Operation of the SDM-2020 with Cisco Routers

COMTECH EF DATA

Application Note
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Overview

The rapid expansion of Internet and growing interest in multimedia applications has spawned demand for bandwidth in terrestrial and satellite networks. In these applications, a commonly encountered type of equipment is the router, such as those manufactured by Cisco Systems. The SDM-2020, with its programmable 1.5 to 100 Mbit/s data rate range, is an excellent partner for operation with routers over satellite links.

Modes of Operation

Several operating modes (**Figure 1**) are proving popular in SDM-2020 applications for Internet traffic with routers:

- Full-duplex links with symmetric and asymmetric data rates.
- One-way simplex links, usually operated asymmetrically:
  - Single, high-data-rate outbound carrier.
  - Multiple, low-data-rate return links.

These networks are carefully managed for growth of capacity/throughput.

- The links use a high-speed serial interface (HSSI) for:
  - Programmable data rate or satellite bandwidth.
- The links deploy QPSK, 8PSK and 16QAM modulation and coding for:
  - Efficient use of available satellite power and bandwidth.
  - Matching and sizing carriers and Receive (Rx) antennas.

Operationally, satellite transmission links are usually implemented in the two physical configurations shown in **Figure 1**. The top segment of the figure (a) shows a standard HSSI port connected for full-duplex traffic to both an SDM-2020 modulator and demodulator using a “Y” -cable. The data traffic is shown with asymmetric data rates of 30 Mbit/s for the Transmit (Tx) data and 12 Mbit/s for receive (Rx) data. The directions for the Tx and Rx data are consistent with the conventions for data terminal equipment (DTE) and data communications equipment (DCE) adopted for data transmission. In these examples, the routers are always DTE and the modem equipment is always DCE.

Part (b) of the figure shows the use of two HSSI ports for simplex operation. This situation arises in multicast applications where the Tx traffic outbound from a single router port is broadcast to multiple destinations. The inbound Rx traffic to the router from each individual destination is returned to a separate HSSI port programmed to the data

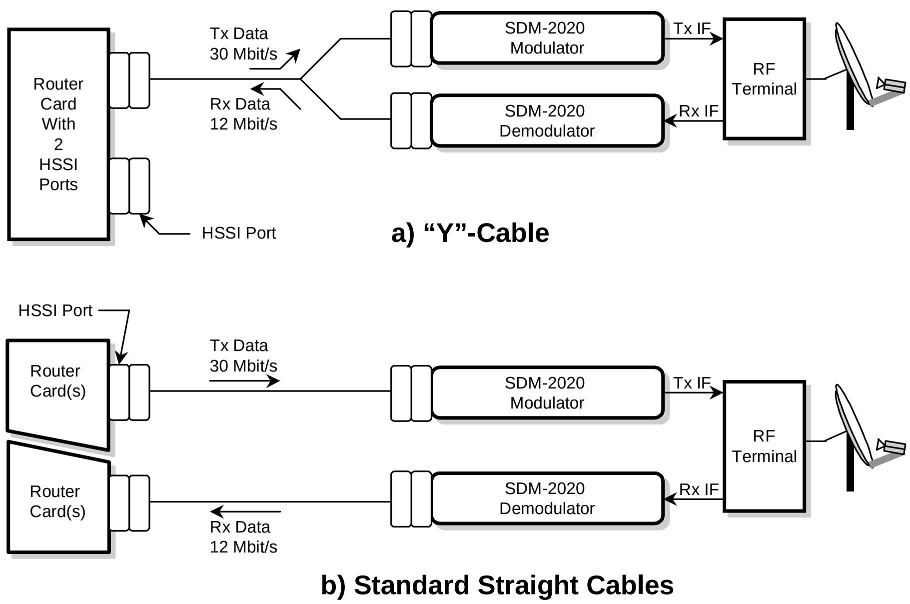


Figure 1. Two Common Configurations for Connecting to Routers.

rate needed to support the required capacity. A standard” HSSI cable[1] connects to each port, although traffic is only simplex for either the Tx or the Rx direction.

[1] Standard cable is the goal, but due to idiosyncrasies discussed later, either a modified cable or an adapter may be required.

Table 1. Minimum Signal Requirements

Signal	Description	Comments
TA	The router asserts this signal to notify the DCE it is ready	The modulator and demodulator ignore this signal.
CA	This is a signal from the DCE to the DTE. When asserted, the router (DTE) sends data. When not asserted, data is not transmitted. **Note:** The router sends TT clock when CA is in either state, provided ST clock is present. If CA is not asserted, the router sends the idle flag 7E (hex). When CA is asserted by the demodulator, the data is OK. When CA is not asserted, data is all 1s (ON or MARK). **Note:** The RT clock continues whether CA is in either state.	CA is generated by both the modulator and demodulator. This is explicit in the simplex mode, Figure 1(b), but calls for a choice when a “Y” cable is used. **CA From Modulator**: Use this when only the Tx status is desired for transmitting Tx data. The CA serves as a modulator-ready indication to the DTE. **CA From Demodulator**: This is a way of providing status about the return link from each destination to the router. When the demodulator is locked and ready, CA is asserted. If CA is not asserted, then the return path is not functioning, and the router can use this information for other routing strategies.
ST	This is the timing from the modulator to the DTE that the router uses to send TT clock and SD data to the modulator.	See discussion below
TT, SD *(see Note)*	These are the clock and data the router sends to the modulator when CA is asserted.	The modulator requires both signals. Do not loop ST to TT as a timing reference, because clock-to-data phasing becomes a function of the data rate and cable length.
RT *(see Note)*	Receive timing from the demodulator to the DTE.	See discussion below
RD	The router (DTE) accepts Rx data from the demodulator provided CA is asserted.	

Setting Up The Link

Now that the basic topology of the link is described, some of the connection details to make each path/link operational are presented in the following paragraphs.

The Cisco router requires certain signals in order to operate. In **Table 1**, these signals are described.

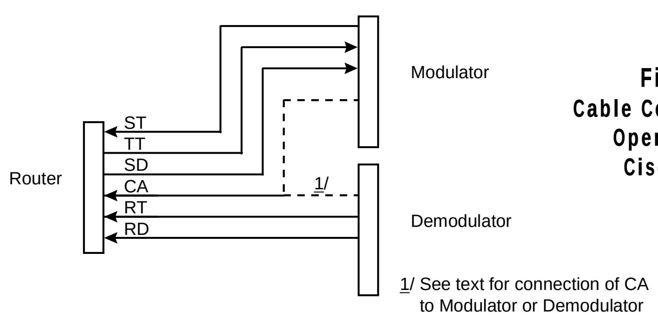
> Note: Earlier models (9-98 and earlier) of the SDM-2020 Modulator and Demodulator had two menus for selecting Normal and Inverted RT and TT clock. The two menus were under the Configuration Interface and Utility Interface. With the earlier demodulators use only the menu under Utility Interface for selecting the clock phase, and for normal HSSI clocking operation select “Inverted” from the RT clock menu. Later versions of the modulator and demodulator have a clock phase selection only in the Configuration Interface menu, and Normal phase is used for HSSI operation.

Check these sites for more information:

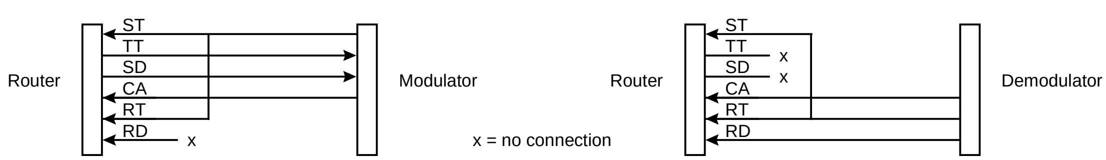
http://www.mouse.demon.nl/ckp/ under serial interface where there is a specification for the HSSI interface.

http://www.cisco.com/warp/public/128/index.shmtl under the HSSI design specification and relevant information.

Further information is also available in EIA/TIA 612 and EIA/TIA 613 standards.



a) Full Duplex, “Y”-Cable



b) Tx Simplex **b) Rx Simplex**

Figure 2. Cable Connections for Operation with Cisco Router

Cisco routers manufactured before September 1998, and possibly later, require special consideration for operation. Since the application note was first released, Cisco has released software updates that should eliminate the need for special wiring of clocks described in this application note. Consult Cisco if there is difficulty with the software updates. As an alternative, try rewiring the cable.

Cisco: Updates For Simplex Operation

Bug case# CSCdk39193, fixed and integrated in the following releases:

11.1(21.01)CA	11.1(21.01)CC
11.1(21.01)CT	12.000(001.001)
12.0(01.01)PI	11.2(16.01)P
12.0(01.01)T	12.0(01.05)W05(07.05)

Before the software update to the Cisco router it was necessary to supply both the ST and RT clocks to the router even when operating in a simplex mode. Referring to **Figure 2**, notice, in all cases, that the router requires CA, ST, and RT. In full-duplex operation, this is not a problem because the clocks are present. In simplex operation though, one of them is absent. Prior to the software update in the router, simplex operation was implemented by looping of ST to RT for Tx simplex operation and by connecting RT to ST for Rx simplex operation.

With the Y-cable there is a choice whether CA is taken from the modulator or demodulator. The decision for which one depends upon what is important for operation in the network.

Although not shown in the figure, it is sometimes simpler to merely loop TA to CA at the router. In this type of connection, the router no longer monitors the status of the DCE.

Testing Setups

Building some special setups can save significant installation time and effort. Items for test purposes include:

Male to female adapter connectors: These permit the connection of null modem cables to the regular cable assemblies for checkout.

Null modem cable and looping plugs: Connecting these devices to the router ports verifies their operation and eliminates the modem from the circuit.

Adapter connector for probing: A cable adapter with the pins exposed for probing with an oscilloscope will resolve timing issues. Male-to-male and female-to-female as well as male-to-female adapters are useful.

Translator for modulator/demodulator: The output of the SDM-2020 modulator is programmable from 50 to 90 MHz and 100 to 180 MHz, while the input to the demodulator is L-Band (950 to 1750 MHz). A translator, **Figure 3**, shifts the output of the modulator to L-Band so the demodulator can lock to the signal. Inexpensive translators are available from Global Communications in the United Kingdom at telephone number + 44 1621 743 440 or web site: http://www.globalcom.co.uk/frame2.html

Note: Low cost translators generally have higher frequency drift and higher phase noise, but they are inexpensive (< $500 US).

Demodulator I/Q monitor: This is an excellent way to view the performance of a link or to find impairments due to VSWR, distortion, transponder compression, interference, phase noise and other problems. The monitor connector plugs into a female 9-pin D connector at the rear of the demodulator and connects the I and Q test points to an oscilloscope. The oscilloscope is used in the X-Y mode to monitor the constellation of the signal, four dots for QPSK, eight dots for 8PSK etc.

Figure 4 shows the wiring of the monitor connector. As an alternative, make an I/Q monitor using a 9-pin male D connector with wire-wrap tails and connect an oscilloscope to the appropriate pins.

When the Cisco router has no actual data, it sends a 7E (hex) idle flag. This is a convenient way to monitor a repetitive pattern for trouble shooting instead of sending actual data into the modulator. The same pattern will exit the demodulator.

Next, check the modulator-to-demodulator connection with a translator to verify they are operating together. The modulator and demodulator will interoperate with no data cable attached when the modulator is looped to the demodulator through the translator as shown in **Figure 3**.

The modulator and demodulator are programmed to the same data rate and code rate. If the translator has a 1000 MHz Local oscillator and the modulator is operating at 140 MHz, then the nominal demodulator operating frequency is 1140 MHz (= 1000 + 140 MHz). When translators with substantial drift are used, reprogramming of the demodulator frequency is required to “find” the carrier.

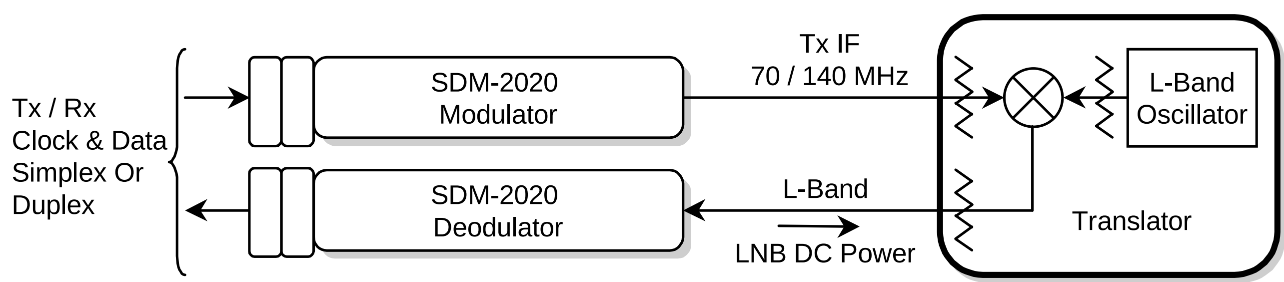


Figure 3. Translator for Looping the SDM-2020

Setting the sweep range on the demodulator to 1000 MHz can help with carrier acquisition by establishing a larger search range. Often a warm up period is required for the local oscillator drift in the translator to subside.

Note, if the transmitter turns off (the green LED on the modulator is off) when the data cable is disconnected, then the modulator Tx Clock activity is set to FAULT. To enable the transmitter when the data connector is removed, change the Tx Clock Activity to ALARM. To set this, enter the Configuration Interface menu using the front panel key-pad, locate the Tx Clock Activity menu and select Alarm.

Finally, the router and modulator/demodulator are connected together for operation at the same data rate to check an individual loop. Continue adding more ports plus modulators and demodulators to the setup to obtain successively larger operational segments of the system.

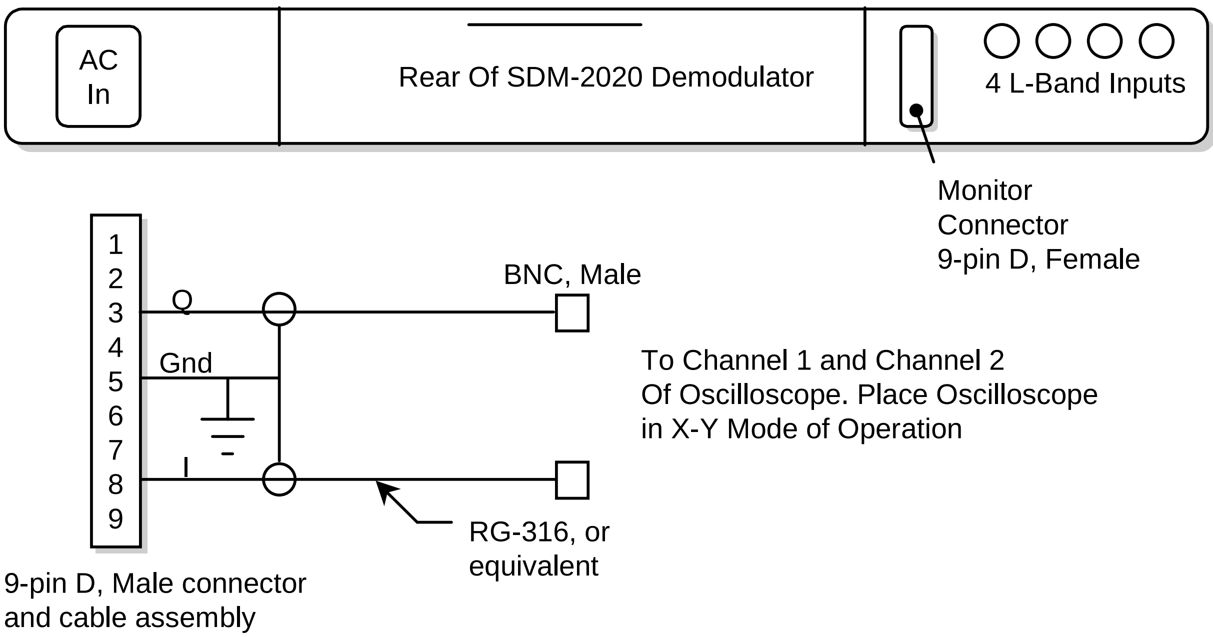


Figure 4 **Monitor Connector for Viewing I/Q Constellation on an Oscilloscope**

Some translators are powered by the LNB voltage (DC) available from the F-connector that is also the L-Band input to the demodulator. This DC voltage can damage spectrum analyzers and other equipment, so a DC block is recommended to protect test equipment. Be sure to program the LNB voltage OFF from the Configuration Demodulator menu when it is no longer needed.