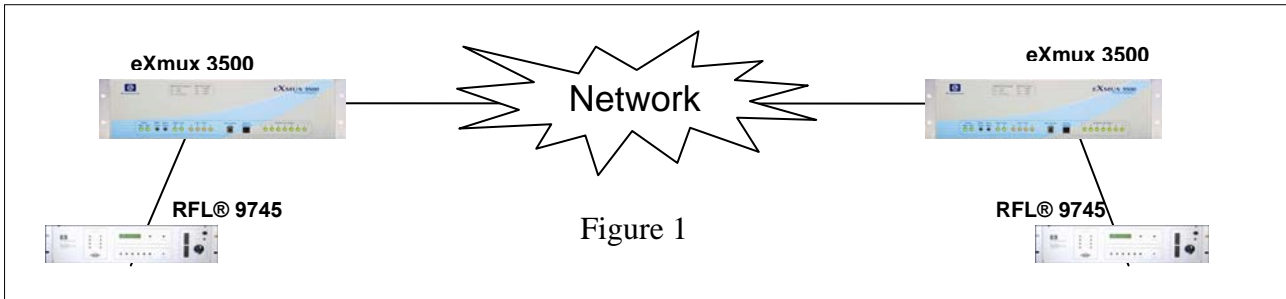


**Digital RFL® 9745 Teleprotection Channel over
the RFL eXmux 3500 IP Access Multiplexer**

The RFL eXmux 3500 is a hardened IP Access Multiplexer engineered for mission critical infrastructures that seamlessly transport voice, serial, video and Ethernet data communications over Ethernet/IP or MPLS networks. The eXmux 3500 is a Layer 2 device with an integrated managed Ethernet switch which allows the eXmux 3500 to be used either in a private network with other eXmux 3500's or as part of a larger Ethernet/IP/MPLS network. Both fiber (using SFPs) and RJ-45 connections are available for the eXmux 3500; uplink speeds of up to a Gigabit are possible.

Figure 1 below depicts the eXmux 3500 as the communications system providing a point-to-point communications circuit between a pair of digital RFL® 9745 Teleprotection Channels. The network cloud is a general representation of an IP network and does not imply a direct point-to-point connection. The communications protocol interface options for the digital RFL® 9745 over the eXmux 3500 are C37.94 Short Haul Fiber, synchronous RS-422/449, X.21 or G.703. Refer to the following table for the correct eXmux 3500 Interface Unit (IU) required for the appropriate 9745 protocol interface. (Refer to application note 3500-0006 for audio channel 9745)

RFL® 9745 Communications Interface	eXmux 3500 Interface Unit (IU)
C37.94 SHF	4-Port C37.94 IU
RS-422/449, X.21	4-Port Synch. Multi-Protocol IU
G.703	4-Port G.703 Synch. IU



Network Performance Consideration

Latency issues should always be considered when installing a teleprotection channel over any kind of multiplexer. The eXmux 3500 when applied over direct fiber connection with minimum jitter buffer delay settings (also referred to as Packet Delay Variation (PDV)) of 1-2ms, will yield a back-to-back communication channel delay of <5ms. In addition to the low latency, when setup in a redundant path configuration the eXmux 3500 has a unique Hitless Switching feature that guarantees no data is lost during any single path failure. For a network with anticipated traffic usage beyond 90% of bandwidth capacity, Quality of Service (QoS) features can always be used to ensure that TDM data has the highest priority.

The network topology should be designed with a minimum number of nodes between the two ends of any teleprotection channel to minimize the jitter buffer delay setting; this will minimize the overall latency. By using the VLAN capability of the eXmux 3500, a secure and direct bidirectional communications channel can be created for the 9745 circuit.

eXmux 3500 Interface Unit Settings:

This application note assumes familiarity with the operation of the eXmux 3500 and the RFL® 9745. The appropriate eXmux 3500 Interface Unit to be used for this circuit should be programmed before mapping. Refer to the eXmux 3500 manual for mapping procedures and specific interface wiring information for each of these IU's.

eXmux 3500 C37.94 IU settings

1. On desired Port tab, set RX Data-Out Polarity and TX Data-In Polarity to **NORMAL**.
2. On Bandwidth tab, set desired Port Bandwidth to **1** (64kbps).

A multimode fiber cable with ST connector is used to connect the RFL® 9745 C37.94 I/O to the eXmux 3500 C37.94 IU.

eXmux 3500 Multi-Protocol Synch IU settings (RS-449 or X.21)

1. On General tab, set choose RS-422 or X.21 Protocol as desired.
2. On desired Port tab, set P(x) Interface Mode to **DCE**. Handshaking Delay **Disable**. RX Data-Out Polarity and TX Data-In Polarity to **NORMAL**. RX Clock Polarity and TX Clock Polarity to **NORMAL**.
3. On Bandwidth tab, set desired Port Bandwidth to **1** (64kbps).

A DB-37F to DB-25M cable is used to connect the RFL® 9745 RS-449 I/O to the eXmux 3500 Synch IU. A DB-15F to DB-25M cable is used to connect the RFL® 9745 X.21 I/O to the eXmux 3500 Synch IU. Refer to the chart below and the 9745/eXmux 3500 manuals for cabling pin out information. RFL can provide the following cable if desired.

RFL® 9745 RS-449 DB-37F	RFL® 9745 X.21 DB-15F	eXmux 3500 Sync IU DB-25M	RFL® 9745 Signal
1	1	1	Chassis Gnd
4	2	2	TX Data Out +
22	9	14	TX Data Out -
5		15	Send Timing +
23		12	Send Timing -
6	4	3	RX Data In +
24	11	16	RX Data In -
8	6	17	Receive Timing +
26	13	9	Receive Timing -
19		7 or 23	Signal Gnd

eXmux 3500 G.703 Synch IU settings

1. On desired Port tab, check enable. Octet Timing **DISABLE**. Loopback **NONE**. RX Data-Out Polarity and TX Data-In Polarity to **NORMAL**.

A DB-15F to DB-15M cable is used to connect the RFL® 9745 G.703 I/O to the eXmux 3500 G.703 Synch IU. Refer to the chart below and the 9745/eXmux 3500 manuals for cabling pin out information. RFL can provide the following cable if desired.

RFL® 9745 G.703 DB-15F	eXmux 3500 G.703 Sync IU DB-15M	RFL® 9745 Signal
1	1	Chassis Gnd
2	2	TX Data (A)
9	9	TX Data (B)
4	4	RX Data (A)
11	11	RX Data (B)

This application note may not apply to other vendors Teleprotection Channel as some settings may be different. Check with the vendor of the device you are using to determine the required eXmux 3500 settings. Contact RFL Electronics at 973-334-3100 for further assistance.