CHAPTER 19

Modems

This chapter presents the PC 98 requirements for modems, fax modems, voice modems, voice/data modems, wireless and cellular modems, and Integrated Service Digital Network (ISDN) modems.

For communications that require a solution based on NDIS under Windows and Windows NT, see the “Network Communications” chapter in Part 4 of this guide.

Contents

PC 98 Modem Design Issues 306
System Requirements for Modems 310
Modem Basic Features 310
    Voice Modem Requirements 314
    Wireless and Cellular Modem Requirements 316
    ISDN Modem Requirements 318
PC 98 Design for Modems 321
    Plug and Play and Bus Design for Modems 321
    Power Management for Modems 323
    Device Drivers and Installation for Modems 324
Modem References 325
Checklist for Modems 326

PC 98 Modem Design Issues

This section presents the key design issues for modems. The Windows and Windows NT operating systems and Win32-based applications use data, fax, voice, and voice/data integration features in modems.

Note: Communications standards mentioned in this chapter are available through ITU Sales, Bellcore, ETSI, or Global Engineering Documents, as described in the "Modem References" section at the end of this chapter.

Basic PC 98 Modem. The fundamental design principle for compatibility with Windows is for the device to be supported by the Universal Modem Driver (Unimodem), which uses INF files to characterize the behavior of a device. A detailed definition of Unimodem requirements is contained in the MDK, available at ftp://ftp.microsoft.com/developr/drg/modem/modemdev.exe.

The new PC 98 requirements and recommendations are directed at the following issues:

- Migrating to even higher speeds of dial-up access based on pulse-code modulation (PCM) modems (that is, ITU V.pcm, X2, and K56Flex).
- Addressing persistent cost-of-ownership problems, particularly modem detection and installation and Internet Service Provider (ISP) call failures.
- Migrating modem functions into the operating system to save costs and to provide upgrade flexibility.
- Addressing the failure of many voice modems to meet the needs of ISVs who are implementing computer-based telephony and need new features to be successful.

Migrating to Higher Speeds with PCM Modems. V.34, as advanced as it is, is not the end of the line for telephone-line modems. ISP access is the driving force for modem use. ISPs use high-density modem pools, which connect to the Public Switched Telephone Network (PSTN) using T1 or ISDN primary rate interface (PRI) links. This creates an opportunity, because the ISP-side modem has direct access to the inside of the digital telephone network, so it can directly modulate the PCM B-channel data.

PCM means that the impairments on the ISP-side analog loop have disappeared; there is no quantization noise or echo. The symbol rate on the remaining loop jumps from 3429 to 8000 per second from the ISP to the end user. The number of bits per symbol is limited by the channel's remaining frequency limitations and the signal power limits imposed by regulatory agencies (to limit cross talk in phone-wire trunks).

This opportunity has spawned diverse approaches. In early 1997, two similar but incompatible proprietary specifications exist: X2 and K56flex. Work is proceeding toward a first-stage international standard: V.pcm. This work will be completed early in 1998.

Addressing Cost of Ownership for Modems. The two largest cost-of-ownership issues for modems are installation problems and operations problems related to creating connections. Plug and Play minimizes installation problems when correctly implemented. However, the explosion in ISP usage has highlighted operations problems. According to public studies, 16.2 percent of ISP access calls fail to connect, and ISPs are commonly spending $6 per subscriber per month in technical support.

A smaller percentage of access calls fail after the connection is made. This failure rate is not acceptable. Three elements needed to change this are:

- Modem and PSTN diagnostics.
- Modems that can easily be upgraded.
- Deterministic modem identification so that upgraded modems still work.

In consultation with leading ISPs and modem manufacturers, Microsoft is developing a standard method for modems to report last-call statistics: the Unimodem Diagnostics command, or AT#UD, as described in the specification on http://www.microsoft.com/hwdev/specs/. This command will be used by Windows and ISP software. The reported last-call information is essential to illuminate problems in user modems, local phone loops, local offices, and ISP-side modems so that they can be diagnosed and fixed.

After a problem has been found, requiring users to replace their modems to fix that problem is too costly for both the user and the manufacturer. Some manufacturers already make their modems with upgradable memory, allowing painless feature or bug-fix upgrades for their customers. The makers of Windows-based modems have also offered this advantage. It is time to make easy user upgradability an industry-wide standard.

But even upgrades can pose hazards. For modems that do not support Plug and Play, the Windows Modem class installer reads a series of AT commands, implements a proprietary algorithm to generate a 32-bit ID, and uses that ID to match to the modem driver. Manufacturers might inadvertently change responses that Unimodem depends on for computing the unique Unimodem ID (ATI and other commands), leaving the user with a modem that is recognized as a “Standard Modem” instead of the actual modem name.

To address the detection problem, modem vendors are required to use bus-specific Plug and Play means to deliver the CompatibleID command, and they are encouraged to use standard methods to report accurate manufacturer and modem names. For information, see specifications for new Unimodem commands and related articles at http://www.microsoft.com/hwdev/hwdev/devdes/.

Migrating Functions to the Operating System with Windows Modems. A traditional modem has several functions implemented in hardware or firmware:

- Telephone network connection—connectors, transformers, relays, codec
- Digital signal processing—V.34, V.32bis, V.8bis, dual tone multifrequency (DTMF), voice processing, speakerphone echo cancellation, and so on
- Modem controller—AT command interpreter (for example, V.25ter)
- Protocol stacks—V.42 error control, V.42bis data compression

A Windows modem moves some of these functions into Windows drivers. A controllerless modem (also known as a host-based controller) is a modem that consists of a digital signal processor (DSP) without the usual microcontroller. The host CPU provides the AT command interpreter, modem control functions, V.42, and V.42bis implementation.

A software modem (also known as host-based signal-processing modem or pumpless modem) performs signal processing on the host Pentium processor or compatible microprocessor and implements the controller as described in the previous paragraph. The modem hardware consists only of a telephone-line interface and DAC and ADC circuitry such as a PCM codec, plus a little bit more. However, the hardware does not contain DSP or a microcontroller.

Advantages of software modems include the following:

- Cost savings
- Flexibility for upgrading to V.pcm, fixing bugs, and so on
- Data processing occurs in the CPU, where it fits
- Separate data and control paths to the hardware are available

Disadvantages of software modems include the following:

- CPU-based functions compete for resources with other uses, such as the operating system, applications, multimedia codecs, and so on
- Difficult to support multiple platforms, including Windows 3.1, Windows 95, Windows NT 3.*x*, and Windows NT 4.0, in addition to current and future versions of the Windows and Windows NT operating systems
- Difficult for users to install retail versions
- Difficult for automatic upgrade during operating system upgrade

Controllerless and software modems are built as custom VxD drivers for Windows and as custom system (.Sys) drivers for Windows NT; each platform requires a different driver. For PC 98, WDM Modem support will provide a common interface so that one driver runs on both Windows 98 and Windows NT 5.0.

Missing Features in Voice Modems. Voice modems are devices that allow a PC to communicate with a speaking and listening human at the other end of a telephone line. These modems digitize the incoming voice for recording; play back digitized audio; and detect various signals such as DTMF, call progress tones, and so on.

Voice capabilities started appearing in modems in the early 1990s, aided by the completion and publication of TIA IS-101 in 1993—the interim standard for Voice Data Communications Equipment (DCE). Now the trial period is over and the TIA-695 standard is complete. In mid-1997, at least 30 percent of modems provided for retail sales were voice capable, with a larger percentage in OEM sales. The following trends are important:

- Computer Telephony (CT). ISVs are figuring out what voice modems need.
- Voice-only devices emerging as a separate category (that is, CT telephones).
- Local handset or telset audio.
- Full-duplex audio for a number of applications.

The first applications for voice modems were focused on telephone answering machine (TAM) functions, such as Microsoft Phone. Some applications, such as Microsoft Operator, use voice modems for adaptive incoming-call selection. Now that the software community has had a chance to experiment, the interest in voice modems has expanded to include the following:

- Speakerphone capabilities, either through the PC or outside of it
- Low-end interactive voice response (IVR) equipment (for example, play voice while performing speech recognition and speaker recognition)
- IP telephony bridging
- Voice-only modems, some of which are integrated with a PC-connected telephone instrument (telset)

System Requirements for Modems

This section summarizes the PC 98 system requirements for modems.

1. Modem device is provided with PC system

Consumer PC 98	*Office PC 98*	*Entertainment PC 98*
Required	*Required, if no network adapter*	*PCM modem required, upgradable to V.pcm*

Recommended: Internal modem, or use USB or PC Card as the external modem connection.

Modem Basic Features

This section defines basic PC 98 hardware feature requirements for modems.

2. Modem supports TIA-602 Hayes-compatible command set

Required

TIA-602 codifies the most common data modem. As part of the command set, the modem must have a distinct means for controlling the reporting of modem-to-modem protocols, so the modem can be forced to generate recognizable reports for modulation, error control, and data compression. Examples include the Wn command, the S95 register, the \Vn command, and the ITU V.25ter +MR, +ER, and +DR commands.

Recommended: ITU V.25ter, which is a superset of TIA-602 with significant and useful improvements. It includes three new components:

- A standard format for extending the AT command set, with standard means for the PC to test the range of supported values for each command. This enables adaptive modem installation.
- Standard extensions for modem ID, port control, modulation control and reporting, error control, and data compression control and reporting. This reduces or eliminates the need for data-modem INF files.
- Annex A (1996) provides standard commands that enable the PC to use V.25, V.8, and V.8bis call-control features for point-to-point data calls and voice/data/video calls.

The particular utility of the standard format is that it allows a future modem installer to adaptively install and use a modem, with minimal need for INF file minidrivers. This will be provided in versions of the MDK available in the second half of 1997.

3. Data modem supports 33.6 Kbps (V.34-1996) with V.42 and V.42bis protocol

Required

This is the minimum modem capability specified for PC 98.

4. Data modem supporting speeds faster than 33.6 Kbps can be upgraded to V.pcm

Required

Any modem that supports speeds faster than 33.6 Kbps must be capable of being upgraded to V.pcm. For Entertainment PC 98 systems, any modem supplied with the system must have this capability.

See the related "PCM modem supports ITU-T V.pcm" requirement later in this chapter.

5. Fax modem supports 14.4 Kbps (V.17) with Class 1 (TIA-578-A) command set

Required

The following are recommended:

- Class 1.0 (ITU T.31) with +FAR support, which allows the hardware to perform adaptive carrier detection
- Class 2.0 (ITU T.32 or TIA-592) for rack-mounted server modems
- Adaptive DATA/FAX call classification based on the Class 2.0 +FAA command or equivalent, particularly for rack-mounted server modems

Windows is bundled with fax-modem support. Windows NT 5.0 and future versions of Microsoft BackOffice® products will support Class 1.0 and Class 2.0 fax modems and use adaptive call-classification support. To benefit from this support, modem vendors should extend their modem INF files to support the new registry keys that are needed to support these features, as defined in the MDK available in the last quarter of 1997.

6. Data modem supports V. 80 for synchronous access

Recommended

This standard provides a control plane for the modem and synchronous access to the data path, the foundation for third-party voice/data/video software (for example, H.324, V.70). Modems that support V.80 should also include V.8bis signaling and V.25ter Annex A as described in the following item.

7. Modem supports adaptive connection, V.25, V.8, and V.8bis call control signaling with V.25ter Annex A modem commands

Recommended

V.25 defines basic call-type selection, with an answer tone, a fax-calling tone, and a data-calling tone. V.8 defines advanced call-type selection, with complex information exchanged between terminals; V.8 is used in V.34, V.pcm, and some digital simultaneous voice/data (DSVD) implementations. V.8bis is required for the following standard multimedia modes: V.61 ASVD, V.70 DSVD, and H.324 video telephony.

V.25ter Annex A enables the PC to participate in call control, allowing flexibility and a visual user interface as well as saving modem complexity.

8. Modem supports delayed and blacklisted number clearing

Recommended

The modem should clear its delayed and blacklisted number tables if the associated handset goes off hook.

During certain international PTT certification processes, modems must support the delayed and blacklisted numbers feature. That means that when the modem fails to connect to a specific number for a certain number of times, the dialed number is stored in an internal list. Any subsequent automated dialing operation to this number is then either delayed for a time (delayed) or might be forbidden until some form of manual intervention occurs (blacklisted). The international certification processes specify that manual intervention using an external device is required in order to clear these numbers.

Windows will provide error messages corresponding to delayed and blacklisted error reports in order to reduce customer confusion.

9. Modem supports TDD, meeting V.18-1996 with V.25ter AT commands

Recommended

People with deafness or reduced hearing can use Telephone Device for the Deaf (TDD), also known as Text Telephones, to communicate over phone lines. The U.S. Americans with Disabilities Act (ADA) requires all businesses of a certain size or larger to have Text Telephone services available and to be able to receive calls from people using Text Telephones.

In North America and Europe, the following types of Text Telephones are used:

- Baudot: 45 or 50 bps Frequency-Shift-Keyed (FSK) and 5-bit Baudot coding
- ASCII: 300 bps Bell 103 and 7-bit ASCII coding
- European Deaf Telephone (EDT): 110 bps half-duplex V.21 and 7-bit coding
- Minitel: V.23 modems and 7-bit coding
- Modems and 7-bit coding
- DTMF: 2-digit or 3-digit character coding

ITU recommendation V.18 codifies how all these devices work and how to adaptively connect to all of them. ITU recommendation V.25ter contains AT commands for control of V.18 features in a modem.

It is recommended to include Text Telephone capability for the type commonly used in the country of sale and use (for example, Baudot in the United States, Minitel in France, and so on).

10. PCM modem supports ITU-T V.pcm
Required
For PCM modems (faster than V.34-1996), ITU V.pcm is a requirement. Compliance testing for this requirement will begin within a reasonable time frame after ITU V.pcm is approved by ITU Study Group 16 (currently projected for January 1998). If V.pcm has not been approved by the time PC 98 compliance testing begins, the modem must be end-user upgradable by software means to the current version of V.pcm. It is critical not to strand end users with devices that must be replaced later.

11. Modem controller meets PC 98 requirements
Required
The following are PC 98 requirements for the modem controller:

- Unimodem Diagnostics command, AT#UD
- Software-upgradable modem controller (that is, upgradable ROM or Windows modem)
- AT command buffer of at least 60 characters
- Semicolon (;) character dial string modifier
- Connection reporting: DCE rate; Error Control, and Data Compression

The following are PC 98 recommendations for the modem controller:

- V.25ter +GMI and +GMM commands for modem identification. This is useful if the modem is installed with a CompatibleID.
- V.25ter +I, +M, +E, and +D commands. This allows automated generation of data modem INF file registry entries.

Voice Modem Requirements

Voice capabilities are not mandatory, but if present, the following requirements and recommendations apply.

There is a separate category of voice-only modem that can be integrated with a telset. These devices are not required to support data or fax, but the following requirements do apply.

12. Voice modem supports TIA-695 (AT+V)

Consumer PC 98	*Office PC 98*	*Entertainment PC 98*
Recommended	*Recommended*	*Required*

TIA IS-101-1994, the interim standard for Voice DCE, has been superseded by TIA-695. TIA-695 adds voice formats and speakerphone control commands. ITU-T plans an equivalent recommendation—V.voice—to be completed and assigned a number in January 1998. V.voice will add some small corrections to TIA-695, plus provisions for duplex voice. See also the “Voice modem supports full-duplex voice I/O” recommendation later in this section.

The following voice modem features are required:

- Voice recording and playback
- DTMF generation and detection during voice I/O
- Voice I/O support of 8-bit, 8-kHz PCM formats: unsigned linear, G.711
- Programmable gain control for all audio channels
- Speakerphone with automatic training (no user intervention)
- Voice I/O to the handset (for voice-only devices)

13. Voice modem support includes PC 98 recommendations

Recommended

The following voice modem features are recommended:

- Caller ID detection, reporting, and repeat (types 1 and 2)
- Sense local telephone line state (ready, busy, disconnected) without going off hook
- Extension telset answer and hang-up detection and reporting
- Programmable gain control for all audio channels
- Remote telset answer and hang-up detection and reporting

- Message waiting signal (stuttered dial tone) detection reporting
- Special Information Tone (SIT) detection and reporting
- Full-duplex voice I/O with echo cancellation, as described in the "Voice modem supports full-duplex voice I/O" requirement later in this section
- Distinctive ring detection and reporting
- Powered interface to the local telset to support voice I/O and DTMF I/O

14. Voice modem supports local telset interfaces

Recommended

For many voice applications, it is desirable for the PC and voice modem to be able to communicate with the person using the telset. This allows a consistent interface between local use and remote use, where remote means calling in from outside or using a cordless phone.

If the device is integrated with a telset, this is straightforward and a requirement; the handset and keypad are directly accessible within the device. If the device is not integrated with a telset, then there is a technical challenge. To gain access to the telset's handset and DTMF keypad, the voice modem must be able to cut the connection from the telset to the PSTN, and then must provide power and signal coupling to that telset.

The difficulty is that the switchable-isolation means (that is, the relay) must be able to withstand real or simulated lightning strikes of 1750 volts (U.S. Federal Communications Commission [FCC] Part 68) to 3750 volts (German FTZ) without catching fire. Therefore, this is a recommendation rather than a requirement for data/fax/voice modems.

15. Voice modem supports simultaneous voice/data integration capabilities

Recommended

A profusion of solutions have been offered for simultaneous multimedia phone calls, including propriety solutions, semi-public solutions (DSVD 1.2 and V.34Q), and standard solutions (ITU V.61, V.70-suite, and H.324-suite). Meanwhile, standard IP-based solutions are the wave of the future. Microsoft NetMeeting™, for example, uses H.323.

Therefore, PSTN voice/data integration is not required for desktops or servers. H.324 is emerging as a standard for consumer installations. To support H.324, modems should support ITU V.80, V.8bis, and V.25ter Annex A.

Note: VoiceView is not supported in Windows 98 or Windows NT 5.0.

16. Voice modem supports speakerphone
Recommended

Audio I/O for speakerphone can be implemented in any of the following ways:

- Built-in audio I/O (microphone and speaker). This support is appropriate for voice-only devices (that is, PC-connected phones).
- Jacks to external audio I/O (that is, microphone and speaker or handset jack). This is common for voice/data/fax modems with a large enough form factor to support the connectors.
- Full-duplex audio. See the "Voice modem supports full-duplex voice I/O" requirement later in this section. This support is appropriate for voice/data/fax modems and essential for PC Card modems, which might lack the connectors for external audio I/O.

17. Voice modem supports full-duplex voice I/O
Recommended

TIA-695 was written for TAM applications, with extensions for control of speakerphone functions. In the latter case, the speakerphone adaptive echo canceller is in the modem DSP, and the audio I/O is directed to separate microphone and speakers.

TIA-695 does not address simultaneous voice playback and recording. The applications that need this include speakerphones using audio I/O in the PC, playback while listening for voice responses, and PTSN-to-IP telephony bridging.

Microsoft is collaborating with other members of TIA TR-30 and ITU-T SG16 to define an addition to the draft recommendation V.voice (that is, TIA-695) to support full-duplex voice. This work could be completed by January 1998. Microsoft support for this feature will be based on that ITU-T recommendation.

Wireless and Cellular Modem Requirements

This section provides PC 98 requirements and recommendations for wireless and cellular modems.

18. Wireless support implemented for modems
Recommended

There is a variety of wireless modems and look-alike modems. These include the common types: North American analog cellular, global system for mobile communications (GSM) and other digital cellular systems, cellular digital packet data (CDPD), and so on. However, there are several other types, such as the Ricochet modem from Metricom.

Windows has registry keys that support analog cellular modems. Windows also supports data access in GSM and other wireless modem types. Participants in the Mobile Data Initiative are developing extensions for other services on digital cellular modems, as described in the following item.

For all wireless and cellular modems, the commands in TIA-678 are recommended. The +WS-46 command, which selects the wide area network (WAN), is required.

19. Digital cellular phone support is implemented for modems
Recommended

Digital cellular support is not a requirement, but if implemented, the following appropriate digital cellular control standards must be supported:

- TIA-678 +WS-46 selector command
- Class 2.0 facsimile services, per appropriate standard

Unlike wireline data modems, these devices are not required to support V.34 signaling; it is not available. 9600 bps capability is required; higher speeds are recommended where available. Class 1.0 fax support is available on some of these devices, but it is not required; the error rates with transparent modem faxes are often very high.

Cellular telephone systems are widely deployed in the industrialized world and are now being deployed internationally. In North America, analog cellular systems (TIA-553) are currently predominant, although two types of digital cellular systems can also be deployed: code division multiplexed access (CDMA, TIA IS-95) and time division multiplexed access (TDMA, IS-136).

In Europe and the rest of the world, the GSM digital cellular system is widely deployed. In Europe, the infrastructure for data, fax, and short messaging is now in place.

For all three digital cellular systems, the system design has been extended to offer data, fax, voice, and short messaging service (SMS) to mobile users. In all cases, a modem pool is added to the ground stations, where connection is made to the PSTN. Access to the logical serial ports of these modems is made using the digital error-controlled radio link to the equipped mobile phone and is exposed on a serial port or associated PC Card.

Digital cellular communications equipment should default to using error correction on the radio link. For example, for GSM 7.07, the modem should initialize to +CBST=,,1 (which selects a “nontransparent” air interface).

The AT command sets for these digital cellular phone systems are contained in the following standards.

Standard	Command set
GSM 7.07	GSM system: data, fax, voice
GSM 7.05	GSM SMS
TIA IS-99	North American CDMA: data and fax
TIA IS-135	North American TDMA: data and fax

The TIA-678 +WS46 command has codes to indicate which system the modem is capable of. For example, the following values, quoted from Table 4 of the standard, are useful.

Value	System
1	Public telephone network (that is, a normal wireline modem)
4	Cellular Digital Packet Data (CDPD)
7	TIA-553 analog cellular system
10	Metricom Ricochet network
12	GSM digital cellular system
13	TIA IS-95 CDMA digital cellular
14	TIA IS-136 TDMA digital cellular (“PCS”)

ISDN Modem Requirements

There are two classes of ISDN adapters: (1) parallel bus devices, supported by NDIS WAN drivers, and (2) serial port devices, supported by Unimodem with INFs. This section addresses serial ISDN modems.

For a general discussion of ISDN and a list of requirements related to parallel bus devices, see the “Network Communications” chapter in Part 4 of this guide.

ISDN modems share the following features:

- ISDN Basic Rate interface (2B+D)
- Serial AT command language, with proprietary ISDN extensions

ISDN modems also share the following differences from wireline PSTN modems:

- User (or device) must configure for switch type and service profile ID (SPID)
- Data only, in increments of one or two 64,000 bps B channels
- Fax not available
- V.42 and V.42bis usually not available

20. ISDN modem supports required command set
Required
An ISDN modem must support basic AT commands (TIA-602, which is a subset of ITU V.25ter). Also, commands to set the switch type and SPID for user selection or if auto-detection fails must be included. This can be implemented in the device or in the communications driver.

21. ISDN modem supports auto-SPID detection algorithms and standard SPID format
Required
An ISDN modem must include commands or means to support software-based automatic switch type and SPID detection using the algorithms as defined by the National ISDN User's Forum (NIUF) in *1997 Version of National ISDN Basic Rate Interface Terminal Equipment Generic Guidelines.* This eliminates the need for the end user to enter the SPIDs.

An ISDN modem must include commands or means to support software-based automatic switch type and SPID detection using the algorithms defined by NIUF. This eliminates the need for the end user to enter the SPIDs and enhances the Plug and Play experience for users.

This requirement applies only in the United States.

22. ISDN modem supports CHAP in firmware if B channels are not exposed
Required
Recommended: Support MS-CHAP.

If the ISDN modem implements support for multilink point-to-point protocol (PPP), it must also support Challenge Handshake Authentication Protocol (CHAP). Supporting multilink PPP on an ISDN modem requires the devices to authenticate the second call themselves.

The remote access server uses CHAP to negotiate the most secure form of encrypted authentication supported by both server and client.

23. ISDN modem exposes both B channels
Recommended
ISDN modems should expose both B channels so that they can support the multilink PPP stack.

External ISDN modems should be on port fast enough to expose the full bandwidth of both B channels, that is, USB. Providing two separate COM-port cables is not an acceptable solution.

24. ISDN modem supports multilink PPP

Recommended

Multilink PPP as defined in RFC 1717 combines several ISDN B channels to increase the bandwidth of PPP links.

Windows and Windows NT operating systems include support for multilink PPP. When using ISDN modems that appear as modems to the operating system, multilink PPP must be implemented in the device. This is because Windows cannot see both B channels of the ISDN connection unless each B channel is exposed as a COM port.

See also the “ISDN modem supports CHAP in firmware if B channels are not exposed” requirement earlier in this section.

This recommendation is for ISDN modems only. Internal ISDN devices with NDIS WAN miniport drivers benefit from the built-in multilink support provided by the remote access services of the operating system, and therefore do not need to provide multilink PPP support.

25. ISDN modem supports asynchronous-to-synchronous conversion

Required

These types of ISDN devices are treated as modems, not as internal ISDN devices supported using NDIS WAN miniports. In the external case, the primary implication is that the operating system will send byte-level PPP (also known as asynchronous PPP). In the NDIS WAN case, the implication is that the operating system will send bit-level PPP (also known as synchronous PPP).

Because ISDN is a synchronous service and an ISDN modem connects to an asynchronous port on the PC, the device must provide some means of converting asynchronous data to synchronous data.

26. ISDN modem uses high-speed port

Recommended

Because of speed limitations inherent in a PC’s COM ports, the connection for ISDN modems should be high-speed, such as USB.

27. ISDN driver supports switch detection

Recommended

The driver can attempt to determine the switch type based on the directory number, or it can use other proprietary solutions to determine the switch type. This enhances the Plug and Play experience for users.

28. ISDN driver supports unattended installation, with limitations
Required

ISDN devices must be capable of being installed without user intervention. The exception is specific ISDN parameters, which must be acquired from the equipment being connected to. Dependent parameters include SPIDs and switch-type IDs.

PC 98 Design for Modems

This section summarizes PC 98 requirements related to the design initiatives in Part 1 of this guide.

Plug and Play and Bus Design for Modems

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

29. Each device has a unique Plug and Play device ID
Required

For a system-board device, there must be a device-specific ID.

Each bus-specific device must provide device IDs in the manner required for the bus it uses as defined in Part 3 of this guide. For example, PCI devices must comply with PCI 2.1 requirements and also must provide a Subsystem ID and Subsystem Vendor ID as defined in the “PCI” chapter in Part 3 of this guide.

Note: The device must implement either a bus Plug and Play ID or a COM-port Plug and Play ID, but not both.

30. Each device has a compatible Plug and Play device ID
Required

The various bus-specific Plug and Play specifications provide the means for reporting a CompatibleID as well as a device unique ID.

At least one CompatibleID is required for PC 98. Its primary use is for back up in case the driver or INF file associated with the unique ID is not available (for example, if the customer lost the disk). The goal is for the modem to retain essential data functionality.

The most useful CompatibleIDs would point either to an earlier version of the same product (whose INF file is included in shipping versions of Windows) or point to a reference INF file (that is, one provided by the modem chip-set manufacturer).

Note: If the CompatibleID is used, it is recommended to provide an accurate, displayable manufacturer and modem name using V.25ter standard ID commands.

31. Automatic resource assignment and dynamic disable capabilities are supported

Required

The system must be capable of automatically assigning, disabling, and relocating the resources used by this device when necessary, using the method required for the related bus class. When the end user changes this device or adds it to the system, setting resource assignments must not require changing jumpers or switches on either the adapter or the system board. In the event of an irreconcilable conflict with other devices on the system, the system must be able to disable the device to prevent the system from stalling.

32. PCI modem meets PCI 2.1 requirements

Required

This device must comply with PCI 2.1 requirements if PCI is used as the bus connection for the modem. This ensures that all Plug and Play requirements are met and that Windows and Windows NT drivers support this device.

33. USB modem meets USB specifications

Required

As required for all PC 98 devices, a modem must meet the specific requirements for the bus it uses, including any device class specifications. For example, a modem that uses USB must comply with all related USB specifications, including:

- *USB Specification, Version 1.0* or higher (also known as the USB core specification)
- *Universal Serial Bus Device Class Definition for Communication Devices, Version 1.0* or higher

  The "Standard Serial Interface Circuit Emulation" appendix in the *USB Device Class Definition for Communication Devices* specifically addresses serial port compatibility.

34. Device Bay modem meets PC 98 requirements

Required

A modem designed as a Device Bay peripheral must interface with either USB, IEEE 1394, or both buses, and must support relevant USB device class specifications. All Device Bay peripherals must meet the requirements defined in *Device Bay Interface Specification, Version 1.0* or higher.

Power Management for Modems

This section summarizes the modem power management requirements. See also the specific power management requirements for each bus defined in Part 3 of this guide.

35. Device complies with device class power management reference specification

Required

The *Communications Device Class Power Management Reference Specification, Version 1.0* or higher, provides definitions of the OnNow device power states (D0–D3) for these devices, including modems. The specification also covers the device functionality expected in each power state and the possible wake-up event definitions for the class.

Power states D0 and D3 are required for modems on power-managed buses, including PCI, CardBus, and USB.

36. Device supports wake-up events

Required

For PC 98, a required modem feature is the ability to cause a wake-up event on an incoming ring as defined in *Communications Device Class Power Management Reference Specification.* Notice that this applies for modems on power-managed buses, including PCI, CardBus, and USB.

The D2 power state is defined specifically for this purpose in the power management reference specification. The ability for a modem to cause a wake-up event from the D3 power state might also be possible and is recommend to realize better system power savings. To comply with this requirement, a modem must be able to cause a wake-up event from either the D2 state, the D3 state, or both states.

Because caller-ID reporting would be missed by PCs while in a sleep state, the ability for a modem to retain and repeat the last caller-ID reporting on demand is strongly recommended. The mechanism for doing this is described in *Communications Device Class Power Management Reference Specification* and in the V.voice and TIA-695 voice modem specifications.

Device Drivers and Installation for Modems

This section summarizes device driver requirements for modems. The items in this section are requirements for all PC 98 systems.

37. Device drivers and installation meet PC 98 requirements

Required

The manufacturer does not need to supply a driver if a PC 98-compliant driver provided with the operating system can be used. If the manufacturer supplies a driver, the requirements for the device drivers and installation are defined in the "Basic PC 98" chapter in Part 2 of this guide. The basic requirements include driver support for unattended installation and Help file support if special driver parameters are used.

For information about support for controllerless and software modems under WDM, see the Windows NT 5.0 DDK. See also the related articles at http://www.microsoft.com/hwdev/pcfuture/. For information about WDM-based modem driver support under Windows NT, see the Windows NT 5.0 DDK.

For guidelines about implementing driver and installation support for modems under the Windows operating system, see the Windows MDK.

38. Driver supports Unimodem

Required

The device driver must include Unimodem support. Typically, this requires a modem INF file, developed and verified using the MDK and pretested by the modem manufacturer.

39. Applications provided with device meet Win32 requirements

Required

Any Windows-based applications provided with the device, such as fax utilities, must meet requirements for software compatibility as defined in the Win32 SDK.

As an API, the Windows Telephony API (TAPI) is the cornerstone of telephony for Windows and Windows NT. Telephony applications and service providers provided with PC 98 systems must be implemented using TAPI 2.0.

Among other enhancements, applications can request, negotiate, and renegotiate QOS parameters with the network and receive indication of QOS on inbound calls and when QOS is changed by the network. For a summary of the TAPI 2.0 architecture and a description of how to write a TAPI service provider, see http://www.microsoft.com/ntserver/communications/. For implementation information, see the Win32 SDK.

Modem References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

ANSI, EIA, TIA, and other standards
Global Engineering Documents
Phone: (800) 854-7179 (US)
(613) 237-4250 (Canada)
(303) 792-2181 (Outside North America)
Fax: (303) 397-2740
ftp://ftp.symbios.com/pub/standards/io/

Bellcore Technical References
Bellcore (Bell Communications Research)
Phone: (800) 521-2673 (North America)
(908) 699-5800 (Outside North America)
http://www.bellcore.com

Communications Device Class Power Management Reference Specification, Version 1.0
http://www.microsoft.com/hwdev/onnow.htm

Device Bay Interface Specification, Version 1.0
http://www.device-bay.org

European Telecommunications Standards Institute (ETSI) or Global System for Mobile (GSM) standards
Phone: +33-92 94 42 00
FAX: +33-93 65 47 16
E-mail: secretariat@etsi.fr

ITU communications standards
ITU Sales
Phone: (41) (22) 730-6141
Fax: (41) (22) 730-5194
E-mail: sales@itu.ch
http://www.itu.ch

PCI Local Bus Specification, Revision 2.1 (PCI 2.1)
http://www.pcisig.com

Plug and Play specifications
http://www.microsoft.com/hwdev/specs/

Telephony API (TAPI) overview and white papers
http://www.microsoft.com/ntserver/communications/
http://www.microsoft.com/win32dev/netwrk/tapiwp.htm

Unimodem Diagnostics Command Reference Specification
Unimodem ID Command Reference Specification
http://www.microsoft.com/hwdev/specs/

USB specifications
http://www.usb.org

WDM device driver support white papers
http://www.microsoft.com/hwdev/pcfuture/

Windows MDK
ftp://ftp.microsoft.com/developr/drg/modem/modemdev.exe

Windows and Windows NT DDK, including information about NDIS and Win32 SDK
MSDN Professional membership

Checklist for Modems

If a recommended feature is implemented, it must meet the PC 98 requirements for that feature as defined in this document.

Consumer PC 98	Office PC 98	Entertainment PC 98
1. Modem device is provided with PC system		
Required	*Required, if no network adapter*	*PCM modem required, upgradable to V.pcm*
2. Modem supports TIA-602 Hayes-compatible command set		
Required		
3. Data modem supports 33.6 Kbps (V.34-1996) with V.42 and V.42bis protocol		
Required		
4. Data modem supporting speeds faster than 33.6 Kbps can be upgraded to V.pcm		
Required		
5. Fax modem supports 14.4 Kbps (V.17) with Class 1 (TIA-578-A) command set		
Required		
6. Data modem supports V. 80 for synchronous access		
Recommended		
7. Modem supports adaptive connection, V.25, V.8, and V.8bis call control signaling with V.25ter Annex A modem commands		
Recommended		
8. Modem supports delayed and blacklisted number clearing		
Recommended		
9. Modem supports TDD, meeting V.18-1996 with V.25ter AT commands		
Recommended		
10. PCM modem supports ITU-T V.pcm		
Required		
11. Modem controller meets PC 98 requirements		
Required		
12. Voice modem supports TIA-695 (AT+V)		
Recommended	*Recommended*	*Required*

13. Voice modem support includes PC 98 recommendations
Recommended

14. Voice modem supports local telset interfaces
Recommended

15. Voice modem supports simultaneous voice/data integration capabilities
Recommended

16. Voice modem supports speakerphone
Recommended

17. Voice modem supports full-duplex voice I/O
Recommended

18. Wireless support implemented for modems
Recommended

19. Digital cellular phone support is implemented for modems
Recommended

20. ISDN modem supports required command set
Required

21. ISDN modem supports auto-SPID detection algorithms and standard SPID format
Required

22. ISDN modem supports CHAP in firmware if B channels are not exposed
Required

23. ISDN modem exposes both B channels
Recommended

24. ISDN modem supports multilink PPP
Recommended

25. ISDN modem supports asynchronous-to-synchronous conversion
Required

26. ISDN modem uses high-speed port
Recommended

27. ISDN driver supports switch detection
Recommended

28. ISDN driver supports unattended installation, with limitations
Required

29. Each device has a unique Plug and Play device ID
Required

30. Each device has a compatible Plug and Play device ID
Required

31. Automatic resource assignment and dynamic disable capabilities are supported
Required

32. PCI modem meets PCI 2.1 requirements
Required

33. USB modem meets USB specifications
Required

34. Device Bay modem meets PC 98 requirements
Required

35. Device complies with device class power management reference specification
Required

36. Device supports wake-up events
Required

37. Device drivers and installation meet PC 98 requirements
Required

38. Driver supports Unimodem
Required

39. Applications provided with device meet Win32 requirements
Required