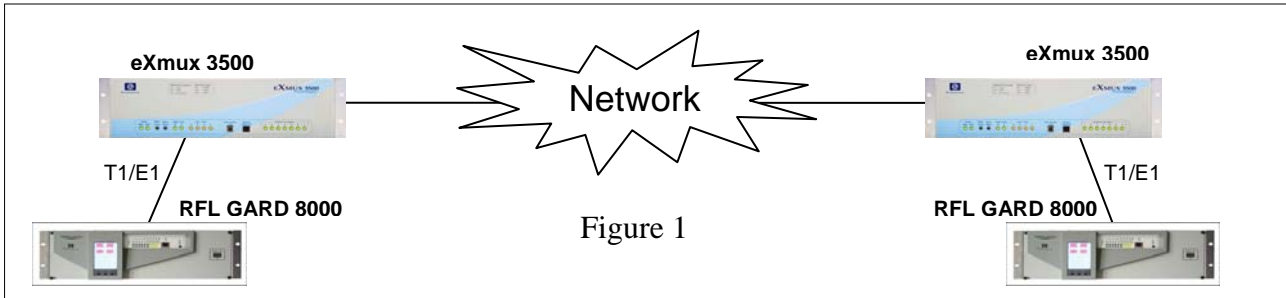


RFL GARD 8000 T1/E1 Channel over the RFL eXmux 3500 IP Access Multiplexer

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 T1 or E1 communications circuit between a pair of RFL GARD 8000's. The network cloud is a general representation of an IP network and does not imply a direct point-to-point connection. Refer to the following table for the correct eXmux 3500 Interface Unit (IU) required for the T1/E1 GARD 8000 interface. (Refer to application note 3500-0013 for digital channel GARD 8000 or 3500-0015 for audio channel GARD 8000)

<u>RFL GARD 8000 Communications Interface</u>	<u>eXmux 3500</u>
T1/E1	T1/E1 Interface Unit (IU) or Integrated T1/E1 port



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 GARD 8000 circuit.

When connecting eXmux 3500's over an IP network, the following information can be used as part of the overall network design to determine communication channel delays. The network topology should be designed with a minimum number of nodes between the two ends of any T1/E1 link to minimize the packet-delay variation (PDV) settings; 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 T1/E1 channel.

Product Latency:

- eXmux 3500 T1/E1 interface inherent back to back channel delay – 2.5ms
- eXmux 3500 T1/E1 asymmetric back to back channel delay – 0.2ms
- eXmux 3500 through node delay – 0.003ms
- eXmux 3500 programmable packet-delay variation (PDV) settings – 1 to 500ms

eXmux 3500 Integrated T1/E1 Port or T1/E1 Interface Unit Settings:

This application note assumes familiarity with the operation of the eXmux 3500 and the RFL GARD 8000. The T1/E1 port parameters 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 the T1/E1 Interface.

eXmux 3500 T1/E1 Port Settings

1. On General tab, **ENABLE** port. Set Framer Mode to **PASSTHRU**. Set Port Framer Mode to **T1** or **E1** as desired. Set TX Clock Source to appropriate setting. See note # 1 below for TX Clock Source setting options. Set Loopback to **DISABLE**.
2. On T1/E1 tab, choose T1 or E1 settings as required.
3. On T1 Signaling tab, verify all T1 signalling is disabled.

Note # 1 - TX Clock Source Settings

The required T1/E1 TX clock source can originate from three different sources. These are:

1. **System Clock** – The eXmux T1/E1 port timing is provided by the eXmux Network System Clock. Refer to the eXmux manual for more information on setting the eXmux System Clock.
2. **Internal Clock** – The eXmux T1/E1 port timing is provided by the eXmux on board Oscillator.
3. **Through Clock** – The eXmux T1/E1 port timing is provided by the recovered clock from the remote node's T1/E1 framer.

The T1/E1 Interface for the GARD 8000 provides both a DB-15M and RJ-48C connector. The T1/E1 Interface Unit (IU) for the eXmux 3500 provides both a DB-15M and RJ-48C connector. The integrated T1/E1 port on the eXmux 3500 only provides an RJ-48C connector. Either one can be used.

Refer to the charts below for pin out information.

eXmux 3500 T1/E1 Port DB-15M	GARD 800 T1/E1 Port DB-15M	GARD T1/E1 Signal
11	9	TX+ OUT
3	1	TX- OUT
9	11	RX+ IN
1	3	RX- IN

eXmux 3500 T1/E1 Port RJ-48C	GARD 800 T1/E1 Port RJ-48C	GARD T1/E1 Signal
2	5	TX+ OUT
1	4	TX- OUT
5	2	RX+ IN
4	1	RX- IN

This application note may not apply to other vendors T1/E1 equipment 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.