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TECHNICAL OVERVIEW

COM PORT VS. NETWORK CARDS

ISDN BRI Terminal Adapter Hardware Implementations

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INTRODUCTION

The Integrated Services Digital Network (ISDN) is coming of age in North America. Both service providers and customer premise equipment (CPE) vendors are rushing to make available new products which can capitalize on the surge in demand. Unfortunately, many equipment vendors have not taken the time to seriously consider the pros and cons of choosing one particular implementation approach over another.

This paper discusses the two primary implementation approaches for bringing ISDN Terminal Adapter (TA) capabilities to the IBM-compatible PC market. These approaches are called the **COM Port Device Solution** and the **Network Card Solution**. Both approaches provide reliable access to the ISDN network, and each approach has its own advantages and disadvantages.

THE COM PORT DEVICE SOLUTION

Hardware

Advantages—Traditional PC asynchronous modems are designed to facilitate communication with PC software via the use of a UART device. In PC terms, this device is referred to as a "COM Port." The UART provides the software with FIFO storage facilities for transmit and receive data. It is responsible for the actual transmission and reception of asynchronous serial data from the line, and it inserts and removes asynchronous character framing (start and stop bits) automatically.

Most modern PCs use a 16550-compatible UART, which provides 16 byte bidirectional transmit and receive FIFOs and also can be configured to transmit serial data at speeds up to 115.2 kbps.

Many ISDN terminal adapters are designed to use the PC's COM port as the primary mechanism for data transfer. External adapters, which plug into the COM port connector on the rear panel, must receive asynchronous data from the PC and transmit this data to the ISDN line in a synchronous manner (no start and stop bits). Most ISDN applications require HDLC framing on the B channel data. HDLC is designed for synchronous environments and provides error detection capabilities. Hardware designed for the COM port solution must provide infrastructure capabilities for handling both asynchronous and synchronous framed data. The hardware must perform an actual conversion as data moves through the terminal adapter.

The COM port solution lends itself well to the implementation requirements of a low-cost, external ISDN TA. Many equipment vendors, however, are providing cost reduced hardware solutions in the form of an internal ISA bus card. Some of these vendors have chosen to retain the software investment in their original external products by simply porting the asynchronous COM port solution to the ISA bus. This type of design is quite popular and allows the vendor's TA software to be relatively unaffected by changes in the hardware design. A UART is still often used on these cards even though they can have access to the entire bandwidth of the ISA bus. This is often the fastest way to market for an ISDN TA vendor.

Disadvantages—The COM port device solution imposes some performance restrictions on the overall data throughput an application can realize while using the ISDN interface. The maximum speed setting for the most common 16550 UART is 115.2 Kbps—below the native rate of the aggregated B channels (128 kbps). Data cannot flow between the PC and the TA any faster than 115.2 Kbps.

A further performance limitation is imposed by the use of asynchronous character framing. An asynchronous character contains at least one start and stop bit for every eight bits of data. This further reduces the efficiency for actual data transfer to 92.16 Kbps.

Software

Advantages—The COM port solution is perceived as providing the simplest migration path to ISDN for traditional modem application. This approach requires the ISDN TA to behave like a traditional AT-compatible modem. Commands to establish and tear down connections are the same as those used for modems. Some new AT commands can be used to configure special ISDN features of the terminal adapter.

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As a result, older applications that only use an asynchronous modem such as Procomm can be made to support the ISDN terminal adapter.

Disadvantages—The COM port solution requires the terminal adapter convert from the protocol used on the asynchronous interface to the protocol required on the ISDN interface. For Internet and remote access applications, the PPP protocol is used for these applications.

Asynchronous and synchronous interfaces require different variants of the PPP protocol. The TA must perform a conversion of each packet from one protocol variant to the other. Most implementations will choose to receive a packet in its entirety from one interface in order to check the CRC and validate the integrity of the packet. The packet is only then converted and sent to the other interface. This introduces a delay of one packet time (or a minimum of 1500x8 bit times) as the packet passes through the TA. This significant delay results in significant wasted usable bandwidth and further impairs performance, especially when negotiating a large packet size.

COM Port Device Conclusions

The COM port solution for the implementation of a PC-based ISDN terminal adapter is attractive when developing an external product. Such a product connects quickly to the serial port on the rear PC panel and is compatible with all software that uses traditional asynchronous modems. However, several performance limitations, which are inherent when using this approach, result in significantly reduced efficiency and an under-utilization of the available bandwidth when two B channels are aggregated. In this case it is probably not worth paying the cost of setting up and using a second B channel for the same logical connection because the incremental bandwidth improvement may not justify the additional cost. Although many ISDN TA vendors have chosen to port asynchronous core designs for use as ISA bus (internal) terminal adapters, these adapters suffer from the same performance limitations as the external products, in spite of the large available ISA bus bandwidth between the host and the adapter.

THE NETWORK DEVICE SOLUTION

Hardware

Advantages—The network device solution requires the hardware to access Local Area Network (LAN) traffic. External versions of these devices provide a physical LAN interface and an ISDN interface in the same device. Such devices monitor LAN packets with certain classes of addresses and route those packets to and from the ISDN interface. These devices handle traffic from several LAN sources and can understand and route multiple LAN protocols. Such a device is, therefore, relatively independent of the nature or capabilities of any host computer that uses its services. LAN interface hardware and sufficient processor support in such a device results in excellent performance capabilities for this type of implementation. The LAN provides a high bandwidth conduit between the PC and the TA, which allows data to be transferred to and from the PC at the full rate of the aggregated ISDN B channels (128 kbps).

When a network device solution is implemented as an ISA bus (or internal) card, the LAN interface hardware is not required. The ISDN TA appears to be a LAN device to the host PC. Only the ISDN and ISA-bus interface components are required to ensure successful, high performance operation. The full bandwidth of the ISA bus can be used to transfer data between the host PC and the TA.

Disadvantages—Although external network devices are quite flexible, hardware for such a device can be much more expensive than its COM port counterparts. This is as a result of the presence of the LAN interface hardware and the additional processor performance and resources required to process and route the LAN traffic.

Internal network device solutions do not require a separate LAN card in the host PC and do not have to route external LAN packets. This type of device is therefore attractive for single PC ISDN applications such as Internet and remote LAN access.

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Software

Advantages—Although the network device implementation of an ISDN TA requires a significant software investment, the payoff is increased flexibility and full performance. Internal implementations of a network driver can take full advantage of the routing capabilities provided by operating systems such as Microsoft's Windows NT. Since TCP/IP is at the heart of the Internet and most office LANs which dominate the corporate environment, a LAN software interface is quite natural for applications that access these environments.

The network device approach to an internal ISDN TA implementation involves the development of a software driver which appears, to upper level users, as a traditional LAN driver. In fact, this driver is an ISDN driver that establishes ISDN connections (on demand if required) and relays the LAN traffic over the ISDN interface. Applications designed to use the LAN are immediately compatible with the ISDN TA.

Microsoft has developed a modified LAN driver interface for Windows 95™ and NT. This is known as an NDIS WAN Miniport interface and drivers which conform to this specification can be used by any Microsoft TAPI compliant applications. This enhancement to Windows 95 allows the new Miniport drivers to provide traditional dial-up services through the TAPI. The NDIS driver provides the best bridge between the WAN capabilities required for an ISDN dial-up connection and the LAN capabilities required for Internet and remote LAN access applications.

Disadvantages—The principal disadvantage of the network device solution for an ISDN TA implementation is its incompatibility with traditional asynchronous modem applications which use the AT command set. This disadvantage does not affect Internet and LAN remote access applications. It only applies to older programs not using the services of TAPI and attempting to communicate with a COM port device. Most communications applications designed for Windows 95 or NT are capable of using TAPI and are, therefore, compatible with the NDIS WAN Miniport implementation of an ISDN network device driver.

Network Device Conclusions

Although older asynchronous software applications do not work with the new class of LAN-style network devices for ISDN, this limitation has no impact on the two primary applications for an ISDN TA– Internet access and LAN remote access. The performance advantages, resulting from the ability to use the full 128 kbps bandwidth of the ISDN for user data, far outweigh any limitations experienced with older asynchronous applications.

THE NETWARP ISDN SOLUTION

Ascend Communications offers the Netwarp 128 ISDN Terminal Adapter for ISA bus IBM-compatible PCs. The NetWarp terminal adapter is a network device solution. It is supported by an NDIS WAN Miniport driver for Windows 95 and NT as well as the Win ISDN API for Windows 3.1x. The card allows host applications to utilize the full bandwidth of the ISDN BRI for application data transfer, providing the maximum performance possible for an ISDN device.

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