IBM Serial Link Implementation Notes

The following discussions clarify some common misconceptions and points of confusion associated with half-duplex, full-duplex, and multipoint connections.

Comparing Half Duplex and Full Duplex

Half-duplex and full-duplex serial links can often be confusing. One reason for the confusion is that there are several different contexts in which these two terms are used. These contexts include asynchronous line implementations, IBM Systems Network Architecture (SNA)-specific implementations, and data communications equipment (DCE) implementations. Each is addressed in the discussions that follow.

Asynchronous Line Definitions

Duplex, as seen on asynchronous communication lines (and in terminal emulation software parameters), implies *full duplex* as it applies to the echoing of transmitted characters by a host back to a terminal. This is also referred to as *echoplex* mode. In this context, half-duplex mode involves no character echo. Some common misconfigurations of terminals and hosts follow:

- Full duplex specified on a terminal when the host is set for half duplex results in typing blind at the terminal.
- Half duplex specified on a terminal when the host is set for full duplex results in double characters on the terminal. This is because the terminal displays entered characters if the terminal's configuration indicates that the host will not echo characters.

Note This interpretation of duplex does not apply in a router context.

IBM SNA-Specific Definitions

IBM's master glossary for VTAM, NCP, and NetView terms defines *duplex*, *full duplex*, and *half duplex* as follows:

- *Duplex*—In data communications, pertaining to a simultaneous two-way independent transmission in both directions; synonymous with full duplex; contrast with half duplex.
- *Half duplex*—In data communications, pertaining to an alternate, one-way-at-a-time, independent transmission; contrast with duplex.

These definitions can be applied in two contexts that are the main source of duplex definition confusion:

- First, there is *full-duplex* and *half-duplex data transfer*. This typically applies to the capability or inability of data terminal equipment (DTE) to support simultaneous, two-way data flow. SNA PU 4 devices (front-end processors such as 3705, 3720, 3725, and 3745 devices) are capable of full-duplex data transfer. Each such device employs a separate data and control path into the control program's transmit and receive buffers.
- Some PU 2.1 devices are also capable of *full duplex data mode*, which is negotiable in the XID-3 format frame—unless the NCP PU definition statement DATMODE=FULL is specified. If FULL is specified, full-duplex mode is forced. PU 2s and PU 1s operate in *half-duplex data mode*.

DCE Definitions

Finally, there is *full duplex* and *half duplex* as it applies to the communication facility, or DCE. This is where most of the technological advancement has been achieved with respect to half and full duplex. DCE installations primarily consist of channel service units (CSUs), data service units (DSUs), or modem devices, and a communications line. The modem can be synchronous or asynchronous and can be analog or digital. The communications line can be two-wire or four-wire and can be leased or switched (that is, dial-up).

Older modems are capable of transmitting or receiving only at a given time. When a DTE wants to transmit data using an older modem, the DTE asserts the Request To Send (RTS) signal to the modem. If the modem *is not* in receive mode, the modem enables its carrier signal in preparation for transmitting data and asserts Clear To Send (CTS). If the modem *is* in receive mode, its Data Carrier Detect (DCD) signal (that is, the carrier signal from the remote modem) is in the active state. The modem does not activate the CTS signal, and the DTE does not transmit, because DCD is in the active state.

Contemporary modems are capable of transmitting and receiving simultaneously over two-wire or four-wire and leased or switched lines. One method uses multiple carrier signals at different frequencies, so that the local modem's transmit and receive signals, as well as the remote modem's transmit and receive signals, each have their own carrier frequency.

DTE equipment in an SDLC environment have configuration options that specify which mode of operation is supported by DCE equipment. The default parameters for most PU 2 devices are set for half duplex, although they can also support full-duplex operation. If the facility is capable of full duplex, RTS can be asserted at all times. If the facility supports half duplex or is operating in a *multipoint* environment using modem-sharing devices (as opposed to multipoint provided by a Postal Telephone and Telegraph [PTT] or by a telephone company), RTS must only be asserted when transmitting. A full-duplex-capable communication facility that connects a PU 4 to a PU 2 device or to a PU 1 device (with each PU device specifying full-duplex DCE capability) experiences improved response time because of reduced turnaround delays.

Older PU 2 and PU 1 devices cannot be configured for full-duplex DCE mode. Also, because older PU 2 and PU 1 devices can only support half-duplex data transfer, transmit and receive data cannot be on the line at the same time (in contrast to a PU 4-to-PU 4 full-duplex exchange).

Understanding Multipoint Connections

Multipoint operation is a method of sharing a communication facility with multiple locations. The telephone company or PTT communications authorities offer two-wire and four-wire multipoint configurations for analog service (modem attachment) or four-wire for digital service (CSU/DSU attachment). Most implementations are master-polling, multiple-slave drop implementations. The master only connects to one drop at a time. The switching takes place at a designated local exchange

in proximity to the master DTE site. Some service providers offer analog multipoint services that support two-way simultaneous communication, which allows DTEs to be configured for permanent RTS.

Modem-sharing devices and line-sharing devices also provide multipoint capability. These implementations allow a single point-to-point link to be shared by multiple devices. Some of these devices have configurable ports for DTE or DCE operation, which allow for configurations that can accommodate multiple sites (called *cascaded configurations*). The main restriction of these devices is that when RTS is active, other users are locked out. You cannot configure DTEs for permanent RTS and you must accept the turnaround delays associated with this mode of operation.