Chapter 14 Network Communications

IMPORTANT: The requirements in this guide provide instructions for designing PC systems that will result in an optimal user experience with typical Windows-based applications running under either the Microsoft Windows Millennium Edition or Windows 2000 Professional or later operating systems. These design requirements are not the basic system requirements for running any version of Windows operating systems.

This chapter presents requirements for network adapters and related networking technologies.

Network communications requirements are based on *Network Driver Interface Specification 5.0* (NDIS 5.0). The Windows 2000 DDK defines the networking requirements, services, terminology, and architecture for the Windows family of operating systems.

Windows uses Bluetooth Wireless Technology as a wireless peripheral bus for cable replacement. NDIS miniport drivers are not required for Bluetooth devices. Requirements for Bluetooth HCI devices and peripherals are listed in Chapter 6, "Buses and Interfaces."

Note: In this chapter, references to adapters, network interfaces, and so on, apply to add-on network adapter cards, network implementations on the system board, and external network interfaces equally and without preference for any of these types of implementation, unless otherwise noted.

Unless this chapter defines a specific requirement or exception, all requirements apply for networking solutions as presented in Chapter 3, "PC System," and Chapter 6, "Buses and Interfaces."

Network Adapter Requirements

This section defines basic hardware feature requirements for all network adapters, including IEEE 802 LAN adapters, ISDN adapters, cable modems, ATM adapters, ADSL, and so on. The applicable requirements for each device category are listed in the related sections later in this chapter.

NET–0245. Network adapter uses NDIS 5.0 miniport driver

The network adapter driver must be based on and comply with NDIS 5.0 in order to take advantage of new operating system capabilities. The driver must follow the NDIS 5.0 miniport driver model defined in the Windows 2000 DDK.

Important: The development of full media access control (MAC) drivers is no longer supported.

If the network device is for connection-oriented media, such as ATM, ISDN, frame relay, or X.25, it must have a connection-oriented miniport driver that follows the connection-oriented model defined for NDIS 5.0. Also, for connection-oriented media, there must be an NDIS 5.0 call manager driver as defined in the Windows 2000 DDK.

In some cases, such as ATM, the call manager driver is included in the operating system. Consequently, for an ATM adapter, the vendor needs to provide only an NDIS 5.0 connection-oriented miniport driver. For connection-oriented media such as ISDN or X.25, the vendor must provide a call manager driver with the hardware, because the call manager is not included in the operating system. Call manager support can be integrated in the connection-oriented miniport driver or implemented as a separate NDIS 5.0 call manager driver. Documentation for both integrated and separated call managers is included in the Windows 2000 DDK.

An NDIS 5.0 miniport driver is required for network adapters that connect to the PC using IEEE 1394 or USB buses. This driver exposes its media type to NDIS 5.0 at its upper edge, and it interfaces with the appropriate bus driver at its lower edge.

NET–0246. Adapter automatically senses presence of functional network connection

Where the network allows it, the network adapter must be capable of dynamically determining whether it is functionally connected to a link partner such as a hub, switch, or router. The device must indicate the link state in the following cases:

- At boot time
- After returning to D0 power state
- When the link state changes while in the D0 power state (no time limit is specified for the required detection or status indication)

If the adapter is on an expansion card that is not used as a boot device, the device drivers can determine the presence of the functional link. If the adapter is not functionally connected to a link partner, the miniport driver must provide appropriate NDIS status indication using support for cable sense in NDIS 5.0.

For information about NDIS status codes and indication mechanisms, see the Windows 2000 DDK.

NET–0247. Adapter automatically senses transceiver type

Network adapters that support multiple transceivers must be capable of automatically detecting which transceiver type is connected to the network unless detection is not possible with the network media available. The network adapter then must automatically drive the correct connection. In all cases, the user must not be required to set jumpers or manually enter information to inform the operating system of the transceiver type.

NET–0248. Adapter can transmit packets from buffers aligned on any boundary

Buffer alignment refers to whether a buffer begins on an odd-byte, word, double word, or other boundary. Adapters must be able to transmit packets, any of whose fragments are on an odd-byte boundary.

For performance reasons, packets must be received into contiguous buffers on a double word boundary.

NET–0249. Adapter communicates with driver across any bridge

If the adapter uses a bridge, all communications must be free of errors across any bridge, such as a PCI bridge adapter.

NET–0250. Networking media supports IP

Any networking media must support IP, yet not preclude the use of other protocols.

NET–0251. PCI-based network adapters are bus masters

The PCI-based network adapter must support PCI bus mastering. PCI bus mastering must be enabled by default. CardBus and mini-PCI implementations need not be bus masters.

Connectionless Requirements

This section lists the requirements related to connectionless media, such as IEEE 802 LAN adapters (with the exception of wireless) and Fiber Distributed Data Interface (FDDI) adapters.

NET–0252. NDIS 5.0 miniport driver is deserialized

NDIS 5.0 introduces support for deserialized miniports. This feature enables performance improvements and scalability on Windows 2000 multiprocessor systems.

NET–0253. Full-duplex adapter automatically detects and switches to full duplex mode

If both the network adapter and switch port in a link pair support full duplex and there exists a standard way for each to detect and negotiate the duplex mode, the network adapter must negotiate full-duplex mode operation by default. Half-duplex mode can be used if that is the only mode supported by one or both link partners, or it can be manually configured if warranted by special conditions. The goal is to configure this setting automatically without end-user intervention.

NET–0254. Adapter supports filtering for at least 16 multicast addresses

This requirement applies to networking technologies, such as Ethernet, that support multicast. This requirement does not apply to technologies such as Token Ring, which distributes IP multicast traffic using the functional address as specified in RFC 1469, listed in "Network Communications References."

NET–0255. Adapter and driver support promiscuous mode

Promiscuous mode ensures that the adapter can be used with Microsoft Network Monitor Agent. This requirement applies only to LAN (nonswitched) media.

Notice that, by default, promiscuous mode is not on. Enabling promiscuous mode must be possible only by using the Microsoft Network Monitor Agent or another similar administrative application.

NET–0256. Adapter can be used as a boot device

A PC system designed for use with Windows 2000 must include remote boot support as defined in the *Preboot Execution Environment (PXE) Specification, Version 2.1*. This support may either be included on the adapter, in the system BIOS, or the support may be split between the adapter and the BIOS. See BIOS–0014.1, "BIOS supports PXE," in Chapter 3.

Note: This is not a requirement for Cardbus adapters or for mini-PCI adapters that are not sold as a part of or with a PC system.

NET–0257. Network adapter and driver supports priority for IEEE 802-style networks

Windows Quality of Service (QOS) components provide link layer priority information to NDIS 5.0 miniport drivers in each transmitted packet's NDIS_PER_PACKET_INFO structure.

Priority values are derived by mapping Internet Engineering Task Force (IETF) Integrated Services (IntServ, RFC 1663) service typed to IEEE 802.1p priority values, referred to as the user priority object. Current IETF references include:

- The Subnet Bandwidth Manager.
- Framework for integrated services over 802 networks.
- Mapping integrated services to 802.1p.

The IntServ service type used for the mapping is determined by QOS-aware applications or, on behalf of the application, by QOS-aware operating system components. Driver support for link layer priority information must adhere to IEEE 802.lp priority values.

IEEE 802.1p/q-capable Ethernet drivers must use the priority level indicated in the NDIS_PER_PACKET_INFO structure to generate the corresponding field in the IEEE 802.1p/q MAC headers of transmitted packets. Similarly, these drivers must extract the appropriate information from the MAC headers of received packets and copy the priority to the NDIS_PER_PACKET_INFO structure before indicating the packet to higher protocol layers.

Notice that any link layer driver has the ability to interpret the priority information in the NDIS_PER_PACKET_INFO structure and use it as appropriate for the particular media.

For more information, see the Windows 2000 DDK and “QOS: Assigning Priority in IEEE 802-style Networks.”

ISDN Requirements

This section summarizes the design features for ISDN devices. It defines general requirements for ISDN and specific requirements for ISDN terminal adapters. For information about the requirements for ISDN modems, see Chapter 13, “Modems.”

The phrase “ISDN modem” indicates an ISDN device that operates as a modem controlled by the AT command set.

In this section, “internal ISDN device” refers to the ISDN terminal adapter, which exposes raw access to its B channels using NDIS miniports. Alternatively, ISDN terminal adapters could be attached to the PC using WDM-supported bus classes such as USB or IEEE 1394, which would physically be an external device.

NET–0258. Internal ISDN device meets PC 2001 network adapter requirements

ISDN adapters must meet all requirements stated in “Network Adapter Requirements,” with the exception of NET–0251, “PCI-based network adapters are bus masters.” PCI ISDN adapters are not required to be bus masters.

NET–0259. Internal ISDN device supports synchronous HDLC framing

High-level Data Link Control (HDLC) framing is a standard for sending synchronous data. Other framing methods are allowed if the miniport driver provides simple HDLC-framed, synchronous PPP packets to NDIS.

NET–0260. NDIS interface and driver support raw, unframed synchronous B channel I/O

The internal ISDN device and the driver must support raw, unframed (non-HDLC) synchronous B channel I/O at 64 Kbps per B channel, with each B channel individually accessible. This support enables H.320 as well as voice calls over ISDN without audio breakup.

For these raw interfaces, the direct path to each B channel must support synchronous transmission and reception of H.221 frames, which are of 20 ms duration. Since underruns or overruns cause degraded audio, hardware buffering must be adequate to prevent B channel underruns and overruns. For Windows Me and Windows 2000, 20 ms is adequate.

NET–0261. ISDN driver supports unattended installation, with limitations

Configuration of the dependent parameters, such as SPIDs and switch-type IDs, must be done through the ISDN configuration wizard included in the operating system.

NET–0262. ISDN device includes software-selectable terminating resistors

If the ISDN device has an S/T-interface for connecting additional ISDN devices, it must also have software-configurable terminating resistors that can be selected on or off. The default value of the termination is on in North America, but off in all other countries, where phone companies unconditionally provide the termination.

Cable Modem Requirements

Cable modem provides two-way services: data flows downstream from the cable operator’s head end and upstream from the customer’s PC. At the head end, the cable data system is terminated by the cable modem termination system (CMTS), which terminates the upstream and downstream RF, MAC layer, and possibly Layer 3 protocols from the cable side. CMTS provides the internetwork connection between the cable system and the rest of the network at the head end. CMTS can be implemented on a proprietary hardware platform or a PC platform running Windows 2000. CMTS can provide different networking functions such as routing or QOS support, for example, Resource Reservation Setup Protocol (RSVP).

The three current cable modem specifications are:

- *Data-Over-Cable Service Interface Specifications* (DOCSIS) developed by the Multimedia Cable Network System (MCNS) consortium.
- IEEE 802.14 Cable TV Working Group, developed by IEEE.
- Digital Video Broadcasting/Digital Audio-Visual Council (DVB/DAVIC), developed by DAVIC and DVB and adopted by European Telecommunications Standards Institute (ETSI) and ITU.

Industry support for DOCSIS is growing rapidly in North America. In present form, its upper layers fully describe IP traffic encapsulated by 802.3/Digital-Intel-Xerox (DIX) Ethernet framing. ATM is left for future study.

External Ethernet DOCSIS cable modems provide IEEE 802.1d bridging for one or more customer premises equipment. A PC attaches to the cable modem indirectly through its 10B-T network adapter. Integrated cable modems attach directly to the PC over buses such as USB, PCI, and IEEE 1394, and they require a vendor-supplied NDIS 5.0 miniport driver. This driver exposes an 802.3/DIX Ethernet adapter interface to the operating system.

In contrast to DOCSIS, both the IEEE 802.14 and the DVB/DAVIC efforts are focused on using ATM, typically implementing an ATM adapter interface and using an NDIS 5.0 ATM miniport driver.

NET–0263. Integrated cable modem meets PC 2001 network adapter requirements

Cable modems must meet all requirements stated in “Network Adapter Requirements.” In addition, the requirement NET–0254, “Adapter supports filtering for at least 16 multicast addresses” applies for an integrated cable modem exposing an Ethernet interface.

NET–0264. Integrated cable modem exposes an ATM or Ethernet interface

An integrated cable modem must expose an ATM or Ethernet interface to the operating system. For the specific requirements if an ATM/cable modem solution is implemented, see “ATM Adapter Requirements.”

ATM Adapter Requirements

This section summarizes requirements for ATM hardware. These requirements also apply to Asymmetric Digital Subscriber Line (ADSL) devices; see “ADSL Requirements.”

The NDIS 5.0 extensions provide kernel-mode NDIS 5.0 client drivers with direct access to connection-oriented media such as ATM. The new architecture for Windows Me and Windows 2000 extends native ATM support to Windows

Sockets 2.0 (WinSock), TAPI, and DirectShow-based applications by providing system-level components that map the applicable WinSock, TAPI, and DirectShow APIs to NDIS 5.0, extending direct ATM access to user-mode applications.

If ATM is included in a PC 2001 system or is specifically designed for Windows Me or Windows 2000, it must meet the requirements defined in this chapter.

For more information related to these requirements, see "ATM Layer Specification," in *ATM User Network Interface (UNI) Specification Version 3.1, 1/e.* This specification includes references to other relevant specifications.

NET–0265. ATM adapter meets PC 2001 network adapter requirements

ATM adapters must meet all requirements stated in "Network Adapter Requirements."

NET–0266. ATM adapter supports a minimum number of simultaneous connections

The virtual path ID (VPI) and virtual channel ID (VCI) ranges supported by the adapter affect the maximum number of simultaneous connections supported on a system.

This affects the applicability of the adapter to ATM applications such as LAN emulation, where at least one dedicated virtual channel (VC) is created between each pair of communicating ATM hosts.

System type	Simultaneous connections
Client (ATM adapter)	64 or more
Client (Integrated ATM/ADSL adapter)	32 or more

A sample driver is provided in the Windows 2000 DDK to guide developers in properly supporting resources to meet this requirement.

NET–0267. ATM adapter supports UBR service type

Unspecified bit rate (UBR) service is used by default for standard ATM services such as LAN Emulation and IP over ATM. In addition, PPP is a widely used model for residential network access, and UBR is used by default for PPP-over-ATM virtual circuits. Therefore, ATM adapters must support the UBR service type.

NET–0268. ATM adapter supports a minimum number of simultaneously active VBR or CBR connections

Support is required for at least two simultaneously active variable bit rate (VBR) or constant bit rate (CBR) connections for basic ATM signaling and management.

Support for at least six VBR/CBR connections is needed for ATM adapters that support multimedia or other traffic that demands QOS.

NET–0269. ATM adapter supports traffic shaping

The ATM adapter must support and enforce all the traffic-shaping rules specified for each service type it supports, including CBR, VBR, available bit rate (ABR), and UBR. This includes enforcement of peak cell rate on UBR virtual circuits, as described in the following requirement.

NET–0270. ATM adapter enforces PCR on UBR virtual circuits

ATM adapters can be used to connect the router, remote access, and content servers to the public ATM network. High-speed residential broadband access networks, such as ADSL and cable modem, can enable direct connection, using an ATM virtual circuit, from home or small office computers to these servers.

To avoid packet loss and ensure efficient network utilization, it is critical that all ATM adapters, integrated ATM/ADSL adapters, and ATM/cable modem adapters enforce requested PCR on UBR virtual circuits. ATM adapters must be able to schedule cells on a UBR virtual circuit at a peak rate less than the line or link rate.

Because any ATM adapter might be installed in a server to which clients connect through the public network, this requirement applies to all ATM adapters.

NET–0271. ATM adapter and driver support dynamic link speed configuration

When connected to a residential broadband network, an ATM adapter must restrict the aggregate transmission rate across all active virtual circuits so that it does not exceed the upstream bandwidth provided by the residential broadband network.

Therefore, all integrated ATM/ADSL adapters and ATM/cable modem adapters must support aggregate shaping of upstream bandwidth, according to the provisioned upstream bandwidth or the trained bandwith, whichever is lower. Some implementations can support rate adoption, and lower-than-provisioned rates might be negotiated because of poor line conditions. In addition, because any 25 Mbps ATM adapter might be used to connect to an ADSL network by way of an external ADSL modem, it is required that all 25 Mbps ATM adapters support this as well. This support is optional for ATM adapters with line rates higher than 25 Mbps.

The Windows ATM Call Manager uses Interim Local Management Interface (ILMI) to query the public network to determine the maximum line rates provisioned for incoming and outgoing traffic. The Call Manager then uses the OID_GEN_CO_LINK_SPEED NDIS request (in SET mode) to set the line rate for both incoming and outgoing traffic, within which the adapter can shape the aggregate of all ATM traffic.

NET–0272. ATM adapter that supports OAM responds to F4 and F5 loopback cells

Adapters that receive F4 and F5 loopback operation and maintenance (OAM) calls must be responded to on adapters that support OAM. This capability is needed for diagnostics. Support for layers F1–F3 is optional.

ADSL Requirements

This section summarizes requirements for ADSL hardware.

Note: All ATM requirements also apply to ADSL devices.

Windows Me and Windows 2000 provides support for ADSL adapters and external ADSL modems, such as those using USB, which provide a faster method for moving data over regular phone lines.

Thirty leading ADSL vendors jointly developed the white paper, *An Interoperable End-to-end Broadband Service Architecture over ADSL Systems (Version 3.0)*, which discusses end-to-end service interoperability over ATM over ADSL. The core idea of this white paper (PPP over ATM over ADSL) has been adopted by the ADSL Forum. This paper is available at the Web site listed in "Network Communications References."

NET–0273. Integrated ADSL modem meets PC 2001 network adapter requirements

ADSL modems must meet all requirements stated in "Network Adapter Requirements." In addition, integrated ADSL modems exposing an Ethernet interface must meet NET–0254, "Adapter supports filtering for at least 16 multicast addresses."

NET–0274. DSL modem supports G.994.1

ITU-T G.994.1, *Handshake procedures for digital subscriber line (DSL) transceivers*, is the international standard that defines mechanisms to allow DSL transceivers to exchange capabilities and to select a common mode of operation. G.994.1 supports modulation standards G.991.1 High bit-rate Digital Subscriber Line (HDSL), G.992.1 (full-rate discrete multitone [DMT] ADSL), G.992.2 ("G.lite" DMT ADSL), T1.413 Issue 2 (ANSI full-rate ADSL), and T1 TR-59 (CAP/QAM).

Use of G.994.1 allows the customer premises and central office DSL modems to negotiate a common mode of operation, and more importantly, identifies the cause of failure when the link is not established due to the incompatible modes of operation of the two modems.

NET–0275. CAP/QAM ADSL modem supports T1 TR-59

U.S. T1 committee Technical Report TR-59, "Single-Carrier Rate Adaptive Digital Subscriber Line (RADSL)," is the industry consensus specification for CAP/QAM ADSL modems. ADSL modems that support CAP/QAM modulation must implement TR-59. CAP/QAM ADSL modems may also support other modulation methods such as DMT.

Note: TR-59 is not a U.S. ANSI standard for ADSL modems, but is supported by some network access providers.

CAP/QAM ADSL modems must support G.994.1.

NET–0276. DMT ADSL modem supports G.992.2

ITU-T G.992.2, also known as G.lite, is the international standard for DMT modems, which includes features to facilitate easy, end-user installation. ADSL modems that support DMT modulation must implement G.992.2. DMT ADSL modems also may support other modulation standards, such as G.992.1, ANSI T1.413 Issue 2, or other modulation methods such as CAP/QAM, and so forth.

DMT ADSL modems must:

- Support the L0 (Full On) and L3 (Idle) link states.
- Support the T0e, T0f, T3a, and T3b link transitions.
- Support G.994.1.

Wireless Networking

Wireless networking media types enable WAN, LAN, and personal area network (PAN) connectivity. This section lists additional requirements for wireless media. For wireless modem requirements, see Chapter 13, "Modems." For more information about Bluetooth devices, see "Bluetooth" in Chapter 6. In addition, wireless adapters must support filtering for at least 16 multicast addresses. See NET–0254, "Adapter supports filtering for at least 16 multicast addresses."

NET–0278. Wireless networking media adapters support wireless extensions to NDIS

Wireless extensions to NDIS are documented in "Network-Dependent Wireless Objects" in Network Drivers in the Windows 2000 DDK. These extensions are based on the work of the Portable Computer and Communications Association, published in *STD-201: Extensions to NDIS for Wireless WANs*, listed in "Network Communications References."

NET–0279. IEEE 802.11 wireless networking adapters support industry specifications

IEEE 802.11 wireless networking adapters must support 11Mbps signaling using Direct Sequence Spread Spectrum.

IrDA Requirements for Network Communications

The interface between IrDA hardware (framers) and the Windows IrDA stack is through NDIS 5.0 miniport drivers that adhere to the conventions defined in *Infrared Extensions to the NDIS Version 4.0 Functional Specification*. The Windows IrDA stack expects that hardware and NDIS drivers deal with framing, transparency, and error detection, as well as supporting media-sense and speed-change commands. Miniport drivers are responsible for discarding incoming frames with bad cyclic redundancy checks. Never forward these frames to the protocol.

Although the IrDA protocol stack in Windows 2000 is different from the one on Windows Me, use the Windows 2000 DDK for driver development for both platforms. The Windows 2000 IrDA protocol stack imposes stricter requirements on drivers than the protocol stack on Windows Me.

NET–0280. Infrared device meets PC 2001 network adapter requirements

IrDA devices must meet all requirements stated in “Network Adapter Requirements.”

NET–0281. Infrared device supports both FIR and SIR

All infrared devices must comply with approved IrDA specifications, including support for SIR, FIR, and optional Very Fast IR (VFIR) data devices.

NET–0282. IrDA hardware supports unattended driver installation

FIR Plug and Play hardware must report a unique Plug and Play ID that matches the combination of the chip set, transceiver, and any other system-specific parameters for the operating system to find and install the correct INF file and the associated driver for the IrDA hardware.

In the best case, the IrDA hardware has only one Plug and Play ID associated INF file and a miniport driver that can autodetect the transceiver type and other system-specific parameters. This combination enables the installation and configuration of the hardware and the driver without user intervention.

In other cases, for example, where the miniport driver cannot autodetect the transceiver type or any other system-specific parameters, a unique Plug and Play ID for each combination of the chip set and the transceiver type must be reported. Also, the vendor must provide for each combination an associated driver and INF file describing the configuration parameters.

Home Networking Media

New networking media types are being invented to make it easy for PC users in homes and small businesses to implement simple LANs without needing to install new wires. This section lists additional requirements for these media. The media types listed in this section cover wireless and re-use of existing telephone wiring.

NET–0283. If implemented, home networking adapter meets PC 2001 network adapter requirements

Home network adapters must meet all requirements stated in "Network Adapter Requirements." In addition, they must meet following requirements:

- NET–0254, "Adapter supports filtering for at least 16 multicast addresses"
- NET–0255, "Adapter and driver support promiscuous mode" for network media that confine network traffic signals within a single home

NET–0284. Network adapter that supports Home RF complies with SWAP specification

A PC 2001 network adapter that implements HomeRF, must comply with *Shared Wireless Access Protocol (SWAP) Specification, Version 1.1*. The HomeRF Working Group (HRFWG) publishes this specification, which is listed in "Network Communications References." The Web site has a technical summary and document ordering information.

NET–0285. If implemented, network adapter that supports HomePNA complies with 1.0 specification.

A PC 2001 network adapter that implements HomePNA technology must comply with the *Home Phoneline Networking Alliance Spec, Version 1.0*.

Plug and Play and Bus Design for Network Communications

The items in this section are requirements for Plug and Play capabilities.

NET–0286. Plug and Play capabilities support multiple adapters

For network communications devices, the Plug and Play IDs and resource support must be sufficient to allow the automatic addition of multiple network communications devices to the system.

NET–0287. All resource settings are reported in the user interface

All resource settings must be viewable in the Device Manager and in the adapter properties dialog boxes. All resource settings that can be changed by the user must be changed using the standard Windows user interface, not through the use of INI files or other setting files.

This requirement implies that all device resources must be set and read through the standard interfaces provided by the bus on which the device resides. For PCI devices, this interface is the PCI configuration space. Also, device parameter settings must be stored in the registry.

NET–0288. External networking devices support standard control interfaces

External networking devices attached using a serial bus (USB, USB 2.0, IEEE 1394, or Bluetooth) must support standard control interface specifications where applicable.

All external USB networking devices must support *Universal Serial Bus Class Definitions for Communication Devices, Version 1.1* (CDC 1.1), listed in "Network Communications References."

If implemented, external USB networking adapters must support one of the following:

- Ethernet connection model (CDC 1.1)
- Remote NDIS over CDC 1.1
- COMMON ISDN-API (CAPI) over CDC 1.1 (ISDN adapters)

If implemented, external IEEE 1394 networking adapters must support remote NDIS over SBP-2.

If implemented, external Bluetooth network devices must support at least one of the applicable profiles defined by the Bluetooth SIG, such as *Specification of the Bluetooth System, Volume 2: Profiles, v1.0B.*

Power Management for Network Communications

This section summarizes the specific power management requirements for network communications devices.

NET–0289. Adapter complies with network power management specification

The *Network Device Class Power Management Reference Specification, Version 1.0a*, provides definitions of the OnNow device power states (D0–D3) for network adapters. The specification also covers the device functionality expected in each power state and the possible wakeup event definitions for the class.

Network communications devices that directly attach to the PC over USB, PCI, and IEEE 1394 must comply with this specification.

NET–0290. Network device supports wakeup events

This requirement applies specifically to the following network communications devices and their associated NDIS 5.0 miniport drivers:

- Ethernet and Token Ring network adapters
- Integrated DOCSIS cable modems
- Other devices that transfer IEEE 802.3/DIX Ethernet framed packets

Note: *Network Device Class Power Management Reference Specification, Version 1.0a,* does not yet define wakeup mechanisms for ISDN adapters or any network communications adapter that uses ATM signaling, including ADSL.

The system must be capable of wakeup from a lower power state based on network events that are specified by the local networking software. As a result of this capability, any standard Windows network access—such as connections to shared drives and WinSock connections, plus service and management applications—can wake a system from lower power states transparently.

External networking devices using USB or IEEE 1394 are not required to support Wake on LAN while operating on bus power. No wireless network connection is required to support Wake on LAN.

Mobile PC Note For mobile PCs, network device wakeup is not required.

As defined in *Network Device Class Power Management Reference Specification,* a network adapter and its driver must support wakeup on receipt of a network wakeup frame. Support for wakeup on detection of a change in the network link state or on receipt of a magic packet event is optional. Implementation details are described in the “Network Wakeup Frames” and “Network Wakeup Frame Details” sections of *Network Device Class Power Management Reference Specification, Version 1.0a,* and in the Windows 2000 DDK.

The packet patterns that define the wakeup frames are provided to the NDIS 5.0 miniport driver by the operating system. To enable Wake on LAN capability for basic networking scenarios, the network adapter must be capable of storing information describing a minimum of three wakeup packet patterns and of generating a wakeup indication on recognition of any wakeup packet. A wakeup packet is a packet that includes a wakeup pattern anywhere within the first 120 bytes of the packet. The minimum set of wake-up packets that must be recognized are the following:

- A packet directed to at least one IP address
- An IP address resolution protocol (ARP) packet
- A packet containing NetBIOS name queries, or any arbitrary string

PCI-based network adapters must support the generation of a power management event (PME# assertion) from the $D3_{cold}$ device state if the physical layer technology is generally capable of operating under the voltage and current constraints of the $D3_{cold}$ device state.

Note: 1000baseSX or 1000baseLX (gigabit Ethernet using optical fiber media) cannot meet this requirement because of the power required to operate the optical physical layer. The same applies for FDDI adapters.

Device Drivers and Installation for Network Communications

This section summarizes requirements for network communications device drivers, in addition to the requirements for using an NDIS 5.0 miniport driver.

NET–0291. Driver works correctly with Microsoft network clients and protocols

This requirement includes the 32-bit Microsoft client and NetWare-compatible clients provided with Windows, whether connected to a Windows 2000 server, a Novell NetWare 3.*x* or 4.*x* server, or a Windows-based peer server. In all cases, this requirement applies to connections using Microsoft TCP/IP, IPX/SPX-compatible protocol, and NetBEUI in LANs and Transmission Control Protocol/Internet Protocol (TCP/IP) in WANs.

NET–0292. NDIS miniport driver makes only NDIS library calls or WDM system calls

A miniport driver must make calls only to the NDIS library or the WDM system to provide binary compatibility of the driver between Windows Me and Windows 2000.

NET–0293. NDIS 5.0 driver uses Windows 2000 INF file format

All network components must use the INF file format defined in the Windows 2000 DDK.

Network Communications References

Following are the references, services, and tools cited in this chapter that are available to help build hardware that works optimally with Windows operating systems.

An Interoperable End-to-End Broadband Service Architecture over ADSL System (Version 3.0)

http://www.microsoft.com/hwdev/publicnet/

ATM User Network Interface (UNI) Specification Version 3.1
Prentice Hall; 1995ISBN 0-13-393828-X
http://www.atmforum.com

Data-Over-Cable Service Interface Specifications (DOCSIS)
Multimedia Cable Network System (MCNS)
http://www.cablemodem.com/

DVB/DAVIC (Digital Video Broadcasting/Digital Audio-Visual Council)
http://www.dvb.org
http://www.davic.org

European Telecommunication Standards Institute (ETSI)
http://www.etsi.org

Handshake procedures for digital subscriber line (DSL) transceivers
http://www.itu.int/

Home Phoneline Networking Alliance Spec, Version 1.0
http://www.homepna.org

Home Radio Frequency Working Group
http://www.homerf.org

IEEE 802.14 Cable TV Working Group
http://www.walkingdog.com/

Infrared Extensions to the NDIS Version 4.0 Functional Specification
http://www.cablemodem.com/

"IP Multicast over Token-Ring Local Area Networks"
RFC 1469
http://www.rfc-editor.org/rfc.html

IrDA specifications
http://www.irda.org

ITU (International Telecommunication Union)
http://www.itu.ch

Network Device Class Power Management Reference Specification, Version 1.0a
http://www.microsoft.com/hwdev/specs/PMref/

Preboot Execution Environment (PXE) Specification, Version 2.1
http://developer.intel.com/ial/wfm/wfmspecs.htm

RFC 1469: See "IP Multicast over Token-Ring Local Area Networks."

Shared Wireless Access Protocol (SWAP) Specification, Version 1.1
http://www.homerf.org/tech/

Specification of the Bluetooth System, Volume 2: Profiles, v1.0B
Bluetooth Special Interest Group (SIG)
www.bluetooth.com

STD-201: Extensions to NDIS for Wireless WANs
http://www.pcca.org/standards/standards.htm

Universal Serial Bus Class Definitions for Communication Devices, Version 1.1
http://www.usb.org/developers/devclass_docs.html

U.S. T1 committee Technical Report TR-59, "Single-Carrier Rate Adaptive Digital Subscriber Line (RADSL)"
http://www.t1.org/html/trs.htm

Windows 98 DDK and Windows 2000 DDK
http://www.microsoft.com/ddk/

Checklist for Network Communications

NET–0245. Network adapter uses NDIS 5.0 miniport driver
NET–0246. Adapter automatically senses presence of functional network connection
NET–0247. Adapter automatically senses transceiver type
NET–0248. Adapter can transmit packets from buffers aligned on any boundary
NET–0249. Adapter communicates with driver across any bridge
NET–0250. Networking media supports IP
NET–0251. PCI-based network adapters are bus masters
NET–0252. NDIS 5.0 miniport driver is deserialized
NET–0253. Full-duplex adapter automatically detects and switches to full duplex mode
NET–0254. Adapter supports filtering for at least 16 multicast addresses
NET–0255. Adapter and driver support promiscuous mode
NET–0256. Adapter can be used as a boot device
NET–0257. Network adapter and driver supports priority for IEEE 802-style networks
NET–0258. Internal ISDN device meets PC 2001 network adapter requirements
NET–0259. Internal ISDN device supports synchronous HDLC framing
NET–0260. NDIS interface and driver support raw, unframed synchronous B channel I/O
NET–0261. ISDN driver supports unattended installation, with limitations
NET–0262. ISDN device includes software-selectable terminating resistors
NET–0263. Integrated cable modem meets PC 2001 network adapter requirements
NET–0264. Integrated cable modem exposes an ATM or Ethernet interface
NET–0265. ATM adapter meets PC 2001 network adapter requirements
NET–0266. ATM adapter supports a minimum number of simultaneous connections
NET–0267. ATM adapter supports UBR service type
NET–0268. ATM adapter supports a minimum number of simultaneously active VBR or CBR connections
NET–0269. ATM adapter supports traffic shaping
NET–0270. ATM adapter enforces PCR on UBR virtual circuits
NET–0271. ATM adapter and driver support dynamic link speed configuration
NET–0272. ATM adapter that supports OAM responds to F4 and F5 loopback cells
NET–0273. Integrated ADSL modem meets PC 2001 network adapter requirements

NET–0274. DSL modem supports G.994.1

NET–0275. CAP/QAM ADSL modem supports T1 TR-59

NET–0276. DMT ADSL modem supports G.992.2

NET–0278. Wireless networking media adapters support wireless extensions to NDIS

NET–0279. IEEE 802.11 wireless networking adapters support industry specifications

NET–0280. Infrared device meets PC 2001 network adapter requirements

NET–0281. Infrared device supports both FIR and SIR

NET–0282. IrDA hardware supports unattended driver installation

NET–0283. If implemented, home networking adapter meets PC 2001 network adapter requirements

NET–0284. Network adapter that supports Home RF complies with SWAP specification

NET–0285. If implemented, network adapter that supports HomePNA complies with 1.0 specification.

NET–0286. Plug and Play capabilities support multiple adapters

NET–0287. All resource settings are reported in the user interface

NET–0288. External networking devices support standard control interfaces

NET–0289. Adapter complies with network power management specification

NET–0290. Network device supports wakeup events

NET–0291. Driver works correctly with Microsoft network clients and protocols

NET–0292. NDIS miniport driver makes only NDIS library calls or WDM system calls

NET–0293. NDIS 5.0 driver uses Windows 2000 INF file format