comunicating through generations

T1/E1 Communications 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 T1/E1 Multiplexers. The network cloud is a general representation of an IP network and does not imply a direct point-to-point connection. The eXmux 3500 has an integrated T1/E1 port in every unit. Additional T1/E1 Interface Units (IU) can be added as required in any position except IU7. Refer to the eXmux 3500 manual for more information.

eXmux 3500   Network   eXmux 3500

T1/E1   T1/E1

T1/E1 Mux   Figure 1   T1/E1 Mux
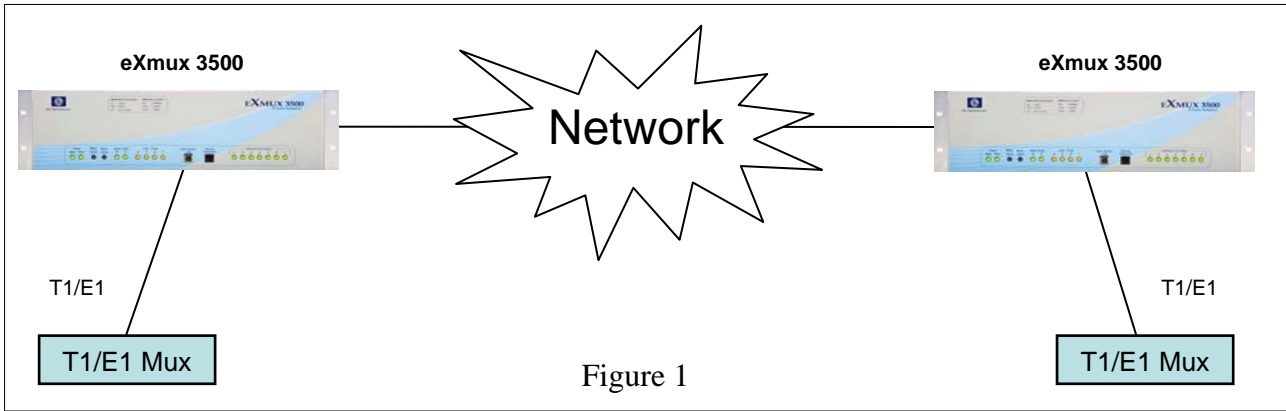
Network Performance Consideration

Various channels that are transported over the T1/E1 Mux may be sensitive to communication channel delays which can affect performance. Latency issues should always be considered when installing a 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. This is in addition to the inherent delay of the T1/E1 Mux itself. 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.

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 Interface Unit Settings:
This application note assumes familiarity with the operation of the eXmux 3500 and the T1/E1 Multiplexer. The appropriate eXmux 3500 T1/E1 port 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 port.

eXmux 3500 T1/E1 settings
1. On General tab, **ENABLE** port. If only a direct point to point T1 link is required, set Framer Mode to **PASSTHRU**. If DS0 grooming (DACS) capability is required, set Framer Mode to **GROOMED**. (Refer to application note 3500-0012 (DS0 Grooming) and eXmux 3500 manual for more information on **GROOMED** mode.) 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, enable Robbed Bit Signaling (RBS) if required for any audio channels.

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.

If the Framer Mode is set for GROOMED the TX Clock Source setting must be set for System Clock since all groomed DS0's must use the same clock.

If the eXmux T1/E1 port is connected to a DACS, THROUGH clock can not be used due to the lower tolerance for clock jitter on a DACS. SYSTEM clock must be used and this system clock can be supplied by either the T1/E1 FRAMER or INTERNAL clock as set by the TDM TIMING setting in main chassis settings menu.

The T1/E1 Interface for the eXmux 3500 provides both a DB-15M and RJ-48C connector. Either one can be used. Refer to the chart below for pin out information.

eXmux 3500 T1/E1 IU DB-15M	eXmux 3500 T1/E1 IU RJ-48C	T1/E1 Signal
9	5	TX+ OUT
1	4	TX- OUT
11	2	RX+ IN
3	1	RX- IN

This application note may not apply to all T1/E1 Multiplexers as some settings may be different. Check with the vendor of the multiplexer you are using to determine the required eXmux 3500 settings. Contact RFL Electronics at 973-334-3100 for further assistance.