

# Vmux-2100

## Voice Trunking Gateway



**TDMoIP**  
Driven™

### FEATURES

- Supports bandwidth efficient transmission of up to 16 E1 or T1 voice trunks over a single link
- Simultaneous transmission over IP and TDM networks
- Unique TDMoIP Multiplexing, together with various voice compression algorithms, provides up to 16:1 effective bandwidth utilization
- Single Ethernet and redundant E1/T1 uplink ports available
- Bandwidth is dynamically allocated according to Voice Activity Detection and silence suppression
- G.168 Echo Cancellation of up to 16 msec per channel
- Group III Fax relay support, at rates of 2.4 to 14.4 kbps
- Transparent modem support for all common rates and standards
- QoS support:
  - Labeling IP level priority (ToS)
  - VLAN tagging and priority labeling according to IEEE 802.1p&q
- Supports HDLC Channel Compression
- DTMF/MFR2/MFC signal detection, generation and relay
- Signaling supported:
  - Transparent CAS signaling, including R2 and E&M
  - Transparent CCS signaling, including ISDN, QSIG and SS7
- Management via user terminal, secured SNMP and Telnet
- Enhanced local and remote diagnostics tools
- Hot swappable voice modules
- Optional dual hot-swappable power supply modules for load sharing and redundancy
- Compact 1U-high platform, compatible with 19" racks

# Vmux-2100

## Voice Trunking Gateway

### DESCRIPTION

- Vmux-2100 is a modular Voice Trunking Gateway that compresses and transports up to 16 E1 or T1 voice trunks over E1, T1 or IP links. Vmux-2100 employs G.723.1, G.729 Annex A and G.711 compression algorithms, together with RAD's unique TDMoIP Multiplexing, to transmit up to 480/384 voice channels, including transparent CAS and CCS signaling, over a single E1/T1 or IP link.
- Voice Activity Detection and silence suppression techniques are used by Vmux-2100, so that bandwidth is only allocated when it is required, thus conserving bandwidth. The gateway detects, generates and relays DTMF/MFR2/MFC signaling.
- Vmux-2100 supports relay of Group III fax, as well as all common modem rates and standards. Modem transmissions are handled as voice band data.
- Vmux-2100, only 1U-high, is a compact modular unit, that can be installed in 19" racks. The unit consists of up to four Voice Compression modules, a single Main Link module, and up to two power supply modules. All

modules are plug-in and field-replaceable. Power supply and Voice Compression modules are hot-swappable.

- Vmux-2100 is unique in that it is a single device that can provide compressed voice transmission over both TDM and IP networks, and easily switch between them whenever this may be advantageous or necessary. Switching transmission between TDM and IP links does not require additional investments in equipment and only minimal configuration changes.

### MAIN LINK MODULE

- The Main Link module features a single 10/100BaseT UTP or fiber optic Ethernet port with optional Auto-Negotiation support. The Ethernet port operates at 10/100 Mbps speeds, half and full duplex. The Ethernet interface is compliant with the IEEE 802.3 standard. It supports full Auto-Negotiation according to 802.3x flow control for full duplex, and backpressure option for half duplex.
- In addition to the standard Ethernet port, the Main Link module can also be ordered with a redundant pair of E1 or T1 ports with RJ-45 connectors.

- E1/T1 link redundancy is controlled by the main board host, based on physical alarm reports, providing automatic switching between the redundant E1/T1 links in case of a link failure.
- Ethernet performance monitoring and statistics are available for frames received and sent to the IP network, collisions, deferred transmission and carrier sense errors (RFC 1643).

### VOICE COMPRESSION MODULES

- Each Vmux-2100 Voice Compression module includes 2 or 4 E1/T1 ports. The timeslots received from the PBX E1/T1 trunks are compressed by the modules using standard G.711, G.723.1, or G.729.A algorithms. The compressed payload bytes are then encapsulated into a TDMoIP frame that runs over IP. The size and packetizing interval are user-configurable. The Ethernet frames are forwarded to the Ethernet switch, which sends them to one of the main links: 10/100BaseT or E1/T1.
- Timeslots are grouped together into bundles. A different destination IP address can be configured for each bundle to support any-to-any connectivity (see Figure 1).

### APPLICATIONS

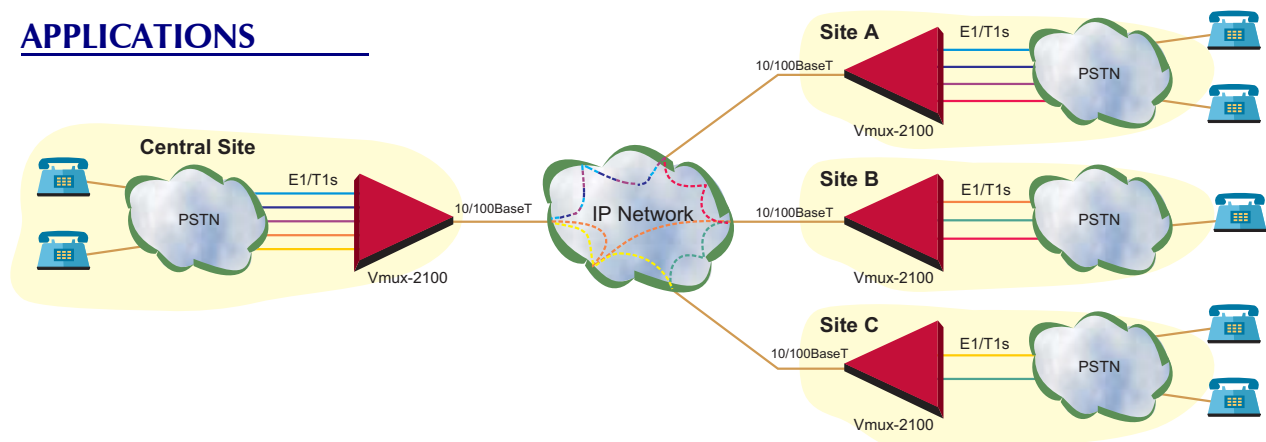


Figure 1. Voice Trunking over IP in an Any-to-Any Point Application

- Vmux-2100 utilizes the Voice Activity Detection mechanism that prevents sending packets when no voice activity is detected, to increase bandwidth utilization and thus support a higher number of voice channels over TDM links than is possible using conventional voice compression methods alone. By TDMoIP Multiplexing and grouping the timeslots of G.723.1 compressed voice together into bundles with a common IP address, actual link bandwidth used per channel can be reduced to as low as 4 kbps (a reduction of 16:1). This enables a single Vmux-2100 unit, fully equipped with four 4-port Voice Compression modules, to compress and transmit up to 16 E1 or T1 trunks (480/384 voice channels) over a single 2 Mbps E1 or 1.5 Mbps T1 link (see Figure 3).
- CAS and CCS signaling are transparently transmitted end-to-end (see Figure 2). Vmux-2100 transmits HDLC-based CCS signaling protocols such as SS7, ISDN and QSIG as HDLC over IP. HDLC frames are removed, and any signal payload is sent in an IP packet. For ISDN and QSIG protocols, this results in significant bandwidth savings.

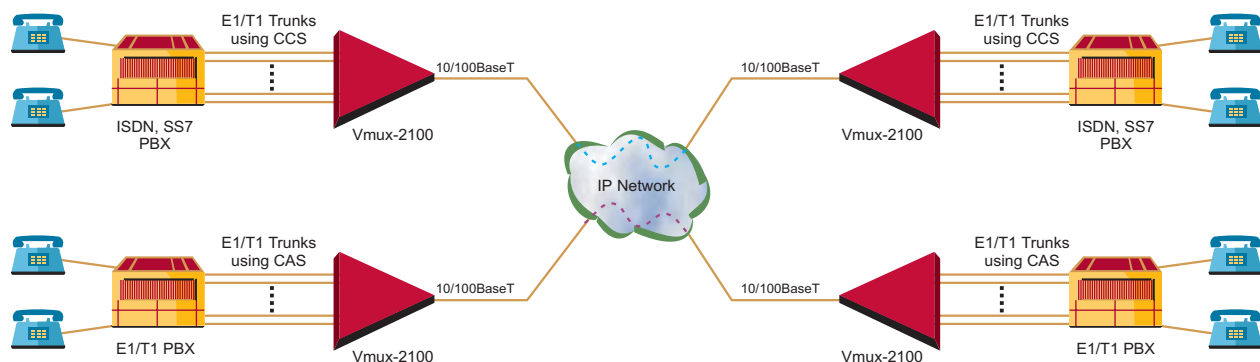
### QOS SUPPORT

- Vmux-2100's IP port complies with all relevant Ethernet LAN standards, such as IEEE 802.3 and 802.3u. It provides reliable, high quality of service (QoS), by optional VLAN tagging and priority labeling according to IEEE 802.1p&q.
- The user can configure the ToS (Type of Service) of the outgoing IP frames. This allows an en-route Layer-3 router or switch, which supports ToS (or Diffserv), to give higher priority to Vmux-2100 IP traffic for delay-sensitive applications.
- Assigned, IANA-registered UDP socket number for TDMoIP simplifies flow classification through switches and routers.

### MANAGEMENT

- All operating parameters of the Vmux-2100 are configured using a simple, menu-based software. For upgrades or backup, software upload and download can be performed via TFTP.

- Vmux-2100 can be configured and monitored via a local ASCII terminal, Telnet, or via RADview, RAD's Network Management system. Vmux-2100 has a DB-9 Control port for the local terminal connection used for monitoring and control. For off-site management, a terminal can also be connected via a modem extension to the Control port using the optional CBL-VMUX-MM-MODEM cable.
- Since Vmux-2100's internal control unit has its own IP address, the Ethernet port can also be conveniently utilized as a connection to management systems running over Ethernet networks. Management connected to the Ethernet port can even serve a remote unit that is connected via an E1/T1 link, by placing the management information in a dedicated timeslot of the TDM link (in-band management). See Figure 4.
- For system security, Vmux-2100 provides four different levels for users: Monitor, Technician, Operator and Administrator. Up to 20 different usernames with passwords can be defined.



**Figure 2. Vmux-2100 Transmitting Compressed Voice over IP, Including Transparent Transmission of CCS and CAS Signaling**

## Voice Trunking Gateway

### SPECIFICATIONS

#### MAIN LINK MODULE

Main Link Module includes a single Ethernet port standard with addition of redundant E1 or T1 ports optional

#### Ethernet Port

- **Number of Ports**  
1
- **Standards**  
IEEE802.3, 802.3u, Ethernet, 802.1p&q
- **Data Rate**  
10 or 100 Mbps, half duplex or full duplex, auto-negotiate
- **Statistics**  
According to RFC 1643, or RFC 2665:
  - **Received frames:**  
Correct Frames, Correct Octets, Alignment Errors, FCS Errors.
  - **Transmitted frames:**  
Correct Frames, Correct Octets, Single Collision, Multiple Collision, Deferred Transmission, Late Collision, Carrier Sense Error
- **Indicators**
  - ACT (green) – blinks when traffic is detected over the Ethernet line
  - LINK (green) – ON when Ethernet line is O.K.

- **Copper UTP Interface**
  - Range: up to 100m on UTP Cat.5 cable
  - Connector: RJ-45
- **Multimode Fiber Interface**
  - Fiber type: 1300 nm, multimode
  - Max range: 2 km (1.2 mile)
  - Connector: LC
- **Single Mode Fiber Interface**
  - Fiber type: 1300 nm, single mode
  - Max range: 20 km (12 mile)
  - Connector: LC

*Note:* Maximum range achieved is subject to actual fiber conditions.

#### E1 Ports

- **Number of Ports**  
2 (one active, other for backup)
  - **Connectors (per port)**  
RJ-45 for balanced interface
- Note:* CBL-RJ45/2BNC adapter is available for converting each Main Link module E1 port RJ-45 connector into a pair of BNC connectors for unbalanced coax interface.

#### T1 Ports

- **Number of Ports**  
2 (one active, other for backup)
- **Statistics**  
Full statistical diagnostics capability according to ANSI T1.403-1989  
Local support of ESF diagnostics according to AT&T PUB 54016
- **Connectors (per port)**  
RJ-45 for balanced interface

*Note:* Additional E1/T1 interface specifications that are applicable for both main link and voice ports are listed under **General**.

#### Control Port

For direct connection of terminal, located on the Main Link module

- **Standards**  
RS-232/V.24 (DCE)
- **Data Rate**  
9.6, 19.2, 38.4, 57.6 or 115.2 kbps
- **Connector**  
DB-9, female

#### VOICE COMPRESSION MODULES

- **Compression Algorithms**  
G.723.1 (6.4 kbps), G.729 A (8 kbps), G.711 (a-law and  $\mu$ -law)
- **Silence Suppression**  
G.723.1 A, G.729B
- **Echo Cancellation**  
16 msec per channel as per G.168
- **Fax Relay**  
Group III, 2.4 to 14.4 kbps
- **Voice Band Data**  
Transparent support for modems
- **Signaling Support**
  - Transparent CAS signaling, including R2 and E&M
  - Transparent CCS signaling, including ISDN, QSIG and SS7
- **MF Signaling Support**  
DTMF, MFR2, MFC detection, generation and relay
- **Ports per Module**  
*according to ordering:*  
**E1 Port Modules**  
2 (60 channels max) or 4 (120 channels max),  
**T1 Port Modules**  
2 (48 channels max) or 4 (96 channels max)



Figure 3. Vmux-2100 Enables Supporting up to 480/384 Voice Channels over a Single E1/T1 TDM Link

### GENERAL

#### E1 Ports

- **Data Rate**  
2.048 Mbps (per port)
- **Standards**  
ITU-T Rec. G.703, G.704, G.706, G.732, G.823
- **Framing**  
G.732N  
G.732N with CRC-4  
G.732S  
G.732S with CRC-4
- **Line Code**  
HDB3
- **Receive Signal Level**  
With LTU: 0 to -43 dB  
Without LTU: 0 to -12 dB
- **Transmit Signal Level**  
Balanced:  $\pm 3V$  ( $\pm 10\%$ )  
For Main Link module only:  
Unbalanced:  $\pm 2.37V$  ( $\pm 10\%$ )
- **Timing**  
Internal or loopback
- **Jitter Performance**  
Per ITU-T G.823
- **Line Type**  
Balanced 4-wire, 120 $\Omega$
- **Indicators (per port)**
  - LOC (red) – indicates Local Sync Loss on port
  - REM (red) – indicates Remote Sync Loss on port
- **Connectors (per port)**  
RJ-45 for balanced interface

#### T1 Ports

- **Data Rate**  
1.544 Mbps (per port)
- **Standards**  
ANSI T1.403, AT&T TR-62411, ITU-T Rec. G.703
- **Framing**  
SF, ESF
- **Line Code**  
AMI
- **Zero Suppression**  
B8ZS
- **Receive Signal Level**  
With CSU: 0 to -36 dB  
Without CSU: 0 to -30 dB
- **Transmit Signal Level**  
With CSU: 0, -7.5, -15, or -22.5 dB  
Without CSU:  $\pm 2.7V$  ( $\pm 10\%$ ) at 0-655 ft
- **Timing**  
Internal or loopback
- **Jitter Performance**  
Per AT&T TR-62411
- **Line Type**  
Balanced 4-wire, 100 $\Omega$
- **Indicators (per port)**
  - RED (red) – indicates Local Sync Loss (Red Alarm) on port
  - YEL (red) – indicates Remote Sync Loss (Yellow Alarm) on port
- **Connector (per port)**  
RJ-45

#### Other

- **E1/T1 Alarms (per port)**  
LOS – Loss of signal  
LOF – Loss of frame  
AIS – Alarm Indication Signal  
RDI – Remote alarm  
LOMF (E1 only) – loss of multiframe alarm  
LCV – line code violation
- **Unit Panel Indicators**
  - TST (yellow) – Indicates test is being run in system
  - ALM (red) – Indicates alarm is present in system
  - PWR 1 (green) – ON when Power Supply 1 module provides power
  - PWR 2 (green) – on when Power Supply 2 module provides power
- **Diagnostics**  
Main Links:
  - IP Diagnostics: Performance monitoring, LAN statistics, PING
  - E1/T1 Diagnostics: Local and Remote Loopbacks
 Voice Compression ports:
  - Local and Remote Loopback, per E1/T1 channel
  - Tone injection towards the local side: per timeslot, per entire E1/T1 channel, or on all E1/T1 channels simultaneously

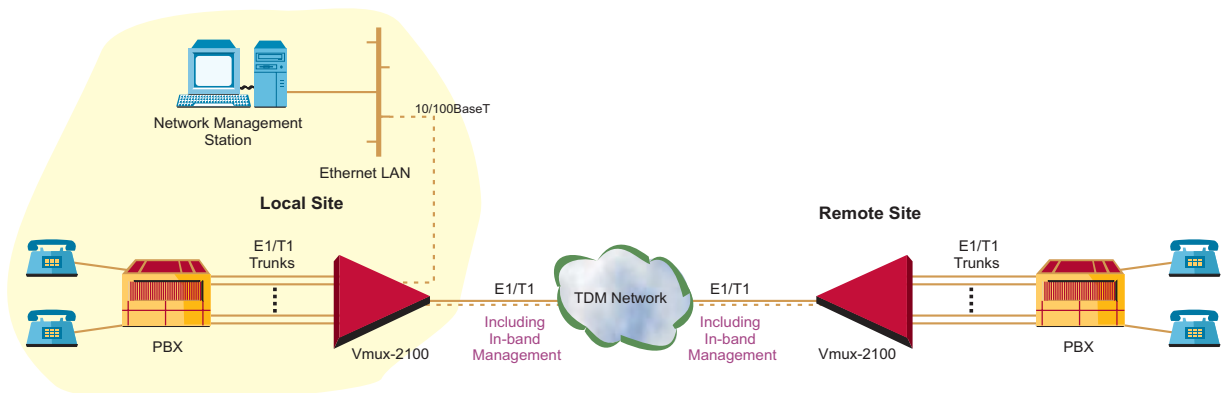


Figure 4. Management from Ethernet LAN to Remote Vmux-2100, In-band, via TDM Link

# Vmux-2100

## Voice Trunking Gateway

- **Power**

Input (according to ordering):

AC: 100 to 240 VAC, 50/60 Hz  
-48 VDC: -36 to -72 VDC  
24 VDC: 18 to 36 VDC

Output (per module):

Up to 15A of 3.3 VDC  
Up to 5A of 5 VDC  
60W Total

**Note:** Two hot-swappable power supply modules can be installed for redundancy and load-sharing.

- **Physical**

Height: 4.3 cm/1.7 in (1.U)  
Width: 43.5 cm/17.1 in  
Depth: 24.0 cm/9.5 in  
Weight: 7 kg/15.5 lb

- **Environment**

Operating temperature:

0 to 50°C / 32 to 122°F

Storage temperature:

-20 to 70°C / -4 to 158°F

Humidity: Up to 90%,  
non-condensing

## ORDERING

### **VMUX-2100/\*-\$**

Voice Trunking Gateway System

**Note:** System includes chassis, power supplies and power supply cables only. A Main Link Module and at least one Voice Compression Module must be ordered for every Vmux-2100 system. All modules can be ordered separately.

### **MODULES**

#### **VMUX-M/ETH@-&**

Main Link Module with single Ethernet port and optional redundant E1/T1 ports

#### **VMUX-M/VC-&-%**

Voice Compression Module

#### **VMUX-2100-PS/\***

Power Supply Module

### **ORDERING OPTIONS**

\* Specify power supply type:

**AC** for 100 to 240 VAC

**DC** for -48 (-36 to -72) VDC

**24** for 24 (18 to 36) VDC

\$ Specify **R** for redundant power supplies (of same type)

@ Specify Ethernet port interface type:

**MM** for multimode 1330nm fiber  
100BaseF interface

**SM** for single mode 1310nm fiber  
100BaseF interface

Default is copper UTP 10/100BaseT interface

& Specify for TDM interface type:

**E1** for E1 ports

**T1** for T1 ports

Default on the main link module is Ethernet port only

% Specify number of ports:

**2** for 2 ports

**4** for 4 ports

### **CABLES**

**Note:** All cables are ordered separately.

#### **CBL-RJ45/2BNC**

Interface adapter for converting a Vmux-2100 Main Link module E1 port's RJ-45 connector into pair of BNC connectors for unbalanced coax interface.

#### **CBL-VMUX-MM-MODEM**

Cable with DB-9 connectors for connecting a modem to the Vmux-2100's Control port. Cable length is 20 cm.

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