

# Vmux-2100

## Modular Voice Trunking Gateway



Efficiently  
transmitting up to 16  
E1 or T1 voice trunks  
over a single E1/T1 or  
Ethernet/IP link

**TDMoIP<sup>®</sup>**  
Driven

- Unique TDMoIP multiplexing allows transmission of the compressed voice over Packet Switched Networks and/or TDM Networks
- Fully transparent to signaling and telephony features
- Automatic link backup mechanism between TDM and Ethernet links ensures system survivability
- HDLC channel compression for CCS protocols
- Compact 1U-high platform, compatible with 19-inch racks

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 496/384 voice channels, including transparent CAS and CCS, over a single E1/T1 or IP link.

Vmux-2100 is unique in that it is a single device able to transmit compressed voice over both TDM and IP networks. It can easily switch between the networks whenever this may be necessary or convenient.

Switching transmission between TDM and IP links does not require additional investments in equipment. It can be performed automatically upon link failure.

Voice Activity Detection (VAD) and silence suppression allow Vmux units to dynamically allocate bandwidth for voice traffic. This results in very efficient bandwidth usage, allowing more bandwidth for data transport. The gateway detects, generates and relays DTMF/MFR2/MFC signaling.

CAS is transparently transmitted end-to-end (see *Figure 1*). When transmitting over non-IP networks (E1, T1 or n x 64 kbps), the A2oMPLS multiplexing format can be used instead of TDMoIP.

**RAD**

data communications

The Access Company

# Vmux-2100

## Modular Voice Trunking Gateway

The A2oMPLS header is smaller than the TDMoIP header, saving a further 5% in bandwidth. This technique is compliant with the MPLS/Frame Relay Alliance 5.0 Implementation Agreement: I.366.2 Voice Trunking Format over MPLS.

Vmux-2100 supports relay of Group III fax, as well as all common modem rates and standards. Other modem and fax rates can be transmitted transparently (voice band data).

Only 1U-high, Vmux-2100 is a compact modular unit that can be installed in 19-inch racks. The unit consists of up to four Voice Compression modules, a single Main 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.

### DATA STREAM TRANSFER

Vmux-2100 transfers the following data streams that are not processed as voice:

**Multiple HDLC channels** – Vmux-2100 supports up to four independent HDLC data streams per E1/T1. Each data stream may occupy one or more timeslots. All CCS protocols, such as SS7, ISDN and QSIG, are supported.

**SS7 channels** – Vmux-2100 supports up to two independent SS7 data streams per E1/T1. Each data stream may occupy one or more timeslots.

**Transparent channels** – Vmux-2100 supports transparent connection between n x 64 channels over IP and TDM networks. This feature operates between two Vmux-2100 units as well as between Vmux-2100 and Vmux-110. Up to eight timeslots per E1/T1 can carry transparent data.

### MAIN MODULE

The Main module features a single 10/100BaseT UTP Ethernet ports (Network and User) with optional autonegotiation support. The Ethernet port operates at 10/100 Mbps speed, half and full duplex.

The Ethernet interfaces comply with the IEEE 802.3 standard. They support full autonegotiation according to 802.3x flow control for full duplex, and backpressure option for half duplex.

In addition to the standard Ethernet port, the Main module can also be ordered with a redundant pair of E1/T1 or n x 64 kbps serial links.

### ENHANCED LINK BACKUP

Vmux-2100 features automatic link backup between the TDM ports and the Ethernet ports on the Main module (in point-to-point applications only). Primary, secondary and tertiary links are configured so that if the primary link fails, Vmux-2100 automatically switches to the next link. Once a failed higher link has been restored, the voice traffic is automatically switched back.

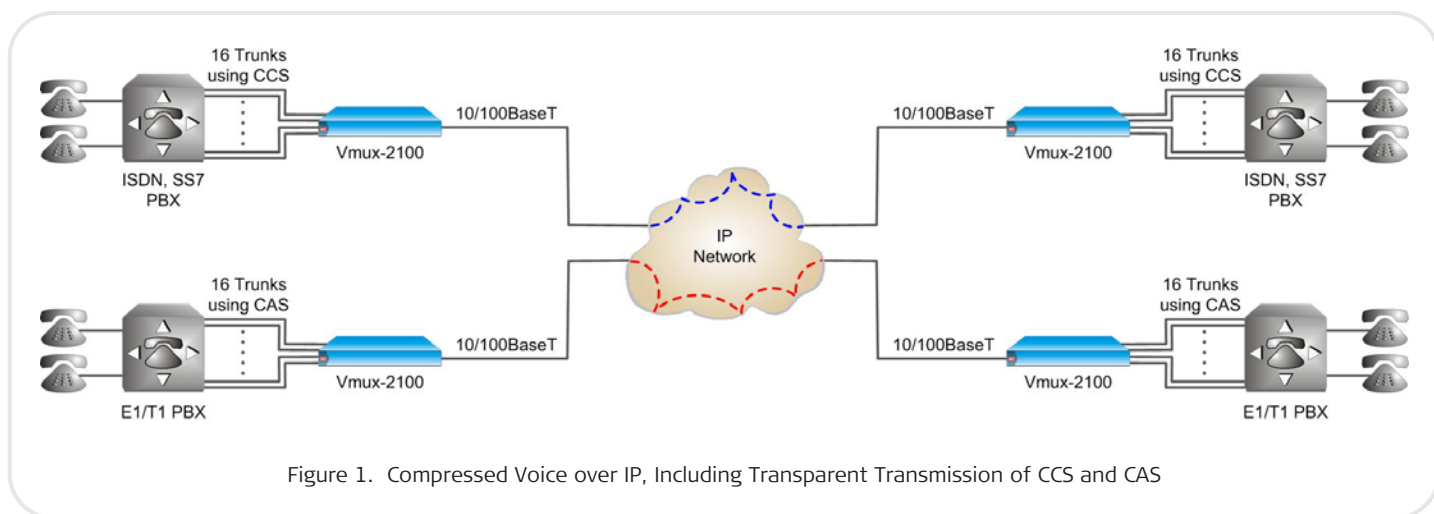


Figure 1. Compressed Voice over IP, Including Transparent Transmission of CCS and CAS

### VOICE COMPRESSION MODULES

Each Vmux-2100 Voice Compression module features two or four E1/T1 ports. The modules compress the timeslots received from the PBX E1/T1 trunks, using standard algorithms and silence suppression. The compressed payload bytes are then encapsulated into a TDMoIP packet and forwarded to the main link.

### BUNDLE CONNECTIVITY CHECK

Vmux-2100 checks voice bundle connectivity using either TDMoIP Layer-4 messages or traditional ICMP (pings). (Layer-4 method is recommended when using routers or firewalls to ensure the Vmux-2100's ability to establish bundle connectivity and also to avoid the flooding the network with pings).

### Q.50 & BANDWIDTH MANAGEMENT

Vmux-2100 employs two types of bandwidth management methods. The Q.50 protocol can be used with PBXs that support it. The proprietary Vmux-2100 bandwidth control can be used when the Q.50 protocol is not supported. Bandwidth management is available only when using link ports on the Main module.

### SUPER TANDEM

In super tandem applications (see Figure 2), where calls are routed through several Vmux-2100 gateways, the intermediate Vmux-2100 gateways sense that the voice has already been compressed by another Vmux, and thus do not uncompress and then recompress the data as it passes through them. This feature ensures that voice is compressed and decompressed only once (at the terminating Vmux-2100 gateways) avoiding voice degradation or delay.

### QoS SUPPORT

The Vmux-2100 IP port complies with all the 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 802.1D&Q.

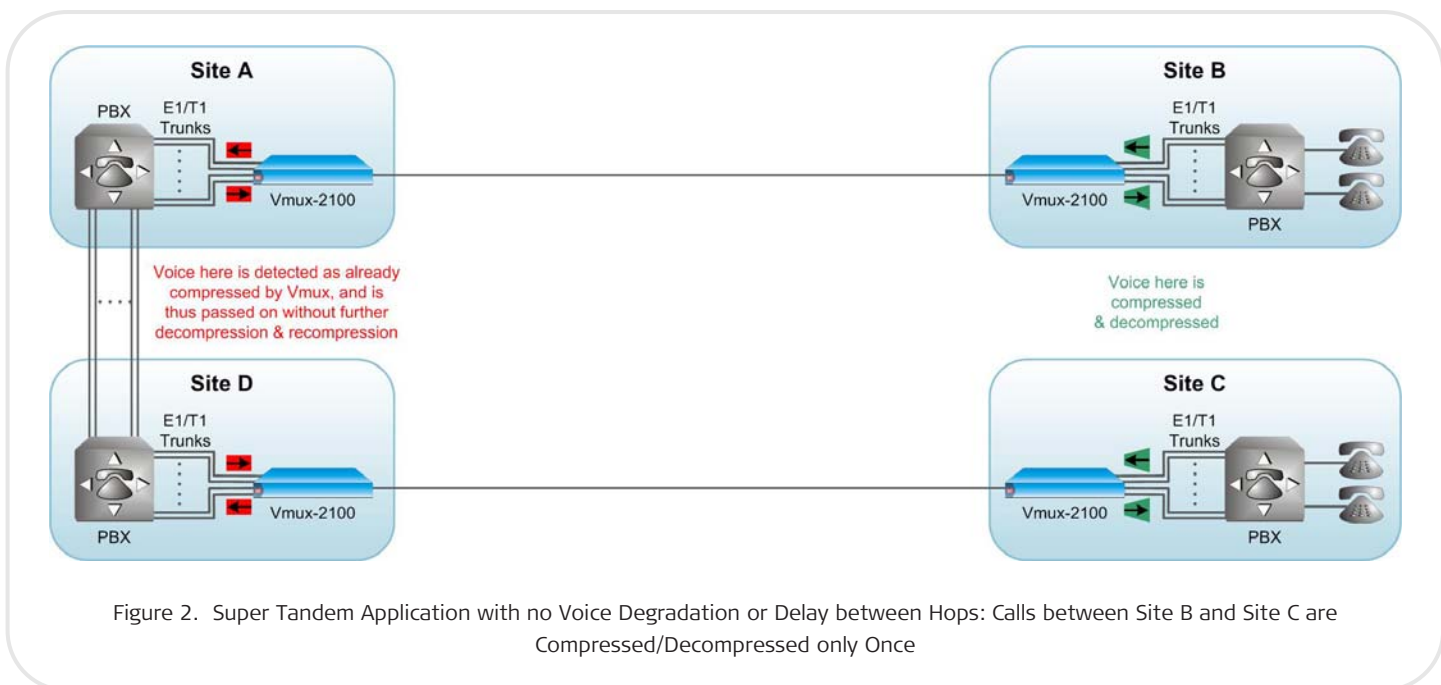


Figure 2. Super Tandem Application with no Voice Degradation or Delay between Hops: Calls between Site B and Site C are Compressed/Decompressed only Once

# Vmux-2100

## Modular Voice Trunking Gateway

### MANAGEMENT

All Vmux-2100 operating parameters are configured using simple, menu-based software. Upgrade or backup software can be uploaded and downloaded 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 features a DB-9 Control port for direct connection of a local terminal for monitoring and control.

The user can configure the Type of Service (ToS) of the outgoing IP packets. This allows an en-route Layer 3 router or switch that supports ToS (or Diffserv), to give higher priority to Vmux-2100 IP traffic for delay-sensitive applications.

An assigned, IANA-registered UDP socket number for TDMoIP packets simplifies flow classification through switches and routers.

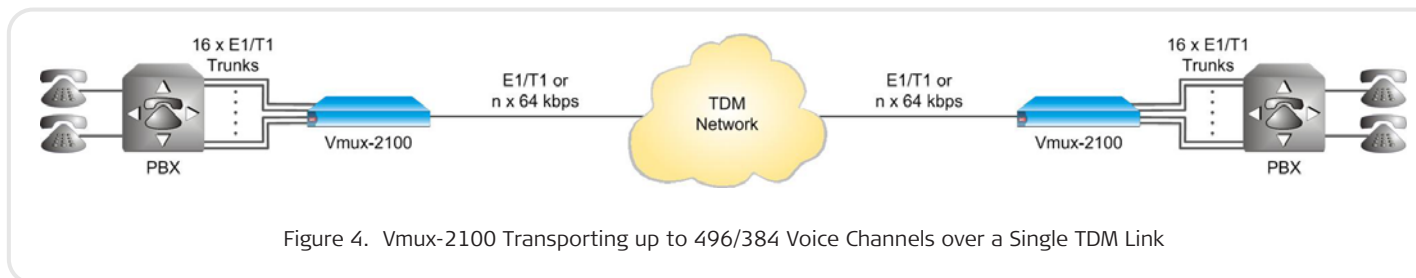
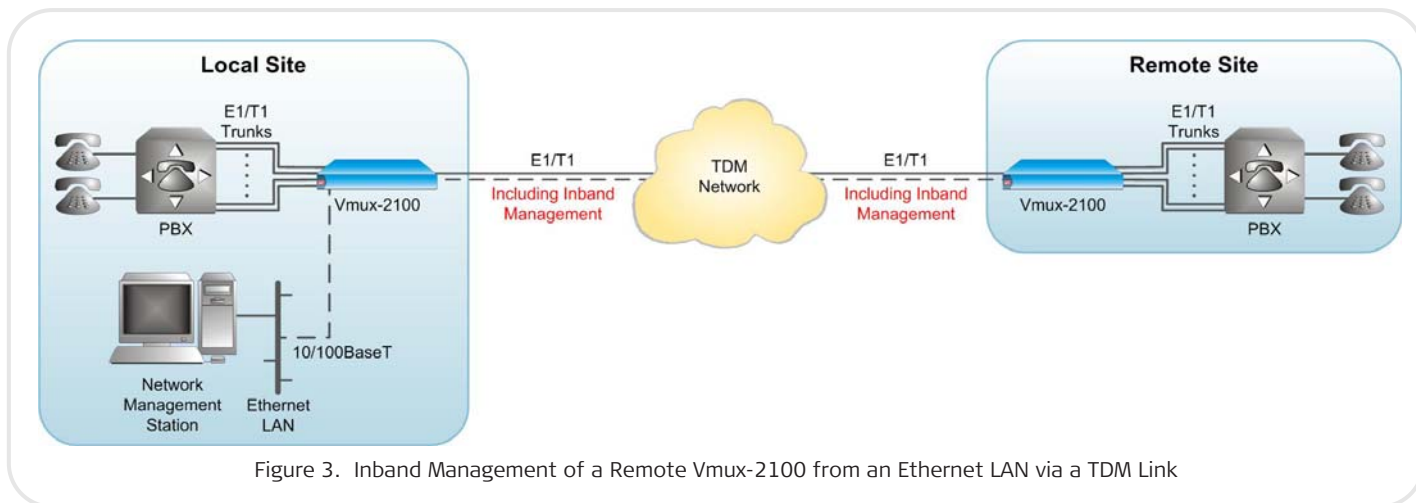
Since Vmux-2100 internal control unit has its own IP address, the Ethernet port can also be used for connecting to management systems running over Ethernet networks. Management systems connected to one unit's Ethernet port can also manage a remote unit, inband (see *Figure 3*).

The LAN traffic connected to the Ethernet port can be inhibited to prevent LAN data bursts from monopolizing the TDM link bandwidth and disrupting voice traffic. This ensures that the link bandwidth will be utilized for voice (and optionally management) traffic only.

For system security, Vmux-2100 provides four different levels of users: Monitor, Technician, Operator and Administrator. Up to 20 different usernames with passwords can be defined.

### DIAGNOSTICS

Vmux-2100 supports local (internal) and remote (external) loopback activation on E1/T1 links. The user can also perform tone injection towards the local PBX. In addition, a ping utility is included to confirm IP connectivity to remote units.



## Specifications

### MAIN MODULE – ETHERNET PORTS

**Note:** The Main module includes a single Ethernet port by default. A redundant pair of E1, T1 or Serial links can be added as an option.

#### Number of ports

1

#### Standards

IEEE 802.3, 802.3u, Ethernet, 802.1D&Q

#### Data Rate

10 or 100 Mbps, half duplex or full duplex, autonegotiation

#### Statistics

According to RFC 2819, RMON-MIB

#### Copper UTP Interface

Range: up to 100m (330 ft) on UTP Cat.5 cable

Connector: RJ-45

#### Indicators

ACT (green) – blinks when traffic is detected over the Ethernet line

LINK (green) – ON when Ethernet line is OK

### MAIN MODULE – E1 LINK

#### Number of Ports

2 (one active, other for backup or two active)

#### Connectors (per port)

RJ-45 balanced/unbalanced (automatic detection)

**Note:** CBL-RJ45/2BNC/E1 adapter cable is available for converting each Main module E1 port RJ-45 connector into a pair of BNC connectors for unbalanced coax interface (see Ordering).

### MAIN MODULE – T1 LINK

#### Number of Ports

2 (one active, other for backup or two active)

#### Statistics

Full statistical diagnostics capability according to ANSI T1.403-1989  
Local support of ESF diagnostics according to AT&T PUB 54016

**Note:** Additional E1/T1 interface specifications that are applicable to main links and voice ports and ports are listed below.

### MAIN MODULE – SERIAL LINK

#### Number of Ports

2 (one active, other for backup)

#### Data Rate

n x 64 kbps, up to 2048 kbps

#### Clock Modes

DCE: Vmux-2100 provides clock to connected equipment

DTE: Vmux-2100 accepts clock from connected equipment

#### Interface

Selectable for V.35, X.21, RS-530, RS-530A, V.36/RS-449, or RS-232

#### Connector

Both ports terminate in a single 50-pin SCSI connector

**Note:** A Y-cable can be ordered for splitting the serial links' single 50-pin SCSI connector into two separate channels with standard V.35, X.21 or RS-530 connectors (see Ordering).

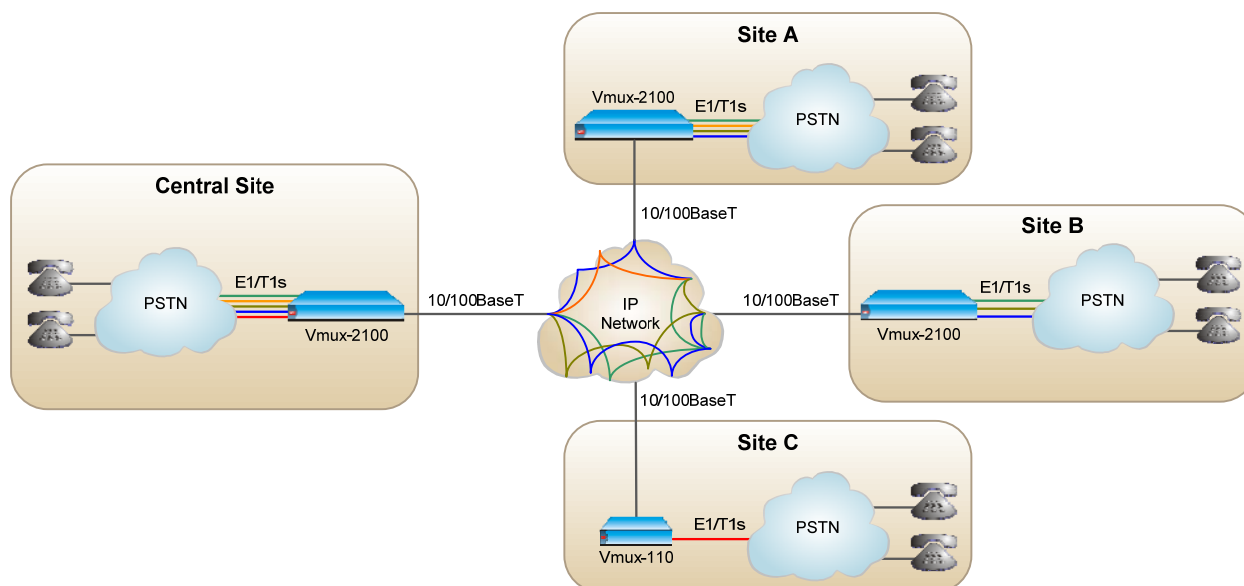


Figure 5. Voice Trunking over IP in an Anv-to-Anv Point Topology

## Vmux-2100

### Modular Voice Trunking Gateway

#### VOICE COMPRESSION MODULES

##### Compression Algorithms

G.723.1 (5.3 or 6.4 kbps)  
G.729A (8 kbps)  
G.711 (A-law or  $\mu$ -law)

##### Silence Suppression

G.723.1A, G.729B

##### Echo Cancellation

32 msec per channel as per G.168

##### Fax Relay

Group III, 4.8, 9.6, 14.4 kbps

##### Modem Relay

V.22/V.22 bis  
V.32/V.32 bis  
V.34 up to 21.6 kbps

##### Voice Band Data

Transparent support for modems and faxes

##### Signaling Support

Transparent CAS, including R2 and E&M  
Transparent CCS, including ISDN, QSIG and SS7  
Clear channel

##### MF Signaling Support

DTMF, MFR2, MFC detection, generation and relay

##### Ports per Module

*(according to ordering)*

E1 Port Modules:

- 2 (62 channels max) or
- 4 (124 channels max)

T1 Port Modules:

- 2 (48 channels max) or
- 4 (96 channels max)

#### E1 INTERFACES

##### 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:  $\pm 3V$  ( $\pm 10\%$ )  
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): Local Sync Loss on port  
REM (red): Remote Sync Loss on port

##### Connectors (per port)

RJ-45 for balanced interface

#### T1 INTERFACES

##### 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): Local Sync Loss (Red Alarm) on port  
YEL (yellow): Remote Sync Loss (Yellow Alarm) on port

##### Connectors (per port)

RJ-45

#### CONTROL PORT

Located on the Main module, for direct connection to terminal.

##### Standards

RS-232/V.24 (DCE)

##### Data Rate

9.6, 19.2, 38.4, 57.6, or 115.2 kbps

##### Connector

DB-9, female

#### DIAGNOSTICS

##### Main Links

IP Diagnostics:

- Performance monitoring
- LAN statistics
- Pings

E1/T1 Diagnostics: local and remote loopbacks

##### Voice Compression Ports

Local and remote loopback per E1/T1 channel

Tone injection towards local side:

- Per timeslot
- Per entire E1/T1 channel
- On all E1/T1 channels simultaneously

**INDICATORS**

**E1/T1 Alarms (per port)**

- LOS – Loss of Signal
- LOF – Loss of Frame
- AIS – Alarm Indication Signal
- RAI – Remote Alarm Indication
- LOMF (E1 only) – Loss of Multiframe
- LCV – Line Code Violation

**Front Panel Indicators**

TST (yellow):

- On when test is running
- Flashes when Sync loss is detected on the TDM uplink (if TDM Line Check feature is enabled)

ALM (red): alarm is present in system

PWR 1 (green): On when Power Supply Module 1 is providing power

PWR 2 (green): On when Power Supply Module 2 is providing power

PWR 2 (green): On when Power Supply Module 2 is providing power

PWR 2 (green): On when Power Supply Module 2 is providing power

**Rear Panel Indicators**

LINK (green): On when the link is active

ACT (yellow): Blinks during LAN traffic activity

**GENERAL**

**Power**

Input (*according to ordering*):

AC: 100 to 240 VAC, 50/60 Hz

48: -48 (-36 to -72) VDC

24: 24 (20 to 36) VDC

Output (per PS module):

3.3 VDC: up to 15A

5 VDC: up to 5A

Total: 60W

**Note:** Two hot-swappable power supply modules can be installed for redundancy

**Physical**

Height: 4.3 cm (1.7 in)

Width: 43.5 cm (17.1 in)

Depth: 24.0 cm (9.5 in)

Weight: 7.0 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

Table 1. Vmux/Gmux Family Comparison

Feature	Vmux-2100 (Ver. 4.1)	Vmux-110 (Ver. 4.1)	Vmux-210 (Ver. 1.1)	Vmux-2120 (Ver. 1.0)	Gmux-2000 (Ver. 3.6)
					
Maximum compression ratio	16:1	16:1	16:1	16:1	16:1
Maximum number of compressed voice channels	496/384	30	30	496/384	3,472
Voice Interface	E1/T1	E1/T1/FXS/FXO/E&M	FXS	E1/T1	E1/T1/STM-1/OC-3
Network Interface	E1/T1, Fast Ethernet	E1/T1, Serial, Fast Ethernet	E1/T1, Serial, Fast Ethernet	E1/T1, Fast Ethernet	E1/T1/STM-1/OC-3, GbE, GbE/2
Signaling	Any	Any	CAS only	Any	Any
Fax/Modem/DTMF Relay	✓	✓	✓	✓	✓
Management	ASCII terminal, Telnet, RADview-SC/Vmux	ASCII terminal, Telnet, RADview-SC/Vmux	ASCII terminal, Telnet, RADview-SC/Vmux	ASCII terminal, Telnet, RADview-SC/Vmux	ASCII terminal, Telnet, RADview-SC/Vmux

## Vmux-2100

### Modular Voice Trunking Gateway

## Ordering

### Vmux-2100/\*/\$

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

#### Legend

- \* Power supply type:
  - AC 100 to 240 VAC
  - 48 -36 to -72 VDC
- \$ Redundant power supply:
  - R Redundant power supply (of same type)

## MODULES

### VMUX-M/M-ETH-#

Main Module with a single Ethernet port by default, and optional redundant E1, T1 or serial links.

#### Legend

# Optional redundant TDM link type:

E1 E1  
T1 T1

### VMUX-M/VCA-£/%

Enhanced Voice Compression Module

#### Legend

£ TDM interface type:

E1 E1  
T1 T1

% Number of E1/T1 ports:

2 2  
4 4

### VMUX-2100-PS/\*

Power Supply Module

## SUPPLIED ACCESSORIES

AC power cord (when AC power supply is ordered)

DC adapter plug (when DC power supply is ordered)

### VMUX/RM

Hardware kit for mounting one Vmux-2100 unit into both 19-inch and ETSI racks

## OPTIONAL ACCESSORIES

### CBL-DB9F-DB9M-STR

Control port cable

### CBL-RJ45/2BNC/E1

Interface adapter cable for converting one Main module E1 port RJ-45 connector into a pair of BNC connectors for unbalanced coax interface

**Note:** For E1 Voice Modules conversion to unbalanced 75Ω interfaces must be performed externally (e.g., using RAD's BE-1 converter).

### RM-VMUX-2100/23

Hardware kit for mounting one Vmux-2100 unit into a 23-inch rack

**International Headquarters**  
24 Raoul Wallenberg Street  
Tel Aviv 69719, Israel  
Tel. 972-3-6458181  
Fax 972-3-6498250, 6474436  
E-mail [market@rad.com](mailto:market@rad.com)



12 avenue des prés  
78059 St Quentin en Yvelines  
Tel: 33 (0)1 77 55 03 00  
Fax: 33 (0)1 30 44 11 95  
E-mail: [sales@cbnetworks.fr](mailto:sales@cbnetworks.fr)



**data communications**  
The Access Company