Clocking on the Serial Access Card

This appendix discusses clocking issues you may wish to take into account when you set the DCE Bit Rate, DCE/DTE Type and DTE Bit Rate attributes for ports on a serial access card (SAC). This discussion presents more detail than many users need. Before reading this appendix, read the descriptions of the DCE Bit Rate, DCE/DTE Type and DTE Bit Rate attributes in the “SAC Port Attributes” section of the chapter “Configuration Attributes.” Return to this discussion if you need more information.

The SAC supports port-based clocking in two modes:

- Reflected clocking, which is used when you set an interface’s DCE/DTE Type attribute to DTE or DCE
- Self clocking, which is used when you set an interface’s DCE/DTE Type attribute to DCE-tt-loop (in the configurator) or dce-internal (in the CLI). (The DCE-tt-loop and dce-internal settings are equivalent.)

The clocking mode you select is dependent on the device to which your SAC port is connected. For all trunk connections (between LightStream 2020s) and for most edge connections (to devices outside the LightStream 2020 network), reflected clocking is preferred because it is simpler to use and allows higher line speeds. Set the port’s DCE/DTE Type attribute to DTE or DCE to use reflected clocking. If you are connecting to a device that does not support reflected clocking, set the SAC port’s DCE/DTE Type to DCE-tt-loop (in the configurator) or dce-internal (in the CLI). These settings cause the port to use self clocking. If your edge device supports reflected clocking, see the section “Reflected Clocking.” If you must use self clocking, see the section “Self Clocking.” The sections on reflected and self clocking explain how to determine DCE Bit Rate settings for SAC ports.

Reflected Clocking

To use reflected clocking on a SAC port, configure its DCE/DTE Type attribute to DCE or DTE. In reflected clocking mode, the maximum clock rate is dependent on the length of the cable that connects the SAC’s serial fantail to the edge device—see Table B-1. The maximum clock rate in hertz is equivalent to the maximum recommended setting of the DCE Bit Rate and DTE Bit Rate attributes in bits per second (bps). For example, the highest setting for a port with 100 feet of cable is 3,072,000 bps.

Table B-1 SAC Reflected Clock Mode Rates

Total Maximum Cable Length (Fantail Cable Plus Data Cable)	V.35 or RS-449 Maximum Clock Rate
50 ft (15.2 m)	6.144 MHz
100 ft (30.5 m)	3.072 MHz

Note X.21 interfaces do not support reflected clocking.

For details on data signalling rate versus cable length, refer to EIA Standard RS-422-A Appendix (Guidelines for Application, Figure A.1). This chart is applicable to the SAC in both RS-449 and V.35 modes.

Self Clocking

Two of the factors that govern self-clocked DCE interfaces on the SAC are

- Length of the data cable
- Clock rate (line speed)

The longer the cable, the slower the clock rate must be. Identify the factor on which you are least flexible, and adjust the other factor to accommodate your needs. For example, if you need to use a 100-foot cable, you must settle for a slower clock speed. Conversely, if high speed is most important to you, you'll want to use the shortest possible cable.

When you have identified your requirements with respect to cable length and clock rate, you can determine maximum clock rate using either of the following methods:

- Use the formula in the section "Calculating Max. Self Clock Rate for a SAC Port" below to make a precise calculation.
- Use the tables in the section "Estimating Max. Self Clock Rate for a SAC Port" below to obtain an estimate.

The tables are appropriate for many applications, but using the formula to calculate the clock rate yields the most precise result. Read both of the subsections that follow before deciding which method to use.

Calculating Max. Self Clock Rate for a SAC Port

To make a precise calculation of the maximum clock rate for a SAC port, use the formula in this section. To use the formula, you must gather the following information:

SAC-logic-delay is 200 nanoseconds (ns) maximum for V.35 interfaces, 140 ns maximum for RS-449/X.21 interfaces.

Total-cable-length, in feet, includes the lengths of the fantail cable plus the data cable.

Cable-prop-delay is 2. (This is the delay introduced by the length of data cable, 2 ns per foot.)

UED is user's equipment delay, in nanoseconds. UED is measured from the time a clock signal is received from the LS2020 at the edge device's I/O connector to the time the edge device responds by transmitting a data signal from the same connector. UED is approximately 0 ns for a wire loopback test. For a typical network application, it might be 200 ns. (The clock rates in the tables in the section that follows were calculated using a UED of 200 ns; see the tables if your UED value is 200 ns or less.) For greatest accuracy, use an oscilloscope to measure UED on your device.

Maximum Clock Rate is expressed in hertz. This maximum clock rate is equivalent to the maximum recommended setting of the DCE Bit Rate and DTE Bit Rate attributes in bits per second (bps). For example, the highest setting for a V.35 port with 42 feet of data cable, 12 feet of fantail cable, and a UED of 200 ns is 880,000 bps.

Use the information you have gathered in this formula:

$$\frac{1}{2\,(\text{SAC-logic-delay} + 2\,(\text{Total-cable-length} * \text{Cable-prop-delay})) + \text{UED}} = \text{Maximum Clock Rate}$$

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Estimating Max. Self Clock Rate for a SAC Port

Use the tables in this section to estimate the maximum clock rate for a self-clocked SAC port. (A self-clocked port is one on which DCE/DTE Type is set to DCE-tt-loop (in the configurator) or dce-internal (in the CLI).)

Caution The tables in this section are based on *our estimate* of the delay introduced into the data circuit by your equipment. (This value is called UED in the previous section.) Our estimate may be inconsistent with the actual operation of your equipment, so you use the values in the tables at your own risk. If the risks outlined here are unacceptable to you, refer to the previous section.

The UED value used for these tables, 200 ns, is a conservative estimate that's typical of our equipment, but your equipment may be faster or slower. Using the tables in this section rather than calculating a maximum clock rate (as described in the previous section) exposes you to the following risks:

- If our estimated UED value is too low for your application, you will see data errors on the line. If this problem occurs, try a slower clock rate.
- If our estimated UED value is too high for your application, no errors will result, but the line will run at a lower speed than is possible.

Use Table B-2 to determine the maximum clock rate for V.35 ports; use Table B-3 to determine the maximum clock rate for RS-449 and X.21 ports. The tables express clock rate values in Hz that are equivalent to the maximum recommended setting of the DCE Bit Rate and DTE Bit Rate attributes in bits per second (bps). For example, the highest setting for a V.35 port with 30 feet of data cable and 12 feet of fantail cable is 880,000 bps.

Table B-2 Maximum Clock Rates for Self-clocked V.35 SAC Ports

Fantail Cable Length	30 ft (9.1 m) Data Cable	50 ft (15.2 m) Data Cable	100 ft (30.5 m) Data Cable
4 ft (1.2 m)	932 kHz	811 kHz	612 kHz
8 ft (2.4 m)	905 kHz	791 kHz	600 kHz
12 ft (3.6 m)	880 kHz	771 kHz	589 kHz

Table B-3 Maximum Clock Rates for Self-clocked RS-449 and X.21 SAC Ports

Fantail Cable Length	30 ft (9.1 m) Data Cable	50 ft (15.2 m) Data Cable	100 ft (30.5 m) Data Cable
4 ft (1.2 m)	1.05 MHz	899 kHz	661 kHz
8 ft (2.4 m)	1.01 MHz	874 kHz	647 kHz
12 ft (3.6 m)	984 kHz	850 kHz	634 kHz