect()** operation, Winsock will terminate the blocking call as soon as possible, but it may not be possible for the socket resources to be released until the connection has completed (and then been reset) or timed out. This is likely to be noticeable only if the application immediately tries to open a new socket (if no sockets are available), or to **connect()** to the same peer.

Canceling an **accept()** or a **select()** call does not adversely impact the sockets passed to these calls. Only the particular call fails; any operation that was legal before the cancel is legal after the cancel, and the state of the socket is not affected in any way.

Canceling any operation other than **accept()** and **select()** can leave the socket in an indeterminate state. If an application cancels a blocking operation on a socket, the only operation that the application can depend on being able to perform on the socket is a call to **closesocket()**, although other operations may work on some Winsock implementations. If an application desires maximum portability, it must be careful not to depend on performing operations after a cancel. An application may reset the connection by setting the timeout on SO_LINGER to 0.

If a cancel operation compromised the integrity of a SOCK_STREAM's data stream in any way, the Winsock provider must reset the connection and fail all future operations other than **closesocket()** with WSAECONNABORTED.

Return Value The value returned by **WSACancelBlockingCall()** is 0 if the operation was successfully canceled. Otherwise the value SOCKET_ERROR is returned, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments Note that it is possible that the network operation completes before the **WSACancelBlockingCall()** is processed, for example if data is received into the user buffer at interrupt time while the application is in a blocking hook. In this case, the blocking operation will return successfully as if **WSACancelBlockingCall()** had never been called. Note that the **WSACancelBlockingCall()** still succeeds in this case; the

only way to know with certainty that an operation was actually canceled is to check for a return code of WSAEINTR from the blocking call.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	Indicates that there is no outstanding blocking call.

3.41 WSACleanup()

Description Terminate use of the Winsock DLL.

#include <winsock.h>

int WSAAPI WSACleanup (void);

Remarks An application or DLL is required to perform a (successful) **WSAStartup()** call before it can use Winsock services. When it has completed the use of Winsock, the application or DLL must call **WSACleanup()** to deregister itself from a Winsock implementation and allow the implementation to free any resources allocated on behalf of the application or DLL. Any open connection-oriented sockets that are connected when **WSACleanup()** is called are reset; sockets which have been closed with **closesocket()** but which still have pending data to be sent are not affected--the pending data is still sent.

There must be a call to **WSACleanup()** for every call to **WSAStartup()** made by a task. Only the final **WSACleanup()** for that task does the actual cleanup; the preceding calls simply decrement an internal reference count in the Winsock DLL. A naive application may ensure that **WSACleanup()** was called enough times by calling **WSACleanup()** in a loop until it returns WSANOTINITIALISED.

Return Value The return value is 0 if the operation was successful. Otherwise the value SOCKET_ERROR is returned, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Comments Attempting to call **WSACleanup()** from within a blocking hook and then failing to check the return code is a common Winsock programming error. If an application needs to quit while a blocking call is outstanding, the application must first cancel the blocking call with **WSACancelBlockingCall()** then issue the **WSACleanup()** call once control has been returned to the application.

In a multithreaded environment, **WSACleanup()** terminates Winsock operations for all threads.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).

See Also **WSAStartup()**

3.42 WSACloseEvent()

Description Closes an open event object handle.

#include <winsock.h>

BOOL WSAAPI WSACloseEvent(WSAEVENT *hEvent* **);**

hEvent Identifies an open event object handle.

Remarks The Win32 implementation of this function is:

```
#define WSACloseEvent( h ) \
        CloseHandle( h )
```

Return Value If the function succeeds, the return value is TRUE.

If the function fails, the return value is FALSE. To get extended error information, call **WSAGetLastError()**.

Error Codes ERROR_INVALID_HANDLE *hEvent* is not a valid event object handle.

See Also **WSACreateEvent().**

3.43 WSAConnect()

Description Establish a connection to a peer, exchange connect data, , and specify needed quality of service based on the supplied flow spec.

#include <winsock.h>

int WSAAPI WSAConnect (SOCKET *s*, **const struct sockaddr FAR *** *name*, **int** *namelen*, **LPWSABUF** *lpCallerData*, **LPWSABUF** *lpCalleeData*, **GROUP** *g*, **LPQOS** *lpSQOS*, **LPQOS** *lpGQOS* **);**

s	A descriptor identifying an unconnected socket.
name	The name of the peer to which the socket is to be connected.
namelen	The length of the *name*.
lpCallerData	A pointer to the user data that is to be transferred to the peer during connection establishment.
lpCalleeData	A pointer to the user data that is to be transferred back from the peer during connection establishment.
lpSQOS	A pointer to the flow specs for socket *s*, one for each direction.
lpGQOS	A pointer to the flow specs for the socket group (if applicable).

Remarks This function is used to create a connection to the specified destination, and to perform a number of other ancillary operations that occur at connect time as well. For connection-oriented sockets (e.g., type SOCK_STREAM), an active connection is initiated to the foreign host using *name* (an address in the name space of the socket; for a detailed description, please see **bind**()). When this call completes successfully, the socket is ready to send/receive data.

For a connectionless socket (e.g., type SOCK_ DGRAM), the operation performed by **WSAConnect()** is merely to establish a default destination address so that the socket may be used on subsequent connection-oriented send and receive operations (**send(), WSASend(), recv(), WSARecv()**). On connectionless sockets, exchange of user to user data is not possible and the corresponding parameters will be silently ignored.

If the socket, *s*, is unbound, unique values are assigned to the local association by the Winsock provider, and the socket is marked as bound. Note that if the address field of the *name* structure is all zeroes, **WSAConnect()** will return the error WSAEADDRNOTAVAIL.

The application is responsible for allocating any memory space pointed to directly or indirectly by any of the parameters it specifies.
The *lpCallerData* is a value parameter which contains any user data that is to be sent along with the connection request. If *lpCallerData* is NULL, no user data will be passed to the peer. The *lpCalleeData* is a result parameter which will contain any user data passed back from the peer as part of the connection establishment. *lpCalleeData->len* initially contains the length of the buffer allocated by the application and pointed

to by *lpCalleeData->buf*. *lpCalleeData->len* will be set to 0 if no user data has been passed back. The *lpCalleeData* information will be valid when the connection operation is complete. For blocking sockets, this will be when the **WSAConnect()** function returns. For non-blocking sockets, this will be after the FD_CONNECT notification has occurred. If *lpCalleeData* is NULL, no user data will be passed back. The exact format of the user data is specific to the address family to which the socket belongs.

At connect time, an application may attempt to override any previous QOS specification made for the socket via **WSAIoctl()** with either the SIO_SET_QOS or SIO_SET_GROUP_QOS opcodes.

lpSQOS specifies two blocks of memory containing the flow specs for socket *s*, one for each direction. If either the associated transport provider in general or the specific type of socket in particular cannot honor the QOS request, an error will be returned as indicated below. The forward or backward flow spec values will be ignored, respectively, for any unidirectional sockets. The first part of each memory block contains the flow parameters common to all providers, optionally followed by any provider specific portion. A NULL value for *lpSQOS* indicates no application supplied QOS.

lpGQOS specifies two blocks of memory containing the flow specs for the socket group (if applicable), one for each direction. The first part of each memory block contains the flow parameters common to all providers, optionally followed by any provider specific portion. A NULL value for *lpGQOS* indicates no application-supplied group QOS.

Comments

When connected sockets break (i.e. become closed for whatever reason), they should be discarded and recreated. It is safest to assume that when things go awry for any reason on a connected socket, the application must discard and recreate the needed sockets in order to return to a stable point.

Return Value

If no error occurs, **WSAConnect()** returns 0. Otherwise, it returns SOCKET_ERROR, and a specific error code may be retrieved by calling **WSAGetLastError().**

On a blocking socket, the return value indicates success or failure of the connection attempt.

On a non-blocking socket (including overlapped sockets), if the return value is SOCKET_ERROR an application should call **WSAGetLastError().** If this indicates an error code of WSAEWOULDBLOCK, then your application can either:

1. Use **select()** to determine the completion of the connection request by checking if the socket is writeable, or

2. If your application is using **WSAAsyncSelect()** to indicate interest in connection events, then your application will receive an FD_CONNECT notification when the connect operation is complete.

3. If your applicationis using **WSAEventSelect()** to indicate interest in connection events, then the associated event object will be signaled when the connect operation is complete.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEADDRINUSE	The specified address is already in use.
WSAEINTR	The (blocking) call was canceled via **WSACancelBlockingCall().**
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEADDRNOTAVAIL	The specified address is not available from the local machine.
WSAEAFNOSUPPORT	Addresses in the specified family cannot be used with this socket.
WSAECONNREFUSED	The attempt to connect was forcefully rejected.
WSAEDESTADDREQ	A destination address is required.
WSAEFAULT	The *namelen* argument is incorrect, the buffer length for *lpCalleeData*, *lpSQOS*, and *lpGQOS* are too small, or the buffer length for *lpCallerData* is too large.
WSAEINVAL	The parameter *s* is a listening socket.
WSAEISCONN	The socket is already connected.
WSAEMFILE	No more socket descriptors are available.
WSAENETUNREACH	The network can't be reached from this host at this time.
WSAENOBUFS	No buffer space is available. The socket cannot be connected.
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	The flow specs specified in *lpSQOS* and *lpGQOS* cannot be satisfied.
WSAEPROTONOSUPPORT	The *lpCallerData* augment is not supported by the service provider.
WSAETIMEDOUT	Attempt to connect timed out without establishing a connection

WSAEWOULDBLOCK	The socket is marked as non-blocking and the connection cannot be completed immediately. It is possible to **select()** the socket while it is connecting by **select()**ing it for writing.

See Also **accept(), bind(), connect(), getsockname(), getsockopt(), socket(), select(), WSAAsyncSelect(), WSAEventSelect().**

3.44 WSACreateEvent()

Description Creates a new event object.

#include <winsock.h>

WSAEVENT WSAAPI WSACreateEvent(VOID);

Remarks The event object created by this function is manual reset, with an initial state of nonsignaled. If a Win32 application desires auto reset events, it may call the native **CreateEvent()** Win32 API directly.

The Win32 implementation of this function is:

```
#define WSACreateEvent() \
        CreateEvent( NULL, FALSE, FALSE, NULL );
```

Return Value If the function succeeds, the return value is the handle of the event object.

If the function fails, the return value is WSA_INVALID_EVENT. To get extended error information, call **WSAGetLastError()**.

Error Codes ERROR_NOT_ENOUGH_MEMORY Not enough free memory available to create the event object.

See Also **WSACloseEvent().**

3.45 WSADuplicateSocket()

Description Create a new socket descriptor for a shared socket.

#include <winsock.h>

SOCKET WSAAPI WSADuplicateSocket (SOCKET *s*, **WSATASK** *hTargetTask* **);**

s Specifies the local socket descriptor.

hTargetTask Specifies the handle of the target task for which the shared socket will be used.

Remarks This function is used to enable socket sharing by creating a new socket descriptor for an underlying shared socket. Shared socket descriptors are created in the context of the source task by supplying an existing, local socket descriptor and a handle to the target task (which could be the same task as the source task) for which the shared socket will be used. The newly created shared socket descriptor only has meaning within the context of the target task.

To get the handle of the target task, it will generally be necessary to use some form of interprocess communication (IPC), which is out of the scope of this specification. Since the created shared socket only has meaning in the target task, the source task must pass the value of the shared socket descriptor to the target task, again via some IPC mechanism. One possible scenario for establishing and using a shared socket is illustrated below:

Source Task	IPC	Destination Task
1) WSASocket()		
2) Request target task handle	⇒	3) Receive task handle request
5) Receive target task handle	⇐	4) Supply task handle
6) WSADuplicateSocket()		
7) Send target socket descriptor	⇒	8) Receive target socket descriptor
9) Use shared socket for sending		10) Use shared socket for receiving

Return Value If no error occurs, **WSADuplicateSocket()** returns a descriptor referencing the new socket. Otherwise, a value of INVALID_SOCKET is returned, and a specific error code may be retrieved by calling **WSAGetLastError().**

Comments **Note: The notification semantics for shared sockets remain an open issue. The text which follows assumes the independent notification proposal.**
Shared sockets may be used in all places where regular sockets are used and are, in fact, indistinguishable from them. Socket descriptors referencing a common underlying socket share all aspects of the underlying socket object with the exception of the notification mechanism. Reference counting is employed to ensure that the underlying socket object is not closed until the last shared socket descriptor is closed.

Since the collection of attributes which comprise a socket's option set is shared, setting any socket option on a shared socket may have a global effect. For example, if one task

uses **ioctlsocket()** on a shared socket to set it into non-blocking mode, this change is visible to all of the shared socketdescriptors that reference the underlying socket.

Each shared socket has an independent notification mechanism which conforms to the usual Winsock conventions. Thus if two or more tasks are sharing an underlying socket and each requests notification via Windows messages when data is ready to be read, all such tasks will receive their stipulated message in an unspecified sequence. The first task to perform a read will get some or all of the available data, the others will get what's left, if any. In other words, it is completely up to tasks which share a socket to coordinate their access to the socket.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	Indicates that one of the specified parameters was invalid
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEMFILE	No more socket descriptors are available.
WSAENOBUFS	No buffer space is available. The socket cannot be created.
WSAENOTSOCK	The descriptor is not a socket.

See Also

3.46 WSAEnumNetworkEvents()

Description Discover occurrences of network events for the indicated socket.

#include <winsock.h>

int WSAAPI WSAEnumNetworkEvents (SOCKET *s*, **WSAEVENT** *hEventObject*, **LPWSANETWORKEVENTS** *lpNetworkEvents*, **LPINT** *lpiCount*)**;**

s A descriptor identifying the socket.

hEventObject An optional handle identifying an associated event object to be reset.

lpNetworkEvents An array of WSANETWORKEVENTS structs, each of which records an occurred network event and the associated error code.

lpiCount The number of elements in the array. Upon returning, this parameter indicates the actual number of elements in the array, or the minimum number of elememts needed to retrieve all the network events if the return value is WSAENOBUFS.

Remarks This function is used to discover which network events have occurred for the indicated socket since the last invocation of this function. It is intended for use in conjunction with **WSAEventSelect(),** which associates an event object with one or more network events. The socket's internal record of network events is copied to *lpNetworkEvents*, whereafter the internal network events record is cleared. If *hEventObject* is non-null, the indicated event object is also reset. The Winsock DLL guarantees that the operations of copying the network event record, clearing it and resetting any associated event object are atomic, such that the next occurrence of a nominated network event will cause the event object to become set.

The following error codes may be returned along with the respective network event:

Event: FD_CONNECT

Error Code	Meaning
WSAEADDRINUSE	The specified address is already in use.
WSAEADDRNOTAVAIL	The specified address is not available from the local machine.
WSAEAFNOSUPPORT	Addresses in the specified family cannot be used with this socket.
WSAECONNREFUSED	The attempt to connect was forcefully rejected.
WSAENETUNREACH	The network can't be reached from this host at this time.
WSAENOBUFS	No buffer space is available. The socket cannot be connected.
WSAETIMEDOUT	Attempt to connect timed out without establishing a connection

Event: FD_CLOSE

Error Code	Meaning
WSAENETDOWN	The network subsystem has failed.
WSAECONNRESET	The connection was reset by the remote side.
WSAECONNABORTED	The connection was aborted due to timeout or other failure.

Event: FD_READ
Event: FD_WRITE
Event: FD_OOB
Event: FD_ACCEPT
Event: FD_QOS
Event: FD_GROUP_QOS

Error Code	Meaning
WSAENETDOWN	The network subsystem has failed.

Return Value The return value is 0 if the operation was successful. Otherwise the value SOCKET_ERROR is returned, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	Indicates that one of the specified parameters was invalid
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAENOBUFS	The supplied buffer is too small.

See Also **WSAEventSelect()**

3.47 WSAEnumProtocols()

Description Retrieve information about available transport protocols.

#include <winsock.h>

int WSAAPI WSAEnumProtocols (LPDWORD *lpdwProtocols*, **LPVOID** *lpProtocolBuffer,* **LPDWORD** *lpdwBufferLength*)**;**

lpdwProtocols A NULL-terminated array of protocol ids. This parameter is optional; if *lpdwProtocols* is NULL, information on all available protocols is returned, otherwise information is retrieved only for those protocols listed in the array.

lpProtocolBuffer A buffer which is filled with PROTOCOL_INFO structures. See below for a detailed description of the contents of the PROTOCOL_INFO structure.

lpdwBufferLength On input, the count of bytes in the *lpProtocolBuffer* buffer passed to **WSAEnumProtocols().** On output, the minimum buffer size that can be passed to **WSAEnumProtocols()** to retrieve all the requested information. This routine has no ability to enumerate over multiple calls; the passed-in buffer must be large enough to hold all entries in order for the routine to succeed. This reduces the complexity of the API and should not pose a problem because the number of protocols loaded on a machine is typically small.

Remarks This function is used to discover information about the collection of transport protocols installed on the local machine. The *lpdwProtocols* parameter can be used as a filter to constrain the amount of information provided. Normally it will be supplied as a NULL pointer which will cause the routine to return information on all available transport protocols.

A PROTOCOL_INFO struct is provided in the buffer pointed to by *lpProtocolBuffer* for each requested protocol. If the supplied buffer is not large enough (as indicated by the input value of *lpdwBufferLength*), the value pointed to by *lpdwBufferLength* will be updated to indicate the required buffer size. The application should then obtain a large enough buffer and call this function again.

Definitions **PROTOCOL_INFO Structure:**

DWORD *dwServiceFlags1* - a bitmask describing the services provided by the protocol. The following values are possible:

XP1_CONNECTIONLESS -the Protocol provides connectionless (datagram) service. If not set, the protocol supports connection-oriented data transfer.

XP1_GUARANTEED_DELIVERY - the protocol guarantees that all data sent will reach the intended desitnation.

XP1_GUARANTEED_ORDER - the protocol guarantees that data will only arrive in the order in which it was sent and that it will not be

duplicated. This characteristic does not necessarily mean that the data will always be delivered, but that any data that is delivered is delivered in the order in which it was sent.

XP1_MESSAGE_ORIENTED - the protocol honors message boundaries, as opposed to a stream-oriented Protocol where there is no concept of message boundaries.

XP1_PSEUDO_STREAM - this is a message oriented protocol, but message boundaries will be ignored for all receives. This is convenient when an application does not desire message framing to be done by the protocol.

XP1_GRACEFUL_CLOSE - the protocol supports two-phase (graceful) close. If not set, only abortive closes are performed.

XP1_EXPEDITED_DATA - the protocol supports expedited (urgent) data.

XP1_CONNECT_DATA - the protocol supports connect data.

XP1_DISCONNECT_DATA - the protocol supports disconnect data.

XP1_SUPPORTS_BROADCAST - the protocol supports a broadcast mechanism.

XP1_SUPPORTS_MULTICAST - the protocol supports a multicast mechanism.

XP1_QOS_SUPPORTED - the protocol supports quality of service requests.

XP1_ENCRYPTS - the protocol supports data encryption.

XP1_INTERRUPT - for 16 bit environments (only), the protocol allows **WSASend()/WSASendto()** and **WSARecv()/WSARecvfrom()** to be invoked in a preemptive VMM context, sometimes referred to as interrupt context.

XP1_UNI_SEND - the protocol is unidirectional in the send direction.

XP1_UNI_RECV - the protocol is unidirectional in the recv direction.

DWORD *dwServiceFlags2* - reserved for additional protocol attribute definitions

DWORD *dwServiceFlags3*- reserved for additional protocol attribute definitions

DWORD *dwServiceFlags4* - reserved for additional protocol attribute definitions

INT *iProviderID*- A unique identifier assigned to the underlying transport service provider at the time it was installed under Winsock 2. This value is useful for instances where more than one service provider is able to implement a particular protocol. An application may use the *iProviderID* value to distinguish between providers that might otherwise be indistinguishable.

INT *iVersion* -Protocol version identifier.

INT *iAddressFamily* - the value to pass as the address family parameter to the **socket**()/**WSASocket**() API in order to open a socket for this protocol. This value also uniquely defines the structure of protocol addresses (SOCKADDRs) used by the protocol.

INT *iMaxSockAddr* - The maximum address length.

INT *iMinSockAddr* - The minimum address length.

INT *iSocketType* - The value to pass as the socket type parameter to the **socket**() API in order to open a socket for this protocol.

INT *iProtocol* - The value to pass as the protocol parameter to the **socket**() API in order to open a socket for this protocol.

BOOL *bNetworkByteOrder* - A flag to indicate whether the protocol's network byte order is "big-endian" or "little-endian".

BOOL *bMultiple* - A flag to indicate that this is one of two or more entries for a single protocol which is capable of implementing multiple behaviors. An example of this is SPX which on the receiving side can behave either as a message oriented or a stream oriented protocol.

BOOL *bFirst* - A flag to indicate that this is the prime or most frequently used entry for a protocol which is capable of implementing multiple behaviors.

DWORD *dwMessageSize* - The maximum message size supported by the protocol. This is the maximum size that can be sent from any of the host's local interfaces. For protocols which do not support message framing, the actual maximum that can be sent to a given address may be less. The following special values are defined:

0 - the protocol is stream-oriented and hence the concept of message size is not relevent.

0x1 - the maximum message size is dependent on the underlying network MTU (maximum sized transmission unit) and hence cannot be known until after a socket is bound. Applications should use **getsockopt()** to retrieve the value of SO_MAX_MSG_SIZE after the socket has been bound to a local address.

0xFFFFFFFF - the protocol is message-oriented, but there is no maximum limit to the size of messages that may be transmitted.

LPSTR *lpProtocol* - a pointer to a human-readable name identifying the protocol, for example "SPX2".

DWORD *dwNameSpaces* - information on which name spaces can be found by the transport this protocol is contained within. Value encoding is TBD.

Return Value If no error occurs, **WSAEnumProtocols()** returns the number of protocols to be reported on. Otherwise a value of TBD is returned and a specific error code may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINPROGRESS	A blocking Winsock call is in progress.
WSAEINVAL	Indicates that one of the specified parameters was invalid.
WSAENOBUFS	The buffer length was too small to receive all the relevant PROTOCOL_INFO structures and associated information. Pass in a buffer at least as large as the value returned in *lpdwBufferLength*.

3.48 WSAEventSelect()

Description Specify an event object to be associated with the supplied set of FD_XXX network events.

#include <winsock.h>

int WSAAPI WSAEventSelect (SOCKET *s*, **WSAEVENT** *hEventObject*, **long** *lNetworkEvents* **);**

s	A descriptor identifying the socket.
hEventObject	A handle identifying the event object to be associated with the supplied set of FD_XXX network events.
lNetworkEvents	A bitmask which specifies the combination of FD_XXX network events in which the application has interest.

Remarks This function is used to specify an event object, *hEventObject*, to be associated with the selected FD_XXX network events, *lNetworkEvents*. The socket for which an event object is specified is identified by *s*. The event object is set when any of the nominated network events occurr.

WSAEventSelect() operates very similarly to **WSAAsyncSelect()**, the difference being in the actions taken when a nominated network event occurs. Whereas **WSAAsyncSelect()** causes an application-specified Windows message to be posted, **WSAEventSelect()** sets the associated event object and records the occurrence of this event by setting the corresponding bit in an internal network event record. An application can use **WSAWaitForMultipleEvents()** or **WSAGetOverlappedResult()** to wait or poll on the event object, and use **WSAEnumNetworkEvents()** to retrieve the contents of the internal network event record and thus determine which of the nominated network events have occurred.

This function automatically sets socket *s* to non-blocking mode, regardless of the value of *lNetworkEvents*. See **ioctlsocket()** about how to set the non-overlapped socket back to blocking mode.

The *lNetworkEvents* parameter is constructed by or'ing any of the values specified in the following list.

Value	Meaning
FD_READ	Want to receive notification of readiness for reading
FD_WRITE	Want to receive notification of readiness for writing
FD_OOB	Want to receive notification of the arrival of out-of-band data
FD_ACCEPT	Want to receive notification of incoming connections
FD_CONNECT	Want to receive notification of completed connection
FD_CLOSE	Want to receive notification of socket closure
FD_QOS	Want to receive notification of socket Quality of Service (QOS) changes

FD_GROUP_QOS	Want to receive notification of socket group Quality of Service (QOS) changes

Issuing a **WSAEventSelect()** for a socket cancels any previous **WSAAsyncSelect()** or **WSAEventSelect()** for the same socket and clears all bits in the internal network event record. For example, to associate an event object with both reading and writing network events, the application must call **WSAEventSelect()** with both FD_READ and FD_WRITE, as follows:

```
rc = WSAEventSelect(s, hEventObject, FD_READ|FD_WRITE);
```

It is not possible to specify different event objects for different network events. The following code will not work; the second call will cancel the effects of the first, and only FD_WRITE network event will be associated with hEventObject2:

```
rc = WSAEventSelect(s, hEventObject1, FD_READ);
rc = WSAEventSelect(s, hEventObject2, FD_WRITE);
```

To cancel the association and selection of network events on a socket, *lNetworkEvents* should be set to zero, in which case the *hEventObject* parameter will be ignored.

```
rc = WSAEventSelect(s, hEventObject, 0);
```

Closing a socket with **closesocket()** also cancels the association and selection of network events specified in **WSAEventSelect()** for the socket. The application, however, still needs to call **WSACloseEvent()** to explicitly close the event object and free any resources.

Since an **accept()'**ed socket has the same properties as the listening socket used to accept it, any **WSAEventSelect()** association and network events selection set for the listening socket apply to the accepted socket. For example, if a listening socket has **WSAEventSelect()** association of *hEventOject* with FD_ACCEPT, FD_READ, and FD_WRITE, then any socket accepted on that listening socket will also have FD_ACCEPT, FD_READ, and FD_WRITE network events associated with the same *hEventObject*. If a different *hEventObject* or network events are desired, the application should call **WSAEventSelect()**, passing the accepted socket and the desired new information.[2]

Return Value The return value is 0 if the application's specification of the network events and the associated event object was successful. Otherwise the value SOCKET_ERROR is returned, and a specific error number may be retrieved by calling **WSAGetLastError()**.

As in the case of the **select()** and **WSAAsyncSelect()** functions, **WSAEventSelect()** will frequently be used to determine when a data transfer operation (**send()** or **recv()**)

---

[2]Note that there is a timing window between the **accept()** call and the call to **WSAEventSelect()** to change the network events or *hEventObject*. An application which desires a different *hEventObject* for the listening and **accept()**'ed sockets should ask for only FD_ACCEPT network event on the listening socket, then set appropriate network events after the **accept()**. Since FD_ACCEPT never happens to a connected socket and FD_READ, FD_WRITE, FD_OOB, and FD_CLOSE never happen to listening sockets, this will not impose difficulties.

can be issued with the expectation of immediate success. Nevertheless, a robust application must be prepared for the possibility that the event object is set and it issues a Winsock call which returns WSAEWOULDBLOCK immediately. For example, the following sequence of operations is possible:

(i) data arrives on socket **s**; Winsock sets the **WSAEventSelect** event object
(ii) application does some other processing
(iii) while processing, application issues an **ioctlsocket(s, FIONREAD...)** and notices that there is data ready to be read
(iv) application issues a **recv(s,...)** to read the data
(v) application eventually waits on event object specified in **WSAEventSelect()**, which returns immediately indicating that data is ready to read
(vi) application issues **recv(s,...)**, which fails with the error WSAEWOULDBLOCK.

Other sequences are possible.

Having successfully recorded the occurrence of the network event (by setting the corresponding bit in the internal network event record) and signaled the associated event object, no further actions are taken for that network event until the application makes the function call which implicitly reenables the setting of that network event and signaling of the associated event object.

Network Event	Re-enabling function
FD_READ	**recv()** or **recvfrom()**
FD_WRITE	**send()** or **sendto()**
FD_OOB	**recv()**
FD_ACCEPT	**accept()** or **WSAAccept()** unless the error code returned is WSATRY_AGAIN indicating that the condition function returned CF_DEFER
FD_CONNECT	NONE
FD_CLOSE	NONE
FD_QOS	**WSAIoctl()** with command SIO_GET_QOS
FD_GROUP_QOS	**WSAIoctl()** with command SIO_GET_GROUP_QOS

Any call to the reenabling routine, even one which fails, results in reenabling of recording and setting for the relevant network event and event object, respectively.

For FD_READ, FD_OOB, and FD_ACCEPT network events, network event recording and event object setting are "level-triggered." This means that if the reenabling routine is called and the relevant network condition is still valid after the call, the network event is recorded and the associated event object is set . This allows an application to be event-driven and not be concerned with the amount of data that arrives at any one time. Consider the following sequence:

(i) transport provider receives 100 bytes of data on socket **s** and causes Winsock DLL to record the FD_READ network event and set the associated event object.
(ii) The application issues **recv(s, buffptr, 50, 0)** to read 50 bytes.

(iii) The transport provider causes Winsock DLL to record the FD_READ network event and sets the associated event object again since there is still data to be read.

With these semantics, an application need not read all available data in response to an FD_READ network event --a single **recv()** in response to each FD_READ network event is appropriate.

The FD_QOS and FD_GROUP_QOS events are considered edge triggered. A message will be posted exactly once when a QOS change occurs. Further messages will not be forthcoming until either the provider detects a further change in QOS or the application renegotiates the QOS for the socket.

If a network event has already happened when the application calls **WSAEventSelect()** or when the reenabling function is called, then a network event is recorded and the associated event object is set as appropriate. All the network events have persistence beyond the occurrence of their respective events. For example, consider the following sequence: 1) an application calls **listen()**, 2) a connect request is received but not yet accepted, 3) the application calls **WSAEventSelect()** specifying that it is interested in the FD_ACCEPT network event for the socket. Due to the persistence of network events, Winsock records the FD_ACCEPT network event and sets the associated event object immediately.

The FD_WRITE network event is handled slightly differently. An FD_WRITE network event is recorded when a socket is first connected with **connect()/WSAConnect()** or accepted with **accept()/WSAAccept()**, and then after a send fails with WSAEWOULDBLOCK and buffer space becomes available. Therefore, an application can assume that sends are possible starting from the first FD_WRITE network event settting and lasting until a send returns WSAEWOULDBLOCK. After such a failure the application will find out that sends are again possible when an FD_WRITE network event is recorded and the associated event object is set .

The FD_OOB network event is used only when a socket is configured to receive out-of-band data separately. If the socket is configured to receive out-of-band data in-line, the out-of-band (expedited) data is treated as normal data and the application should register an interest in, and will get, FD_READ network event, not FD_OOB network event. An application may set or inspect the way in which out-of-band data is to be handled by using **setsockopt()** or **getsockopt()** for the SO_OOBINLINE option.

The error code in an FD_CLOSE network event indicates whether the socket close was graceful or abortive. If the error code is 0, then the close was graceful; if the error code is WSAECONNRESET, then the socket's virtual circuit was reset. This only applies to connection-oriented sockets such as SOCK_STREAM.

The FD_CLOSE network event is recorded when a close indication is received for the virtual circuit corresponding to the socket. In TCP terms, this means that the FD_CLOSE is recorded when the connection goes into the FIN WAIT or CLOSE WAIT states. This results from the remote end performing a **shutdown()** on the send side or a **closesocket().**

Please note Winsock will record ONLY an FD_CLOSE network event to indicate closure of a virtual circuit. It will NOT record an FD_READ network event to indicate this condition.

The FD_QOS or FD_GROUP_QOS network event is recorded when any field in the flow spec associated with socket *s* or the socket group that *s* belongs to has changed, respectively. Applications should use **WSAIoctl()** with command SIO_GET_QOS or SIO_GET_GROUP_QOS to get the current QOS for socket *s* or for the socket group *s* belongs to, respectively.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	Indicates that one of the specified parameters was invalid, or the specified socket is in an invalid state.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAENOTSOCK	The descriptor is not a socket.

See Also **WSACloseEvent(),WSACreateEvent(), WSAEnumNetworkEvents(), WSAGetOverlappedResult(),WSAWaitForMultipleEvents().**

3.49 WSAGetLastError()

Description Get the error status for the last operation which failed.

#include <winsock.h>

int WSAAPI WSAGetLastError (void);

Remarks This function returns the last network error that occurred. When a particular Winsock function indicates that an error has occurred, this function should be called to retrieve the appropriate error code.

Return Value The return value indicates the error code for the last Winsock routine performed by this thread.

See Also **WSASetLastError()**

3.50 WSAGetOverlappedResult()

Description Returns the results of an overlapped operation on the specified socket.

#include <winsock.h>

BOOL WSAAPI WSAGetOverlappedResult(SOCKET *s*, **LPWSAOVERLAPPED** *lpOverlapped*, **LPDWORD** *lpcbTransfer*, **BOOL** *fWait*, **LPDWORD** *lpdwFlags* **);**

s	Identifies the socket. This is the same socket that was specified when the overlapped operation was started by a call to **WSARecv(), WSARecvfrom(), WSASend(),** or **WSASendto()**.
lpOverlapped	Points to a WSAOVERLAPPED structure that was specified when the overlapped operation was started.
lpcbTransfer	Points to a 32-bit variable that receives the number of bytes that were actually transferred by a send or receive operation.
fWait	Specifies whether the function should wait for the pending overlapped operation to complete. If TRUE, the function does not return until the operation has been completed. If FALSE and the operation is still pending, the function returns FALSE and the **WSAGetLastError**() function returns WSA_IO_INCOMPLETE.
lpdwFlags	Points to a 32-bit variable that will receive one or more flags that supplement the completion status. For example, if partial data is received over a message-oriented transport, this is indicated here.

Remarks The results reported by the **WSAGetOverlappedResult()** function are those of the specified socket's last overlapped operation to which the specified WSAOVERLAPPED structure was provided, and for which the operation's results were pending. A pending operation is indicated when the function that started the operation returns FALSE, and the **WSAGetLastError()** function returns WSA_IO_PENDING. When an I/O operation is pending, the function that started the operation resets the *hEvent* member of the WSAOVERLAPPED structure to the nonsignaled state. Then when the pending operation has been completed, the system sets the event object to the signaled state.

If the *fWait* parameter is TRUE, **WSAGetOverlappedResult()** determines whether the pending operation has been completed by waiting for the event object to be in the signaled state.

Return Value If the function succeeds, the return value is TRUE. This means that the overlapped operation has completed and that the value pointed to by *lpcbTransfer* has been updated. The application should call **WSAGetLastError** to obtain any error status for the overlapped operation. If the function fails, the return value is FALSE. This means that either the overlapped operation has not completed or that completion status could not be determined due to errors in one or more parameters. On failure, the value pointed to by *lpcbTransfer* will not be updated. Use **WSAGetLastError()** to determine the cause of the failure.

Error Codes

WSAENOTSOCK	The descriptor is not a socket.

WSA_INVALID_HANDLE	The *hEvent* field of the WSAOVERLAPPED structure does not contain a valid event object handle.
WSA_INVALID_PARAMETER	One of the parameters is unacceptable.
WSA_IO_INCOMPLETE	*fWait* is FALSE and the I/O operation has not yet completed.

See Also **WSACreateEvent(), WSAWaitForMultipleEvents(), WSARecv(), WSARecvfrom(), WSASend(), WSASendto(), WSAConnect(), WSAAccept().**

3.51 WSAGetQoSByName()

Description Initializes the QoS based on a template.

#include <winsock.h>

BOOL WSAAPI WSAGetQOSByName(SOCKET *s***, LPWSABUF** *lpQOSName***, LPQOS** *lpQOS***);**

s	A descriptor identifying a socket.
lpQOSName	Specifies the QoS template name.
lpQOS	A pointer to the QOS structure to be filled.

Remarks Initializes the QoS structure based on a named template.

Return Value If the function succeeds, the return value is TRUE. If the function fails, the return value is FALSE. To get extended error information, call **WSAGetLastError()**.

Error Codes WSA_INVALID_PARAMETER The specified QoS template is invalid.

See Also **WSAConnect(), WSAAccept(), getsockopt().**

3.52 WSAHtonl()

Description Convert a **u_long** from a specified host byte order to network byte order.

#include <winsock.h>

u_long WSAAPI WSAHtonl (u_long *hostlong* **);**

netOrder	A boolean indicating whether network byte order should be considered "big-endian"(*netOrder = 0),* or "little-endian" (*netOrder = 1).*
hostlong	A 32-bit number in host byte order.

Remarks This routine takes a 32-bit number in the specified host byte order and returns a 32-bit number in network byte order.

Return Value **WSAHtonl()** returns the value in network byte order.

See Also **htonl**(), **htons**(), **ntohs(), ntohl(), WSAHtons(), WSANtohl(), WSANtohs**().

3.53 WSAHtons()

Description Convert a **u_short** from a specified host byte order to network byte order.

#include <winsock.h>

u_short WSAAPI WSAHtons (u_short *hostshort* **);**

netOrder A boolean indicating whether network byte order should be considered "big-endian"(*netOrder = 0),* or "little-endian" (*netOrder = 1).*

hostshort A 16-bit number in host byte order.

Remarks This routine takes a 16-bit number in the specified host byte order and returns a 16-bit number in network byte order.

Return Value **WSAHtons()** returns the value in network byte order.

See Also **htonl**(), **htons**(), **ntohs(), ntohl(), WSAHtonl(), WSANtohl(), WSANtohs**().

3.54 WSAIoctl()

Description Control the mode of a socket.

#include <winsock.h>

int WSAAPI WSAIoctl(SOCKET *s*, DWORD *dwIoControlCode*, LPVOID *lpvInBuffer*, DWORD *cbInBuffer*, LPVOID *lpvOutBuffer*, DWORD, *cbOutBuffer*, LPDWORD *lpcbBytesReturned*, LPWSAOVERLAPPED *lpOverlapped*, **LPWSAOVERLAPPED_COMPLETION_ROUTINE** *lpCompletionRoutine*);**

s handle to a socket

dwIoControlCode control code of operation to perform

lpvInBuffer address of input buffer

cbInBuffer size of input buffer

lpvOutBuffer address of output buffer

cbOutBuffer size of output buffer

lpcbBytesReturned address of actual bytes of output

lpoOverlapped address of WSAOVERLAPPED structure

lpCompletionRoutine A pointer to the completion routine called when the operation has been completed.

Remarks This routine is used to to set or retrieve operating parameters associated with the socket, the transport protocol, or the communications subsystem. For non-overlapped socket, this function behaves like the standard **ioctlsocket()** API with identical blocking semantics and the *lpOverlapped* and *lpCompletionRoutine* parameters are ignored. For overlapped sockets, the final completion status is retrieved via the **WSAGetOverlappedResult()** API. The *lpcbBytesReturned* parameter is ignored.

In as much as the *dwControlCode* parameter is now a 32 bit entity, it is possible to adopt an encoding scheme that preserves the currently defined **ioctlsocket()** opcodes while providing a convenient way to partition the opcode identifier space. The *dwIoControlCode* parameter is architected to allow for protocol and vendor independence when adding new control codes, while retaining backward compability with the Windows Sockets 1.1 and Unix control codes. The *dwIoControlCode* parameter has the following form:

3 1	3 0	2 9	2 8	2 7	2 6	2 5	2 4	2 3	2 2	2 1	2 0	1 9	1 8	1 7	1 6	1 5	1 4	1 3	1 2	1 1	1 0	9	8	7	6	5	4	3	2	1	0
I	**O**	**V**	**T**		**Vendor/Protocol**											**Code**															

I is set if the input buffer is valid for the code, as with **IOC_IN**.

O is set if the output buffer is valid for the code, as with **IOC_OUT**. Note that for codes with both input and output parameters, both **I** and **O** will be set.

V is set if there are no parameters for the code, as with **IOC_VOID**.

T is a two-bit quantity which defines the type of ioctl. The following values are defined:

> **0** - The ioctl is a standard Unix ioctl code, as with FIONREAD, FIONBIO, etc.
>
> **1** - The ioctl is a generic Windows Sockets 2.0 ioctl code. New ioctl codes defined for Windows Sockets 2.0 will have **T == 1**.
>
> **2** - The ioctl applies only to a specific protocol.
>
> **3** - The ioctl applies only to a specific vendor's provider. This type allows companies to be assigned a vendor number which appears in the **Vendor/Protocol** field, and then the vendor can define new ioctls specific to that vendor without having to register the ioctl with a clearinghouse, thereby providing vendor flexibility and privacy.

Vendor/Protocol - An 11-bit quantity which defines the vendor who owns the code (if **T == 3**) or which defines the protocol to which the code applies (if **T == 2**). If this is a Unix ioctl code (**T == 0**) then this field has the same value as the code on Unix. If this is a generic Windows Sockets 2.0 ioctl (**T == 1**) then this field can be used as an extension of the "code" field to provide additional code values.

Code - The specific ioctl code for the operation.

The following Unix commands are supported:

Command	Semantics
FIONBIO	Enable or disable non-blocking mode on socket *s*. *argp* points at an **unsigned long**, which is non-zero if non-blocking mode is to be enabled and zero if it is to be disabled. When a socket is created, it operates in blocking mode (i.e. non-blocking mode is disabled). This is consistent with BSD sockets. The **WSAAsyncSelect()** or **WSAEventSelect()** routine automatically sets a socket to nonblocking mode. If **WSAAsyncSelect()** or **WSAEventSelect()** has been issued on a socket, then any attempt to use **ioctlsocket()** to set the socket back to blocking mode will fail with WSAEINVAL. To set the socket back to blocking mode, an application must first disable **WSAAsyncSelect()** by calling **WSAAsyncSelect()** with the *lEvent* parameter equal to 0, or disable **WSAEventSelect()** by calling **WSAEventSelect()** with the *lNetworkEvents* parameter equal to 0.
FIONREAD	Determine the amount of data which can be read atomically from socket *s*. *lpvOutBuffer* points at an **unsigned long** in which **WSAIoctl ()** stores the result. If *s* is stream-oriented (e.g., type SOCK_STREAM), FIONREAD returns the total amount of data which may be read in a single receive operation; this is normally the same as the total amount of data queued on the socket. If *s* is

message-oriented (e.g., type SOCK_DGRAM), FIONREAD returns the size of the first datagram (message) queued on the socket.

SIOCATMARK Determine whether or not all out-of-band data has been read. This applies only to a socket of stream style (e.g., type SOCK_STREAM) which has been configured for in-line reception of any out-of-band data (SO_OOBINLINE). If no out-of-band data is waiting to be read, the operation returns TRUE. Otherwise it returns FALSE, and the next receive operation performed on the socket will retrieve some or all of the data preceding the "mark"; the application should use the SIOCATMARK operation to determine whether any remains. If there is any normal data preceding the "urgent" (out of band) data, it will be received in order. (Note that receive operations will never mix out-of-band and normal data in the same call.) *lpvOutBuffer* points at a **BOOL** in which **WSAIoctl ()** stores the result.

The following Winsock 2 commands are supported:

Command Semantics

SIO_GET_QOS Retrieve the QOS structure associated with the socket. No input buffer is required, the QOS structure will be copied into the ouput buffer. The WSAENOPROTOOPT error code is indicated for service providers which do not support QOS.

SIO_GET_GROUP_QOS
Retrieve the QOS structure associated with the socket group to which this socket belongs. No input buffer is required, the QOS structure will be copied into the ouput buffer. If this socket does not belong to an appropriate socket group, the *SendingFlowspec* and *ReceivingFlowspec* fields of the returned QOS struct are set to NULL. The WSAENOPROTOOPT error code is indicated for service providers which do not support QOS.

SIO_SET_QOS Establish the supplied QOS structure with the socket. No output buffer is required, the QOS structure will be obtained from the input buffer. The WSAENOPROTOOPT error code is indicated for service providers which do not support QOS.

SIO_SET_GROUP_QOS
Establish the supplied QOS structure with the socket group to which this socket belongs. No output buffer is required, the QOS structure will be obtained from the input buffer. The WSAENOPROTOOPT error code is indicated for service providers which do not support QOS.

When called with an overlapped socket, the *lpOverlapped* parameter must be valid for the duration of the overlapped operation. The WSAOVERLAPPED structure has the following form:

```
typedef struct _WSAOVERLAPPED {
      DWORD       Internal;          // reserved
      DWORD       InternalHigh;      // reserved
      DWORD       Offset;            // ignored
```

```
        DWORD       OffsetHigh;       // ignored
        WSAEVENT    hEvent;
} WSAOVERLAPPED, LPWSAOVERLAPPED;
```

If the *lpCompletionRoutine* parameter is NULL, the *hEvent* field of *lpOverlapped* must be a valid event object handle which is signaled when the overlapped operation completes. An application can use **WSAWaitForMultipleEvents()** or **WSAGetOverlappedResult()** to wait or poll on the event object.

If *lpCompletionRoutine* is not NULL, the *hEvent* field is ignored and can be used by the application to pass context information to the completion routine.

The prototype of the completion routine is as follows:

VOID CALLBACK CompletionRoutine(**DWORD** *dwError***,**
DWORD *cbTransferred***, LPWSAOVERLAPPED** *lpOverlapped* **);**

CompletionRoutine is a placeholder for an application-defined or library-defined function. *dwError* specifies the completion status for the overlapped operation as indicated by *lpOverlapped*. *cbTransferred* specifies the number of bytes returned. This function does not return a value.

Returning from this function allows invocation of another pending completion routine for this socket. The completion routines may be called in any order, not necessarily in the same order the overlapped operations are completed.

Compatibility

The ioctl codes with **T == 0** are a subset of the ioctl codes used in Berkeley sockets. In particular, there is no command which is equivalent to FIOASYNC.

Return Value

Upon successful completion, the **WSAIoctl ()** returns 0. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSAENETDOWN	The network subsystem has failed.
WSAEINVAL	*cmd* is not a valid command, or *a* supplied input parameter is not acceptable, or the command is not applicable to the type of socket supplied
WSAEINPROGRESS	The function is invoked when a callback is in progress.
WSAENOTSOCK	The descriptor *s* is not a socket.

See Also

socket(), **WSAsocket()**, **setsockopt()**, **getsockopt().**

3.55 WASIsBlocking()

Description Determine if a blocking call is in progress.

#include <winsock.h>

BOOL WSAAPI WSAIsBlocking (void);

Remarks This function allows a task to determine if it is executing while waiting for a previous blocking call to complete.

Return Value The return value is TRUE if there is an outstanding blocking function awaiting completion. Otherwise, it is FALSE.

Comments In Win16 environments, although a call issued on a blocking socket appears to an application program as though it "blocks", the Winsock DLL has to relinquish the processor to allow other applications to run. This means that it is possible for the application which issued the blocking call to be re-entered, depending on the message(s) it receives. In this instance, the **WSAIsBlocking()** function can be used to ascertain whether the task has been re-entered while waiting for an outstanding blocking call to complete. Note that Winsock prohibits more than one outstanding call per thread.

3.55 WSANtohl()

Description Convert a **u_long** from a specified network byte order to host byte order.

#include <winsock.h>

u_long WSAAPI WSANtohl (bool *netOrder*, **u_long** *netlong* **);**

netOrder	A boolean indicating whether network byte order should be considered "big-endian"(*netOrder = 0),* or "little-endian" (*netOrder = 1).*
netlong	A 32-bit number in network byte order.

Remarks This routine takes a 32-bit number in the specified network byte order and returns a 32-bit number in host byte order.

Return Value **WSANtohl()** returns the value in host byte order.

See Also **ntohl(), htonl()**, **htons()**, **ntohs(), WSAHtonl(), WSAHtons(), WSANtohs()**.

3.56 WSANtohs()

Description Convert a **u_short** from a specified network byte order to host byte order.

#include <winsock.h>

u_short WSAAPI WSANtohs (bool *netOrder*, **u_short** *netshort* **);**

netOrder A boolean indicating whether network byte order should be considered "big-endian"(*netOrder = 0),* or "little-endian" (*netOrder = 1).*

netshort A 16-bit number in network byte order.

Remarks This routine takes a 16-bit number in the specified network byte order and returns a 16-bit number in host byte order.

Return Value **WSANtohs()** returns the value in host byte order.

See Also **htonl**(), **htons**(), **ntohs(), ntohl(), WSAHtonl(), WSAHtons(), WSANtohl**().

3.57 WSARecv()

Description Receive data from a socket

#include <winsock.h>

int WSAAPI WSARecv (SOCKET *s*, **LPWSABUF** *lpBuffesr*, **DWORD** *dwBufferCount*, **LPDWORD** *lpNumberOfBytesRecvd*, **LPINT** *lpFlags,* **LPWSAOVERLAPPED** *lpOverlapped*, **LPWSAOVERLAPPED_COMPLETION_ROUTINE** *lpCompletionRoutine* **);**

s	A descriptor identifying a connected socket.
lpBuffers	A pointer to an array of **WSABUF** structures. Each **WSABUF** structure contains a pointer to a buffer and the length of the buffer.
dwBufferCount	The number of **WSABUF** structures in the *lpBuffers* array.
lpNumberOfBytesRecvd	A pointer to the number of bytes received by this call if the receive operation completes immediately.
lpFlags	A pointer to flags.
lpOverlapped	A pointer to a WSAOVERLAPPED structure (ignored for non-overlapped sockets).
lpCompletionRoutine	A pointer to the completion routine called when the receive operation has been completed (ignored for non-overlapped sockets).

Remarks This function provides functionality over and above the standard **recv()** function in three important areas:

- It can be used in conjunction with overlapped sockets to perform overlapped receive operations.
- It allows multiple receive buffers to be specified making it applicable to the scatter/gather type of I/O.
- The *lpFlags* parameter is both an INPUT and an OUTPUT paramter, allowing applications to sense the output state of the MSG_PARTIAL flag bit. Note however, that the MSG_PARTIAL flag bit is not supported by all protocols.

WSARecv() is primarily used on a connection-oriented socket specified by *s.* It may also be used, however, on connectionless sockets which have a stipulated default peer address established via the **connect()** or **WSAConnect()** functions.

For overlapped sockets **WSARecv()** is used to post one or more buffers into which incoming data will be placed as it becomes available, after which the application-specified completion indication (invocation of the completion routine or setting of an event object) occurs. The final completion status is retrieved via **WSAGetOverlappedResult().**

For non-overlapped sockets, the blocking semantics are identical to that of the standard **recv()** function and the *lpOverlapped* and *lpCompletionRoutine* parameters are ignored. Any data which has already been received and buffered by the transport will be copied into the supplied user buffers. For the case of a blocking socket with no data currently having been received and buffered by the transport, the call will block until data is received.

The **WSABUF** structures pointed to by the *lpBuffers* parameter are transient. If this operation completes in an overlapped manner, it is the service provider's responsibility to capture these **WSABUF** structures before returning from this call. This enables applications to build stack-based **WSABUF** arrays.

For byte stream style sockets (e.g., type SOCK_STREAM), incoming data is placed into the buffers until the buffers are filled, the connection is closed, or internally buffered data is exhausted. . Regardless of whether or not the incoming data fills the buffers, the completion indication occurs for overlapped sockets. For message-oriented sockets (e.g., type SOCK_DGRAM), an incoming message is placed into the supplied buffers, up to the total size of the buffers supplied, and the completion indication occurs for overlapped sockets. If the message is larger than the buffer supplied, the buffer is filled with the first part of the message. The MSG_PARTIAL flag is set for the socket, if this feature is supported by the underlying protocol, and subsequent receive operation(s) will retrive the rest of the message. Otherwise, the excess data is lost, and **WSARecv()** returns the error WSAEMSGSIZE.

If the socket is connection-oriented and the remote side has shut down the connection gracefully, **WSARecv()** will fail with the error WSAEDISCON. If the connection has been reset, a **WSARecv()** will fail with the error WSAECONNRESET.

lpFlags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *lpFlags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_PEEK	Peek at the incoming data. The data is copied into the buffer but is not removed from the input queue. This flag is valid only for non-overlapped sockets.
MSG_OOB	Process out-of-band data (See section B.3.2.3 for a discussion of this topic.)
MSG_PARTIAL	The data supplied is a portion of the message transmitted by the sender. Remaining portions of the message will normally be made available in subsequent receive operations. The next receive operation with MSG_PARTIAL flag cleared indicates end of sender's message.

If an overlapped operation completes immediately, the *lpNumberOfBytesRecvd* parameter is filled with the number of bytes received. If the overlapped operation is successfully initated and completes later, *lpNumberOfBytesRecvd* is not updated. Applications may determine the amount of data transferred either via the *cbTransferred*

parameter in the completion function (if specified), or via the *lpcbTransfer* parameter in **WSAGetOverlappedResult()**.

For message-oriented sockets, the MSG_PARTIAL bit is set in the *lpFlags* parameter if a partial message is received. If a complete message is received, MSG_PARTIAL is cleared in *lpFlags*. In the case of delayed completion, the value pointed to by *lpFlags* is not updated until the completion indication has been given.

Overlapped socket I/O:

This function may be called from within the completion routine of a previous **WSARead()**, **WSAReadfrom()**, **WSASend()** or **WSASendto()** function. In Win16 environments, this function may also be called from within a preemptive VMM context provided that the XP1_INTERRUPT bit in the associated PROTOCOL_INFO struct is TRUE.

The *lpOverlapped* parameter must be valid for the duration of the overlapped operation. If multiple I/O operations are simultaneously outstanding, each must referece a separate overlapped structure. The WSAOVERLAPPED structure has the following form:

```
typedef struct _WSAOVERLAPPED {
      DWORD       Internal;         // reserved
      DWORD       InternalHigh;     // reserved
      DWORD       Offset;           // ignored
      DWORD       OffsetHigh;       // ignored
      WSAEVENT    hEvent;
} WSAOVERLAPPED, FAR *LPWSAOVERLAPPED;
```

If the *lpCompletionRoutine* parameter is NULL, the *hEvent* field of *lpOverlapped* must be a valid event object handle which is signaled when the overlapped operation completes. An application can use **WSAWaitForMultipleEvents()** or **WSAGetOverlappedResult()** to wait or poll on the event object.

If *lpCompletionRoutine* is not NULL, the *hEvent* field is ignored and can be used by the application to pass context information to the completion routine

In Win16 environments, callback functions may be invoked in a preemptive VMM context which is sometimes referred to as an interrupt context. Applications must be aware that in this special context a very limited set of runtime and Windows library functions can be safely made. As a rule, an application should confine itself to the same set of runtime functions that the Windows documentation indicates may safely be called during a multimedia timer callback function.

In Windows 95 and NT, the completion function follows the same rules as stipulated for Win32 file I/O completion routines. The completion function will not be invoked until the thread is in an alertable wait state such as can occur when the function **WSAWaitForMultipleEvents()** is invoked.

In all environments, transports do allow an application to invoke send and receive operations from within the context of the socket I/O completion function, and guarantee that, for a given socket, I/O completion functions will not be nested. This permits time-sensitive data transmissions to occur entirely within a preemptive context.

The prototype of the completion routine is as follows:

VOID CALLBACK CompletionRoutine(DWORD *dwError*,
DWORD *cbTransferred*, **LPWSAOVERLAPPED** *lpOverlapped* **);**

CompletionRoutine is a placeholder for an application-defined or library-defined function name. *dwError* specifies the completion status for the overlapped operation as indicated by *lpOverlapped*. *cbTransferred* specifies the number of bytes received. This function does not return a value.

Returning from this function allows invocation of another pending completion routine for this socket. In Win32 environments, all waiting completion routines are called before the alterable thread's wait is satisfied with a return code of WSA_IO_COMPLETION. The completion routines may be called in any order, not necessarily in the same order the overlapped operations are completed. However, the posted buffers are guaranteed to be filled in the same order they are supplied

Return Value

If no error occurs and the receive operation has completed immediately, **WSARecv()** returns 0. Note that in this case the completion indication (invocation of the designated completion routine or the setting of an event object) will have already occurred. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**. The error code WSA_IO_PENDING indicates that the overlapped operation has been successfully initiated and that completion will be indicated at a later time. Any other error code indicates that the overlapped operations was not successfully initiated and no completion indication will occur.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAENOTCONN	The socket is not connected.
WSAENETRESET	The connection must be reset because the service provider dropped it.
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	MSG_OOB was specified, but the socket is not stream style such as type SOCK_STREAM, out-of-band data is not supported in the communication domain associated with this socket, or the socket is unidirectional and supports only send operations.
WSAESHUTDOWN	The socket has been shutdown; it is not possible to **WSARecv()** on a socket after **shutdown()** has been invoked with *how* set to SD_RECEIVE or SD_BOTH.

WSAEWOULDBLOCK	Overlapped sockets: There are too many outstanding overlapped I/O requests. Non-overlapped sockets: The socket is marked as non-blocking and the receive operation cannot be completed immediately.
WSAEMSGSIZE	The message was too large to fit into the specified buffer and was truncated.
WSAEINVAL	The socket has not been bound with **bind()**, or the socket is not created with the overlapped flag**.**
WSAECONNABORTED	The virtual circuit was aborted due to timeout or other failure.
WSAECONNRESET	The virtual circuit was reset by the remote side.
WSAEDISCON	The remote side gracefully close the connection.
WSA_IO_PENDING	An overlapped operation was successfully initiated and completion will be indicated at a later time.

See Also **WSACloseEvent(),WSACreateEvent(), WSAGetOverlappedResult(), WSASocket(), WSAWaitForMultipleEvents()**

3.58 WSARecvfrom()

Description Receive a datagram and store the source address.

#include <winsock.h>

int WSAAPI WSARecvfrom (SOCKET *s*, **LPWSABUF** *lpBuffesr*, **DWORD** *dwBufferCount*, **LPDWORD** *lpNumberOfBytesRecvd*, **LPINT** *lpFlags*, **LPVOID** *lpFrom*, **LPINT** *lpFromlen*, **LPWSAOVERLAPPED** *lpOverlapped*, **LPWSAOVERLAPPED_COMPLETION_ROUTINE** *lpCompletionRoutine* **);**

s	A descriptor identifying a socket
lpBuffers	A pointer to an array of **WSABUF** structures. Each **WSABUF** structure contains a pointer to a buffer and the length of the buffer.
dwBufferCount	The number of **WSABUF** structures in the *lpBuffers* array.
lpNumberOfBytesRecvd	A pointer to the number of bytes received by this call if the receive operation completes immediately.
lpFlags	A pointer to flags.
lpFrom	An optional pointer to a buffer which will hold the source address upon the completion of the overlapped operation.
lpFromlen	An optional pointer to the size of the *from* buffer.
lpOverlapped	A pointer to a WSAOVERLAPPED structure (ignored for non-overlapped sockets).
lpCompletionRoutine	A pointer to the completion routine called when the receive operation has been completed (ignored for non-overlapped sockets).

Remarks This function provides functionality over and above the standard **recvfrom()** function in three important areas:

- It can be used in conjunction with overlapped sockets to perform overlapped receive operations.
- It allows multiple receive buffers to be specified making it applicable to the scatter/gather type of I/O.
- The *lpFlags* parameter is both an INPUT and an OUTPUT paramter, allowing applications to sense the output state of the MSG_PARTIAL flag bit. Note however, that the MSG_PARTIAL flag bit is not supported by all protocols.

WSARecvFrom() is used primarily on a connectionless socket specified by *s*.

For overlapped sockets, this function is used to post one or more buffers into which incoming data will be placed as it becomes available on a (possibly connected) socket, after which the application-specified completion indication (invocation of the completion routine or setting of an event object) occurs. The final completion status is

retrieved via **WSAGetOverlappedResult().** Also note that the values pointed to by *lpFrom* and *lpFromlen* are not updated until completion is indicated. Applications must not use or disturb these values until they have been updated.

For non-overlapped sockets, the blocking semantics are identical to that of the standard **recvfrom()** function and the *lpOverlapped* and *lpCompletionRoutine* parameters are ignored. Any data which has already been received and buffered by the transport will be copied into the supplied user buffers. For the case of a blocking socket with no data currently having been received and buffered by the transport, the call will block until data is received.

For connectionless socket types, the address from which the data originated is copied to the buffer pointed by *lpFrom*. The value pointed to by *lpFromlen* is initialized to the size of this buffer, and is modified on return to indicate the actual size of the address stored there. As noted previously for overlapped sockets, the *lpFrom* and *lpFromlen* parameters are not updated until after the overlapped I/O has completed. The *lpFrom* and *lpFromlen* parameters are ignored for connection-oriented sockets.

For byte stream style sockets (e.g., type SOCK_STREAM), incoming data is placed into the buffers until the buffers are filled, the connection is closed, or internally buffered data is exhausted. Regardless of whether or not the incoming data fills the buffer, the completion indication occurs for overlapped sockets. For message-oriented sockets, an incoming message is placed into the supplied buffers, up to the total size of the buffers supplied, and the completion indication occurs for overlapped sockets. If the message is larger than the buffer supplied, the buffer is filled with the first part of the message. The MSG_PARTIAL flag is set for the socket, if this feature is supported by the underlying protocol, and subsequent receive operation(s) will retrive the rest of the message. Otherwise, the excess data is lost, and **WSARecvfrom()** returns the error code WSAEMSGSIZE.

If the socket is connection-oriented and the remote side has shut down the connection gracefully, a **WSARecvfrom()** will fail with the error WSAEDISCON. If the connection has been reset **WSARecvfrom()** will fail with the error WSAECONNRESET.

lpFlags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *flags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_PEEK	Peek at the incoming data. The data is copied into the buffer but is not removed from the input queue. This flag is valid only for non-overlapped sockets.
MSG_OOB	Process out-of-band data (See section B.3.2.3 for a discussion of this topic.)
MSG_PARTIAL	The data supplied is a portion of the message transmitted by the sender. Remaining portions of the message will normally be made available in subsequent receive operations. The next receive operation with MSG_PARTIAL flag cleared indicates end of sender's message.

If an overlapped operation completes immediately, the *lpNumberOfBytesRecvd* parameter is filled with the number of bytes received. If the overlapped operation is successfully initated and completes later, *lpNumberOfBytesRecvd* is not updated. Applications may determine the amount of data transferred either via the *cbTransferred* parameter in the completion function (if specified), or via the *lpcbTransfer* parameter in **WSAGetOverlappedResult()**.

For message-oriented sockets, the MSG_PARTIAL bit is set in the *lpFlags* parameter if a partial message is received. If a complete message is received, MSG_PARTIAL is cleared in *lpFlags*. In the case of delayed completion, the value pointed to by *lpFlags* is not updated until the completion indication has been given.

Overlapped socket I/O:
This function may be called from within the completion routine of a previous **WSARead()**, **WSAReadFrom()**, **WSASend()** or **WSASendTo()** function. In Win16 environments, this function may also be called from within a preemptive VMM context provided that the XP1_INTERRUPT bit in tthe associated PROTOCOL_INFO struct is TRUE.

The *lpOverlapped* parameter must be valid for the duration of the overlapped operation. If multiple I/O operations are simultaneously outstanding, each must referece a separate overlapped structure. The WSAOVERLAPPED structure has the following form:

```
typedef struct _WSAOVERLAPPED {
      DWORD       Internal;          // reserved
      DWORD       InternalHigh;      // reserved
      DWORD       Offset;            // ignored
      DWORD       OffsetHigh;        // ignored
      WSAEVENT    hEvent;
} WSAOVERLAPPED, FAR * LPWSAOVERLAPPED;
```

If the *lpCompletionRoutine* parameter is NULL, the *hEvent* field of *lpOverlapped* must be an event object handle which is signaled when the overlapped operation completes. An application can use **WSAWaitForMultipleEvents()** or **WSAGetOverlappedResult()** to wait or poll on the event object.

If *lpCompletionRoutine* is not NULL, the *hEvent* field is ignored and can be used by the application to pass context information to the completion routine.

In Win16 environments, completion functions may be invoked in a preemptive VMM context which is sometimes referred to as an interrupt context. Applications must be aware that in this special context a very limited set of runtime and Windows library functions can be safely made. As a rule, an application should confine itself to the same set of runtime functions that the Windows documentation indicates may safely be called during a multimedia timer callback function.

In Windows 95 and NT, the completion function follows the same rules as stipulated for Win32 file I/O completion routines. The completion function will not be invoked until the thread is in an alertable wait state such as can occur when the function **WSAWaitForMultipleEvents()** is invoked.

In all environments, transports do allow an application to invoke send and receive operations from within the context of the socket I/O completion function, and guarantee

that, for a given socket, I/O completion functions will not be nested. This permits time-sensitive data transmissions to occur entirely within a preemptive context.

The prototype of the completion routine is as follows:

VOID CALLBACK CompletionRoutine(**DWORD** *dwError***,**
DWORD *cbTransferred***, LPWSAOVERLAPPED** *lpOverlapped* **);**

CompletionRoutine is a placeholder for an application-defined or library-defined function name. *dwError* specifies the completion status for the overlapped operation as indicated by *lpOverlapped*. *cbTransferred* specifies the number of bytes received. This function does not return a value.

Returning from this function allows invocation of another pending completion routine for this socket. In Win32 environments, all waiting completion routines are called before the alterable thread's wait is satisfied with a return code of WSA_IO_COMPLETION. The completion routines may be called in any order, not necessarily in the same order the overlapped operations are completed. However, the posted buffers are guaranteed to be filled in the same order they are supplied

Return Value

If no error occurs and the receive operation has completed immediately, **WSARecvfrom()** returns 0. Note that in this case the completion indication (invocation of the designated completion routine or the setting of an event object) will have already occurred. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**. The error code WSA_IO_PENDING indicates that the overlapped operation has been successfully initiated and that completion will be indicated at a later time. Any other error code indicates that the overlapped operations was not successfully initiated and no completion indication will occur.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEFAULT	The *lpFromlen* argument was invalid: the *lpFrom* buffer was too small to accommodate the peer address.
WSAEINVAL	The socket has not been bound with **bind()**, or the socket is not created with the overlapped flag**.**
WSAENETRESET	The connection must be reset because the Winsock provider dropped it.
WSAENOTCONN	The socket is not connected (connection-oriented sockets only).
WSAENOTSOCK	The descriptor is not a socket.

WSAEOPNOTSUPP	MSG_OOB was specified, but the socket is not stream style such as type SOCK_STREAM, out-of-band data is not supported in the communication domain associated with this socket, or the socket is unidirectional and supports only send operations.
WSAESHUTDOWN	The socket has been shutdown; it is not possible to **WSARecvfrom()** on a socket after **shutdown()** has been invoked with *how* set to SD_RECEIVE or SD_BOTH.
WSAEWOULDBLOCK	Overlapped sockets: There are too many outstanding overlapped I/O requests. . Non-overlapped sockets: The socket is marked as non-blocking and the receive operation cannot be completed immediately.
WSAEMSGSIZE	The message was too large to fit into the specified buffer and was truncated.
WSAECONNABORTED	The virtual circuit was aborted due to timeout or other failure.
WSAECONNRESET	The virtual circuit was reset by the remote side.
WSAEDISCON	The remote side gracefully close the connection.
WSA_IO_PENDING	An overlapped operation was successfully initiated and completion will be indicated at a later time.

See Also **WSACloseEvent(),WSACreateEvent(), WSAGetOverlappedResult(), WSASocket(), WSAWaitForMultipleEvents()**

3.59 WSAResetEvent()

Description Resets the state of the specified event object to nonsignaled.

#include <winsock.h>

BOOL WSAAPI WSAResetEvent(WSAEVENT *hEvent* **);**

hEvent Identifies an open event object handle.

Remarks The Win32 implementation of this function is:

```
#define WSAResetEvent( h )
        ResetEvent( h )
```

Return Value If the function succeeds, the return value is TRUE. If the function fails, the return value is FALSE. To get extended error information, call **WSAGetLastError**().

Error Codes WSA_INVALID_HANDLE *hEvent* is not a valid event object handle.

See Also **WSACreateEvent(), WSASetEvent(), WSACloseEvent().**

3.60 WSASend()

Description Send data on a connected socket

#include <winsock.h>

int WSAAPI WSASend (SOCKET *s*, **LPWSABUF***lpBuffesr*, **DWORD** *dwBufferCount*, **LPDWORD** *lpNumberOfBytesSent*, **int** *iFlags,* **LPWSAOVERLAPPED** *lpOverlapped*, **LPWSAOVERLAPPED_COMPLETION_ROUTINE** *lpCompletionRoutine* **);**

s	A descriptor identifying a connected socket.
lpBuffers	A pointer to an array of **WSABUF** structures. Each **WSABUF** structure contains a pointer to a buffer and the length of the buffer.
dwBufferCount	The number of **WSABUF** structures in the *lpBuffers* array.
lpNumberOfBytesSent	A pointer to the number of bytes sent by this call if the I/O operation completes immediately.
iFlags	Flags.
lpOverlapped	A pointer to a WSAOVERLAPPED structure (ignored for non-overlapped sockets).
lpCompletionRoutine	A pointer to the completion routine called when the send operation has been completed (ignored for non-overlapped sockets).

Remarks This function provides functionality over and above the standard **send()** function in two important areas:

- It can be used in conjunction with overlapped sockets to perform overlapped send operations.
- It allows multiple send buffers to be specified making it applicable to the scatter/gather type of I/O.

WSASend() is used to write outgoing data from one or more buffers on a connection-oriented socket specified by *s*. It may also be used, however, on connectionless sockets which have a stipulated default peer address established via the **connect()** or **WSAConnect()** functions.

For overlapped sockets (created using **WSASocket()** with flag WSA_FLAG_OVERLAPPED) this will occur using overlapped I/O. A completion indication will occur (invocation of the completion routine or setting of an event object) when the supplied buffer(s) have been consumed by the transport. The final completion status is retrieved via **WSAGetOverlappedResult().**

For non-overlapped sockets, the last two parameters (*lpOverlapped, lpCompletionRoutine*) are ignored and **WSASend()** adopts the same blocking semantics

as **send()**. Data is copied from the supplied buffer(s) into the transport's buffer. If the socket is non-blocking and there is not sufficient space in the transport's buffer, **WSASend()** will return with only part of the application's buffers having been consumed. Given the same buffer situation and a blocking socket, **WSASend()** will block until all of the application's buffer contents have been consumed.

For message-oriented sockets, care must be taken not to exceed the maximum message size of the underlying provider, which can be obtained by getting the value of socket option SO_MAX_MSG_SIZE. If the data is too long to pass atomically through the underlying protocol the error WSAEMSGSIZE is returned, and no data is transmitted.

Note that the successful completion of a **WSASend()** does not indicate that the data was successfully delivered.

Flags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *flags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_DONTROUTE	Specifies that the data should not be subject to routing. A Winsock service provider may choose to ignore this flag; see also the discussion of the SO_DONTROUTE option in section B.3.4 .
MSG_OOB	Send out-of-band data (stream style socket such as SOCK_STREAM only; see also section B.3.2.3)
MSG_PARTIAL	Specifies that *lpBuffers* only contains a partial message. Note that this flag will be ignored by transports which do not support partial message transmissions.

Overlapped socket I/O:

If an overlapped operation completes immediately, the value pointed to by the *lpNumberOfBytesSent* parameter is updated with the number of bytes sent. Otherwise, this parameter will be ignored. Applications may determine the amount of data transferred either via the *cbTransferred* parameter in the completion function (if specified), or via the *lpcbTransfer* parameter in **WSAGetOverlappedResult()**.

This function may be called from within the completion routine of a previous **WSARead()**, **WSAReadFrom()**, **WSASend()** or **WSASendTo()** function. In Win16 environments, this function may also be called from within a preemptive VMM context provided that the XP1_INTERRUPT bit in the socket's PROTOCOL_INFO struct is TRUE.

The *lpOverlapped* parameter must be valid for the duration of the overlapped operation. If multiple I/O operations are simultaneously outstanding, each must referece a separate overlapped structure. The WSAOVERLAPPED structure has the following form:

```
typedef struct _WSAOVERLAPPED {
      DWORD       Internal;         // reserved
```

```
        DWORD       InternalHigh;     // reserved
        DWORD       Offset;           // ignored
        DWORD       OffsetHigh;       // ignored
        WSAEVENT    hEvent;
    } WSAOVERLAPPED, FAR * LPWSAOVERLAPPED;
```

If the *lpCompletionRoutine* parameter is NULL, the *hEvent* field of *lpOverlapped* must be a valid event object handle which is signaled when the overlapped operation completes. An application can use **WSAWaitForMultipleEvents()** or **WSAGetOverlappedResult()** to wait or poll on the event object.

If *lpCompletionRoutine* is not NULL, the *hEvent* field is ignored and can be used by the application to pass context information to the completion routine.

In Win16 environments, callback functions may be invoked in a preemptive VMM context which is sometimes referred to as an interrupt context. Applications must be aware that in this special context a very limited set of runtime and Windows library functions can be safely made. As a rule, an application should confine itself to the same set of runtime functions that the Windows documentation indicates may safely be called during a multimedia timer callback function.

In Windows 95 and NT, the completion function follows the same rules as stipulated for Win32 file I/O completion routines. The completion function will not be invoked until the thread is in an alertable wait state such as can occur when the function **WSAWaitForMultipleEvents()** is invoked.

In all environments, transports do allow an application to invoke send and receive operations from within the context of the socket I/O completion function, and guarantee that, for a given socket, I/O completion functions will not be nested. This permits time-sensitive data transmissions to occur entirely within a preemptive context.

The prototype of the completion routine is as follows:

VOID CALLBACK CompletionRoutine(DWORD *dwError***,**
DWORD *cbTransferred***, LPWSAOVERLAPPED** *lpOverlapped* **);**

CompletionRoutine is a placeholder for an application-defined or library-defined function name. *dwError* specifies the completion status for the overlapped operation as indicated by *lpOverlapped*. *cbTransferred* specifies the number of bytes sent. This function does not return a value.

Returning from this function allows invocation of another pending completion routine for this socket. In Win32 environments, all waiting completion routines are called before the alterable thread's wait is satisfied with a return code of WSA_IO_COMPLETION. The completion routines may be called in any order, not necessarily in the same order the overlapped operations are completed. However, the posted buffers are guaranteed to be sent in the same order they are supplied

Return Value

If no error occurs and the receive operation has completed immediately, **WSASend()** returns 0. Note that in this case the completion indication (invocation of the designated completion routine or the setting of an event object) will have already occurred. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**. The error code WSA_IO_PENDING

indicates that the overlapped operation has been successfully initiated and that completion will be indicated at a later time. Any other error code indicates that the overlapped operations was not successfully initiated and no completion indication will occur.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEACCES	The requested address is a broadcast address, but the appropriate flag was not set.
WSAEFAULT	The *lpBuffer* argument is not in a valid part of the user address space.
WSAENETRESET	The connection must be reset because the Winsock provider dropped it.
WSAENOBUFS	The Winsock provider reports a buffer deadlock.
WSAENOTCONN	The socket is not connected.
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	MSG_OOB was specified, but the socket is not stream style such as type SOCK_STREAM, out-of-band data is not supported in the communication domain associated with this socket, or the socket is unidirectional and supports only receive operations.
WSAESHUTDOWN	The socket has been shutdown; it is not possible to **WSASend()** on a socket after **shutdown()** has been invoked with how set to SD_SEND or SD_BOTH.
WSAEWOULDBLOCK	There are too many outstanding overlapped I/O requests.
WSAEMSGSIZE	The socket is message-oriented, and the message is larger than the maximum supported by the underlying transport.
WSAEINVAL	The socket has not been bound with **bind()**, or the socket is not created with the overlapped flag**.**
WSAECONNABORTED	The virtual circuit was aborted due to timeout or other failure.
WSAECONNRESET	The virtual circuit was reset by the remote side.

WSA_IO_PENDING	An overlapped operation was successfully initiated and completion will be indicated at a later time.

See Also **WSACloseEvent(),WSACreateEvent(), WSAGetOverlappedResult(), WSASocket(), WSAWaitForMultipleEvents()**

3.61 WSASendto()

Description Send data to a specific destination, using overlapped I/O where applicable.

#include <winsock.h>

int WSAAPI WSASendto (SOCKET *s*, **LPWSABUF***lpBuffers*, **DWORD** *dwBufferCount*, **LPDWORD** *lpNumberOfBytesSent*, **int** *iFlags,* **LPVOID** *lpTo,* **int** *iTolen,* **LPWSAOVERLAPPED** *lpOverlapped*, **LPWSAOVERLAPPED_COMPLETION_ROUTINE** *lpCompletionRoutine* **);**

s	A descriptor identifying a connected socket which was created using **WSASocket()** with flag WSA_FLAG_OVERLAPPED.
lpBuffers	A pointer to an array of **WSABUF** structures. Each **WSABUF** structure contains a pointer to a buffer and the length of the buffer.
dwBufferCount	The number of **WSABUF** structures in the *lpBuffers* array.
lpNumberOfBytesSent	A pointer to the number of bytes sent by this call if the I/O operation completes immediately.
iFlags	Flags.
lpTo	An optional pointer to the address of the target socket.
iTolen	The size of the address in *lpTo*.
lpOverlapped	A pointer to a WSAOVERLAPPED structure (ignored for non-overlapped sockets).
lpCompletionRoutine	A pointer to the completion routine called when the send operation has been completed (ignored for non-overlapped sockets).

Remarks This function provides functionality over and above the standard **sendto()** function in two important areas:

- It can be used in conjunction with overlapped sockets to perform overlapped send operations.
- It allows multiple send buffers to be specified making it applicable to the scatter/gather type of I/O.

WSASendto() is used to write outgoing data from one or more buffers on a connectionless socket specified by *s*. **WSASendto()** is normally used on a connectionless socket to send a datagram to a specific peer socket identified by the *lpTo* parameter. On a connection-oriented socket, the *lpTo* and *iTolen* parameters are ignored; in this case the **WSASendto()** is equivalent to **WSASend**().

For overlapped sockets (created using **WSASocket()** with flag WSA_FLAG_OVERLAPPED) this will occur using overlapped I/O. A completion indication will occur (invocation of the completion routine or setting of an event object) when the supplied buffer(s) have been consumed by the transport. The final completion status is retrieved via **WSAGetOverlappedResult().**

For non-overlapped sockets, the last two parameters (*lpOverlapped, lpCompletionRoutine*) are ignored and **WSASend()** adopts the same blocking semantics as **send()**. Data is copied from the supplied buffer(s) into the transport's buffer. If the socket is non-blocking and there is not sufficient space in the transport's buffer, **WSASend()** will return with only part of the application's buffers having been consumed. Given the same buffer situation and a blocking socket, **WSASend()** will block until all of the application's buffer contents have been consumed.

For message-oriented sockets, care must be taken not to exceed the maximum message size of the underlying transport, which can be obtained by getting the value of socket option SO_MAX_MSG_SIZE. If the data is too long to pass atomically through the underlying protocol the error WSAEMSGSIZE is returned, and no data is transmitted.

Note that the successful completion of a **WSASendto()** does not indicate that the data was successfully delivered.

Flags may be used to influence the behavior of the function invocation beyond the options specified for the associated socket. That is, the semantics of this function are determined by the socket options and the *flags* parameter. The latter is constructed by or-ing any of the following values:

Value	Meaning
MSG_DONTROUTE	Specifies that the data should not be subject to routing. A Winsock service provider may choose to ignore this flag; see also the discussion of the SO_DONTROUTE option in section B.3.4 .
MSG_OOB	Send out-of-band data (stream style socket such as SOCK_STREAM only; see also section B.3.2.3)
MSG_PARTIAL	Specifies that *lpBuffer* only contains a partial message. Note that this flag will be ignored by transports which do not support partial message transmissions.

Overlapped socket I/O:
If an overlapped operation completes immediately, the value pointed to by the *lpNumberOfBytesSent* parameter is updated with the number of bytes sent. Otherwise, this parameter will be ignored. Applications may determine the amount of data transferred either via the *cbTransferred* parameter in the completion function (if specified), or via the *lpcbTransfer* parameter in **WSAGetOverlappedResult()**.

This function may be called from within the completion routine of a previous **WSARead()**, **WSAReadFrom()**, **WSASend()** or **WSASendTo()** function. In Win16 environments, this function may also be called from within a preemptive VMM context

provided that the XP1_INTERRUPT bit in the socket's PROTOCOL_INFO struct is TRUE.

The *lpOverlapped* parameter must be valid for the duration of the overlapped operation. If multiple I/O operations are simultaneously outstanding, each must referece a separate overlapped structure. The WSAOVERLAPPED structure has the following form:

```
typedef struct _WSAOVERLAPPED {
      DWORD       Internal;         // reserved
      DWORD       InternalHigh;     // reserved
      DWORD       Offset;           // ignored
      DWORD       OffsetHigh;       // ignored
      WSAEVENT    hEvent;
} WSAOVERLAPPED, FAR * LPWSAOVERLAPPED;
```

If the *lpCompletionRoutine* parameter is NULL, the *hEvent* field of *lpOverlapped* must be an event object handle which is signaled when the overlapped operation completes. An application can use **WSAWaitForMultipleEvents()** or **WSAGetOverlappedResult()** to wait or poll on the event object.

If *lpCompletionRoutine* is not NULL, the *hEvent* field is ignored and can be used by the application to pass context information to the completion routine.

In Win16 environments, callback functions may be invoked in a preemptive VMM context which is sometimes referred to as an interrupt context. Applications must be aware that in this special context a very limited set of runtime and Windows library functions can be safely made. As a rule, an application should confine itself to the same set of runtime functions that the Windows documentation indicates may safely be called during a multimedia timer callback function.

In Windows 95 and NT, the completion function follows the same rules as stipulated for Win32 file I/O completion routines. The completion function will not be invoked until the thread is in an alertable wait state such as can occur when the function **WSAWaitForMultipleEvents()** is invoked.

In all environments, transports do allow an application to invoke send and receive operations from within the context of the socket I/O completion function, and guarantee that, for a given socket, I/O completion functions will not be nested. This permits time-sensitive data transmissions to occur entirely within a preemptive context.

The prototype of the completion routine is as follows:

VOID CALLBACK CompletionRoutine(DWORD *dwError***,**
DWORD *cbTransferred***, LPWSAOVERLAPPED** *lpOverlapped* **);**

CompletionRoutine is a placeholder for an application-defined or library-defined function name. *dwError* specifies the completion status for the overlapped operation as indicated by *lpOverlapped*. *cbTransferred* specifies the number of bytes sent. This function does not return a value.

Returning from this function allows invocation of another pending completion routine for this socket. In Win32 environments, all waiting completion routines are called before the alterable thread's wait is satisfied with a return code of WSA_IO_COMPLETION. The completion routines may be called in any order, not

necessarily in the same order the overlapped operations are completed. However, the posted buffers are guaranteed to be sent in the same order they are supplied

Return Value

If no error occurs and the receive operation has completed immediately, **WSASendto()** returns 0. Note that in this case the completion indication (invocation of the designated completion routine or the setting of an event object) will have already occurred. Otherwise, a value of SOCKET_ERROR is returned, and a specific error code may be retrieved by calling **WSAGetLastError()**. The error code WSA_IO_PENDING indicates that the overlapped operation has been successfully initiated and that completion will be indicated at a later time. Any other error code indicates that the overlapped operations was not successfully initiated and no completion indication will occur.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEACCES	The requested address is a broadcast address, but the appropriate flag was not set.
WSAEFAULT	The *lpBuffer* or *lpTo* parameters are not part of the user address space, or the *lpTo* argument is too small.
WSAENETRESET	The connection must be reset because the Winsock provider dropped it.
WSAENOBUFS	The Winsock provider reports a buffer deadlock.
WSAENOTCONN	The socket is not connected (connection-oriented sockets only)
WSAENOTSOCK	The descriptor is not a socket.
WSAEOPNOTSUPP	MSG_OOB was specified, but the socket is not stream style such as type SOCK_STREAM, out-of-band data is not supported in the communication domain associated with this socket, or the socket is unidirectional and supports only receive operations.
WSAESHUTDOWN	The socket has been shutdown; it is not possible to **WSASendto()** on a socket after **shutdown()** has been invoked with how set to SD_SEND or SD_BOTH.
WSAEWOULDBLOCK	There are too many outstanding overlapped I/O requests.
WSAEMSGSIZE	The socket is message-oriented, and the message is larger than the maximum supported by the underlying transport.

WSAEINVAL	The socket has not been bound with **bind()**, or the socket is not created with the overlapped flag**.**
WSAECONNABORTED	The virtual circuit was aborted due to timeout or other failure.
WSAECONNRESET	The virtual circuit was reset by the remote side.
WSAEADDRNOTAVAIL	The specified address is not available from the local machine.
WSAEAFNOSUPPORT	Addresses in the specified family cannot be used with this socket.
WSAEDESTADDRREQ	A destination address is required.
WSAENETUNREACH	The network can't be reached from this host at this time.
WSA_IO_PENDING	An overlapped operation was successfully initiated and completion will be indicated at a later time.

See Also **WSACloseEvent(),WSACreateEvent(), WSAGetOverlappedResult(), WSASocket(), WSAWaitForMultipleEvents()**

3.62 WSASetBlockingHook()

Description Establish an application-specific blocking hook function.

#include <winsock.h>

FARPROC WSAAPI WSASetBlockingHook (FARPROC *lpBlockFunc* **);**

lpBlockFunc A pointer to the procedure instance address of the blocking function to be installed.

Remarks This function installs a new function which a Winsock implementation should use to implement blocking socket function calls.

A Winsock implementation includes a default mechanism by which blocking socket functions are implemented. The function **WSASetBlockingHook()** gives the application the ability to execute its own function at "blocking" time in place of the default function.

When an application invokes a blocking Winsock operation, Winsock initiates the operation and then enters a loop which is similar to the following pseudocode:

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

Note that Winsock implementations may perform the above steps in a different order; for example, the check for operation complete may occur before calling the blocking hook. The default **BlockingHook()** function is equivalent to:

```
BOOL DefaultBlockingHook(void) {
     MSG msg;
     BOOL ret;
     /* get the next message if any */
     ret = (BOOL)PeekMessage(&msg,NULL,0,0,PM_REMOVE);
     /* if we got one, process it */
     if (ret) {
          TranslateMessage(&msg);
          DispatchMessage(&msg);
     }
     /* TRUE if we got a message */
     return ret;
}
```

The **WSASetBlockingHook()** function is provided to support those applications which require more complex message processing - for example, those employing the MDI (multiple document interface) model. It is not intended as a mechanism for performing

general applications functions. In particular, the only Winsock function which may be issued from a custom blocking hook function is **WSACancelBlockingCall()**, which will cause the blocking loop to terminate.

This function must be implemented on a per-task basis for non-multithreaded versions of Windows and on a per-thread basis for multithreaded versions of Windows such as Windows NT. It thus provides for a particular task or thread to replace the blocking mechanism without affecting other tasks or threads.

In multithreaded versions of Windows, there is no default blocking hook--blocking calls block the thread that makes the call. However, an application may install a specific blocking hook by calling **WSASetBlockingHook().**
This allows easy portability of applications that depend on the blocking hook behavior.

Return Value The return value is a pointer to the procedure-instance of the previously installed blocking function. The application or library that calls the **WSASetBlockingHook ()** function should save this return value so that it can be restored if necessary. (If "nesting" is not important, the application may simply discard the value returned by **WSASetBlockingHook()** and eventually use **WSAUnhookBlockingHook()** to restore the default mechanism.) If the operation fails, a NULL pointer is returned, and a specific error number may be retrieved by calling **WSAGetLastError()**.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).

See Also **WSAUnhookBlockingHook()**

3.63 WSASetEvent()

Description Sets the state of the specified event object to signaled.

#include <winsock.h>

BOOL WSAAPI WSASetEvent(WSAEVENT *hEvent* **);**

hEvent Identifies an open event object handle.

Remarks The Win32 implementation of this function is:

```
#define WSASetEvent( h ) \
        SetEvent( h )
```

Return Value If the function succeeds, the return value is TRUE.

If the function fails, the return value is FALSE. To get extended error information, call **WSAGetLastError()**.

Error Codes WSA_INVALID_HANDLE *hEvent* is not a valid event object handle.

See Also **WSACreateEvent(), WSAResetEvent(), WSACloseEvent().**

3.64 WSASetLastError()

Description Set the error code which can be retrieved by **WSAGetLastError()**.

#include <winsock.h>

void WSAAPI WSASetLastError (int *iError* **);**

iError	Specifies the error code to be returned by a subsequent **WSAGetLastError()** call.

Remarks This function allows an application to set the error code to be returned by a subsequent **WSAGetLastError()** call for the current thread. Note that any subsequent Winsock routine called by the application will override the error code as set by this routine.

Return Value None.

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.

See Also **WSAGetLastError()**

3.65 WSASocket()

Description Create a socket which is bound to a specific transport service provider, optionally create and/or join a socket group.

#include <winsock.h>

SOCKET WSAAPI WSASocket (int *af***, int** *type***, int** protocol, **LPROTOCOL_INFO** *lpProtocolInfo*, **int** *iFlags***);**

af	An address family specification.
type	A type specification for the new socket.
protocol	A particular protocol to be used with the socket, or 0 if the caller does not wish to specify a protocol.
lpProtocolInfo	A pointer to a PROTOCOL_INFO struct that defines the characteristics of the socket to be created. If this parameter is not NULL, the first three parameters (*af, type, protocol*) are ignored.
g	The identifier of the socket group.
iFlags	The socket attribute specification.

Remarks **WSASocket()** causes a socket descriptor and any related resources to be allocated and associated with a transport service provider. This association will occur in one of two ways, depending on whether the *lpProtocolInfo* parameter is specified as a NULL pointer. If *lpProtocolInfo* is non-NULL, the first three parameters (*af, type, protocol*) will be ignored, and the transport provider indicated in the referenced PROTOCOL_INFO struct will be used. Applications may obtain PROTOCOL_INFO structs by using **WSAEnumProtocols()**.

If *lpProtocolInfo* is NULL, the first three parameters (*af, type, protocol*) will determine which service provider is used. The Winsock DLL will select the first transport provider able to support the stipulated address family, socket type and protocol values. If *protocol* is not specified (i.e., equal to zero), the default for the specified socket type is used. However, the address family may be given as AF_UNSPEC (unspecified), in which case the *protocol* parameter must be specified. The protocol number to use is particular to the "communication domain" in which communication is to take place.

Parameter *g* is used to indicate the appropriate actions on socket groups:

if *g* is an existing socket group id, join the new socket to this group, provided all the requirements set by this group are met; or

if *g* = SG_UNCONSTRAINED_GROUP, create an unconstrained socket group and have the new socket be the first member; or

if *g* = SG_CONSTRAINED_GROUP, create a constrained socket group and have the new socket be the first member; or

if *g* = NULL, no group operation is performed

For unconstrained groups, any set of sockets may be grouped together as long as they are supported by a single service provider. A constrained socket group may consist

only of connection-oriented sockets, and requires that connections on all grouped sockets be to the same address on the same host. For newly created socket groups, the new group id can be retrieved by using **getsockopt()** with option SO_GROUP_ID, if this operation completes successfully. A socket group and its associated ID remain valid until the last socket belonging to this socket group is closed.

The *iFlags* parameter may be used to specify the attributes of the socket by or-ing any of the following Flags:

Flag	Meaning
WSA_FLAG_OVERLAPPED	This flag causes an overlapped socket to be created. Overlapped sockets may utilize **WSASend()**, **WSASendto()**, **WSARecv()**, **WSARecvfrom()** for overlapped I/O operations, which allows multiple of these operations to be initiated and in progress simultaneously.

Connection-oriented sockets such as SOCK_STREAM provide full-duplex connections, and must be in a connected state before any data may be sent or received on it. A connection to another socket is created with a **connect**()**/WSAConnect**() call. Once connected, data may be transferred using **send**()**/WSASend**() and **recv**()**/WSARecv**() calls. When a session has been completed, a **closesocket**() must be performed.

The communications protocols used to implement a reliable, connection-oriented socket ensure that data is not lost or duplicated. If data for which the peer protocol has buffer space cannot be successfully transmitted within a reasonable length of time, the connection is considered broken and subsequent calls will fail with the error code set to WSAETIMEDOUT.

Connectionless, message-oriented sockets allow sending and receiving of datagrams to and from arbitrary peers using **sendto()/WSASendto()** and **recvfrom()/WSARecvFrom()**. If such a socket is **connect()**ed to a specific peer, datagrams may be send to that peer using **send**()**/WSASend**() and may be received from (only) this peer using **recv**()**/WSARecv**().

Return Value

If no error occurs, **WSASocket()** returns a descriptor referencing the new socket. Otherwise, a value of INVALID_SOCKET is returned, and a specific error code may be retrieved by calling **WSAGetLastError().**

Error Codes

WSANOTINITIALISED	A successful **WSAStartup()** must occur before using this API.
WSAENETDOWN	The network subsystem has failed.
WSAEAFNOSUPPORT	The specified address family is not supported.
WSAEINPROGRESS	A blocking Winsock call is in progress, or the service provider is still processing a callback function (see section **B.3.6.6**).
WSAEMFILE	No more socket descriptors are available.

WSAENOBUFS	No buffer space is available. The socket cannot be created.
WSAEPROTONOSUPPORT	The specified protocol is not supported.
WSAEPROTOTYPE	The specified protocol is the wrong type for this socket.
WSAESOCKTNOSUPPORT	The specified socket type is not supported in this address family.
WSAEINVAL	The parameter *g* specified is not valid.

See Also **accept()**, **bind()**, **connect()**, **getsockname()**, **getsockopt()**, **setsockopt()**, **listen()**, **recv()**, **recvfrom()**, **select()**, **send()**, **sendto()**, **shutdown()**, **ioctlsocket()**.

3.66 WSAStartup()

Description

```
#include <winsock.h>
```