RFL GARD 8000 Audio 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 analog 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 analog GARD 8000. (Refer to application note 3500-0013 for digital channel GARD 8000 or 3500-14 for T1/E1 channel GARD 8000)

RFL GARD 8000 Communications Interface	**eXmux 3500 Interface Unit (IU)**
4-Wire Audio	8-Port 4-Wire Audio IU

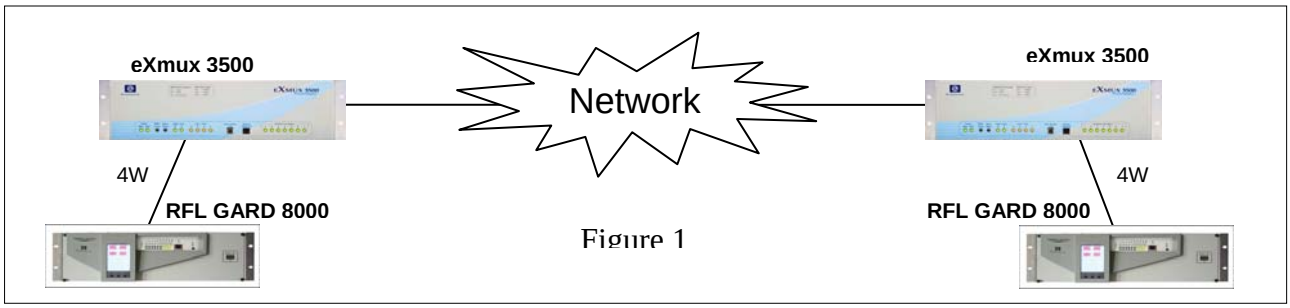

Figure 1

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.

eXmux 3500 Interface Unit Settings:

This application note assumes familiarity with the operation of the eXmux 3500 and the RFL GARD 8000. 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 4-Wire Audio IU settings

1. On desired Port tab, check enable. Set desired TX & RX levels (See level setting information below). Signaling **DISABLE.** FXS/FXO Mode **NORMAL**. TX & RX Test Tone **DISABLE**. Loopback **NONE**. Force busy **DISABLE**.
2. On u/A-Law tab, choose **u-Law.**

How to determine eXmux 3500 level settings from GARD 8000 composite tone:

The correct eXmux 3500 level settings are determined from the peak composite signal from the GARD 8000. This composite signal is based on the signal level of each tone and number of tones transmitted. For example, a 4 tone signal from the GARD 8000 provides a composite signal level that is 12dB above the level of each individual tone (assuming all signals are at the same level). If the 4 tones of the GARD 8000 are each set to transmit and receive at -10dB, then the eXmux 3500 4W Audio IU should be programmed for a TX and RX level of +2dB. This will ensure a correct signal level being sent to the receiving GARD 8000. An example is shown below.

# Tones on GARD 8000 Channel	8000 TX Levels	Composite Tone Adjustment	Tx and RX levels set on eXmux 4W Audio IU
1	-10dB	0	-10dB
2	-10dB	6	-4dB
3	-10dB	9.5	-.5dB
4	-10dB	12	+2dB

A 4 wire terminal to RJ-45 cable is used to connect the RFL GARD 8000 4-wire Audio Module to the eXmux 3500 4-wire Audio IU. Refer to the chart below and the GARD 8000/eXmux 3500 manuals for cabling pin out information. RFL can provide the following cable if desired.

RFL GARD 8000 4-Wire Module	eXmux 3500 4-Wire Audio IU RJ-45	RFL GARD 8000 Signal
RX	1	RX in
RX	2	RX in
TX	5	TX out
TX	4	TX out

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.