MOTOROLA

T1/Voice Circuit Replacement
Applications Overview

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MOTOROLA CANOPY/RAD DATA COMMUNICATIONS

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THE INTENT OF THIS GUIDE

The purpose of this document is to provide the dealer/customer with suggestions/ recommendations with regards to potential T1/Voice circuit replacement applications utilizing Canopy and RAD products. This document is not meant to replace any dealer/customer provided system design or on-site work effort (such as site and path drive surveys - which would be a necessary component of any successful installation). Please refer to the Canopy and RAD product manuals and user guides (which can be found on the http:// motorola.canopywireless.com and www.radusa.com Web sites) and/or for more detailed explanations with regards to the Canopy and RAD product settings/configurations noted in this document.

NOTE

RAD product configuration guides are available through the RPSD presales engineering group.

WHAT THE READER SHOULD KNOW

- The person reviewing and/or implementing the applications noted in this document has a basic understanding of Ethernet (i.e. has at a minimum reviewed the IP-101 Networking Basics document).

- The person reviewing and/or implementing the applications noted in this document has a basic understanding of Canopy products and has attended Canopy product training.

- The person reviewing and/or implementing the applications noted in this document has a basic understanding of tower hardware and electrical requirements (i.e. the specifications noted in the R56 manual - http://R56.mot.com).

- The person reviewing and/or implementing the applications noted in this document has a basic understanding of the actual bandwidth throughput available through the various Canopy AP, SM, and BH products, i.e. that any/all single frequency radios operate in a half duplex mode – minus any overhead required between the pair of radios (subtract 30% from the aggregate Ethernet throughput for overhead – and then divide by the remaining bandwidth by 2 to derive the actual bi-directional full duplex Ethernet throughput).

- That all of the Canopy units/products noted in this document have been upgraded to the latest firmware revisions (as noted on the http://motorola.canopywireless.com/support_software.php Web site).

- Canopy product requirements for use with the RAD product line:

  - IPmux and Megaplex products require a backhaul link between locations.

  - VMUX products will work with any of the Canopy products (i.e. the backhaul or AP/SM products) as wireless Ethernet connections/links between locations.

- The DTE devices attached to the RAD components at either end of the link can handle/accept a link latency greater than 20ms (milli-seconds).

- Reflector units are used on any/all backhaul links, regardless of the length of the transmission path, for optimum link efficiency and throughput.

> **NOTE**
>
> RAD Product Configuration guides are available. Please contact the Site Equipment Team (sitequip@motorola.com) for further information.
>
> Some of the drawings and/or information contained in this presentation were provided by RAD Data Communications – www.radusa.com.

TELEPHONY AND TDM OVER IP BASIC

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TELEPHONY BASICS

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FIGURE 1-1 A TELEPHONE LINE OR PBX EXTENSION CIRCUIT

TABLE 1-1 TELEPHONY BASICS

Item	Description
POTS	Plain Old Telephone System
POTS Lines	Business Lines
Business Lines	The telephone line into your residence
"TIP and Ring"	The red and green wires used in a normal "POTS" line telephone connection.
E&M voice circuit - Older technology, "Ear and Mouth"	Simulates the operation of a 4 wire voice grade data circuit (full duplex voice/audio operation - 2 wires transmit and 2 wires receive). Solid State E&M leads can be made to toggle to possible use with a low voltage relay to provide a contact closure.

TABLE 1-1 TELEPHONY BASICS

Item	Description
FXS Voice Interface - "acts like a telephone line"	Outputs dial tone and ring voltage.
	FXS (Foreign eXchange Subscriber Interface (i.e. "RJ-11 plug on the wall") delivers POTS service from the local phone company's Central Office (CO) and must be connected to subscriber equipment (telephones, modems, and fax machines). In other words an FXS interface points to the subscriber. An FXS interface provides the following primary services to a subscriber device:Dial Tone)
	• Battery Current • Ring Voltage
FXO Voice Interface - "acts like a telephone"	Performs "hook switch"/ off hook /"Tip and Ring " loop start line activation (and provides audio input/output interfaces).
	FXO - Foreign eXchange Office interface (the plug on the phone) receives POTS services, typically from a Central Office of the Public Switched Telephone Network (PSTN). In other words, a FXO interface points to the Telco office. An FXO interface provides the following primary service to the Telco network device:
	• On-hook/off-hook indication (loop closure)
Loop start - "hook switch"/ off hook /"Tip and Ring short"	Provides line activation signaling to the PBX voice switch (normal POTS Business line activation scheme) by shorting the Tip and Ring (red and green) wires together momentarily.
Ground start - "hook switch"/ off hook /"Tip" short to ground	Provides line activation signaling to the PBX/Voice switch (normal Pay Phone line activation scheme).

TDM OVER IP

- Protocol for extending circuits over IP / Ethernet networks

- Transparent to circuit's protocols and signaling

- Good for voice, data and video over IP

  - Simpler and less expensive than VoIP and ATM

  - Supports legacy PBX - including proprietary features

  - Beats VoIP with lower latency and higher quality voice

- TDMoIP technology provides circuit extension over IP

- It tunnels (or extends) layer 1 traffic over layer 3 (IP) networks

- What does tunneling leased lines mean to us?

  - No fork lift upgrades necessary

  - All PBX and Centrex features (Call conferencing, call forwarding, caller id…) are maintained

  - Structured and unstructured T1, E1, and analog telephones are supported

- Allows for the integration of voice and data without the inherent dangers and cost of a completely new phone system

RAD TDM OVER IP VOICE TRANSPORT PRODUCTS

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TDMoIP Gateways

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Figure 2-1 TDMoIP Gateways

MP2100/MP2104 with ML-IP:
•IP Channel bank
•Ethernet switch with UTP & Fiber
•50 I/O modules for voice, fax and data
•Ring, star and daisy-chain topologies

RADview:
• SNMP-based Network Management
• Java-based Service Center application
  utilizing CORBA API's.
•"Point-and-click" provisioning
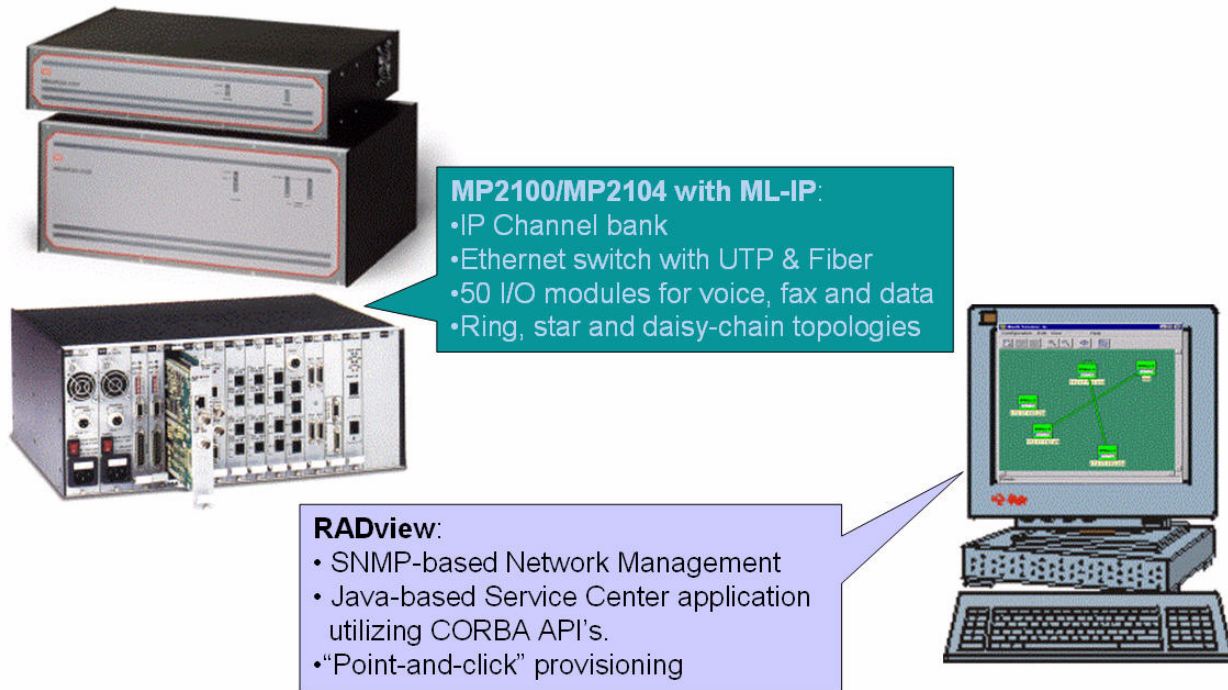
IPMUX-1 / 1E

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INTERFACES

- IPmux-1: Single E1/T1 (balanced/unbalanced)
- IPmux-1E: 4 FXS, FXO, E&M or BRI
- Optical or UTP Ethernet Network uplink
- Optional user Ethernet port with rate limiting and VLAN support
- Optional External clock port

ADVANCED FEATURES

- Optional Internal Echo Canceller (IPmux-1/1E)
- Bundle redundancy
- Dynamic Bandwidth Allocation (CAS only)
- DHCP client support
- Packets Re-ordering capability
- SNMP Management

FIGURE 2-2 IPMUX-1 / 1E

IPMUX-11

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PHYSICAL INTERFACES

- Ports 1, 2 support UTP 10/100BaseT, MM Fiber 100BaseFx, SM Fiber 100BaseFx
- Port 3 always UTP
- External clock port

FUNCTIONALITY

- Port 1 - Network port
- Port 2 - Network (phase 2) or User port
- Port 3 - User port

USER PORTS SUPPORT

- Rate limiting
- VLAN membership
- Double VLAN (VLAN stacking)

FIGURE 2-3 IPMUX-11 – BACK PANEL VIEW
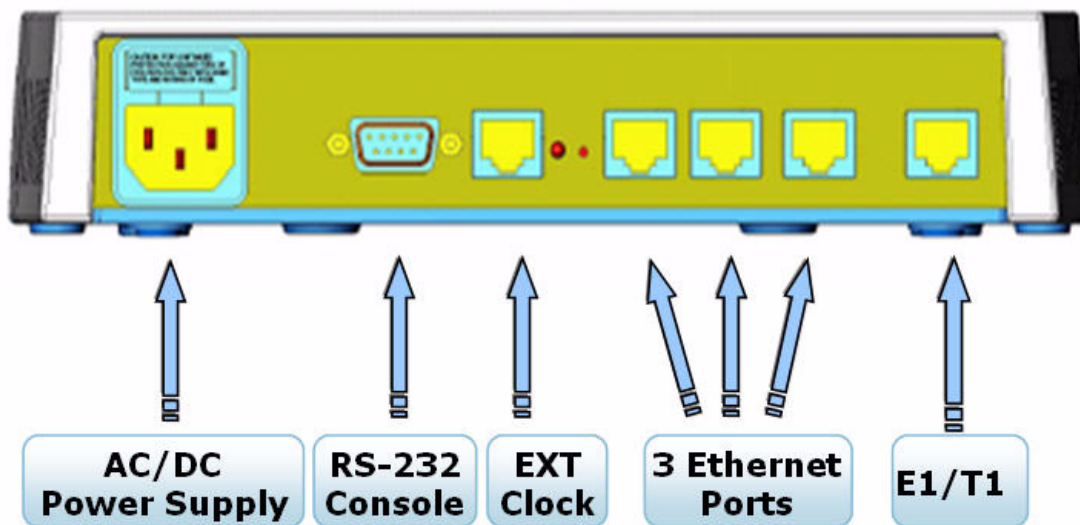
IPMUX-14

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- Based on RAD TDMoIP ASIC

- Four E1/T1 port + 3 LAN ports (Two fiber/copper and one copper)

- Enhanced layer 2 traffic engineering as in IPmux-11

- Multi-bundling support in phase 2

FIGURE 2-4 IPMUX-14 – BACK PANEL VIEW
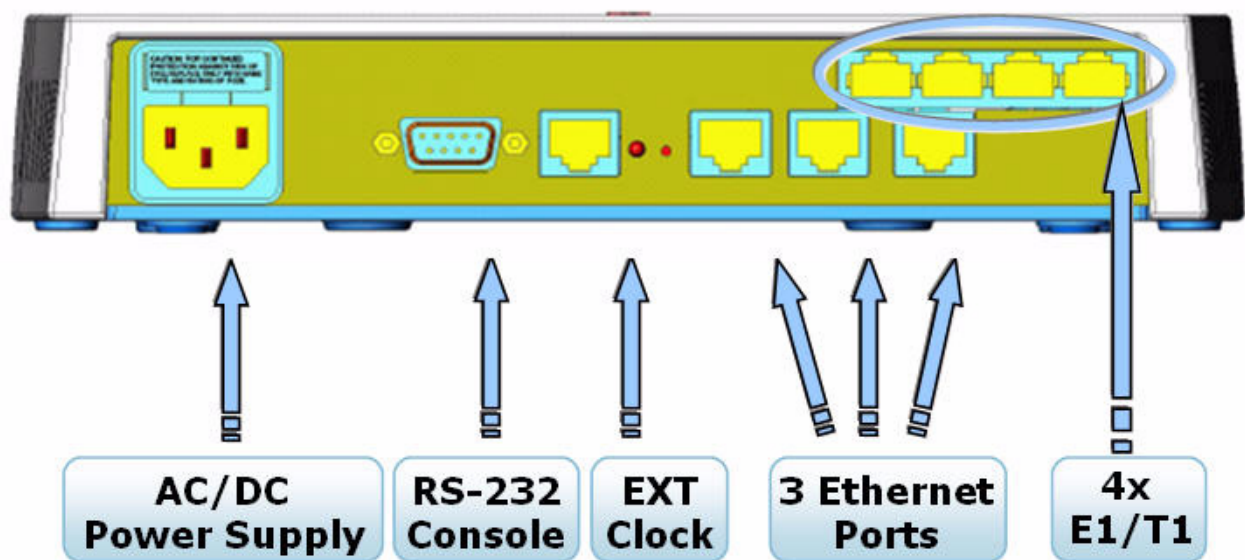
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CANOPY/RAD PRODUCT APPLICATIONS

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The following information in this chapter discuss various applications for the RAD and Canopy products which have been designed and/or installed by RSPD dealers and customers. Please use these applications as guidelines and/or examples when discussing possible variations on these applications with your customers.

> **NOTE**
>
> RAD Product Configuration guides are available. Please contact the Site Equipment Team (Sitequip@motorola.com) for further information. Some of the drawings and/ or information contained in document were provided by RAD Data Communications - www.radusa.com.

POINT-TO-POINT SOLUTIONS FOR EXTENDING LAN AND T1/E1/VOICE MULTIPLE MEDIA TYPES

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FIGURE 3-1 LAN AND T1/E1/VOICE MULTIPLE MEDIA TYPES
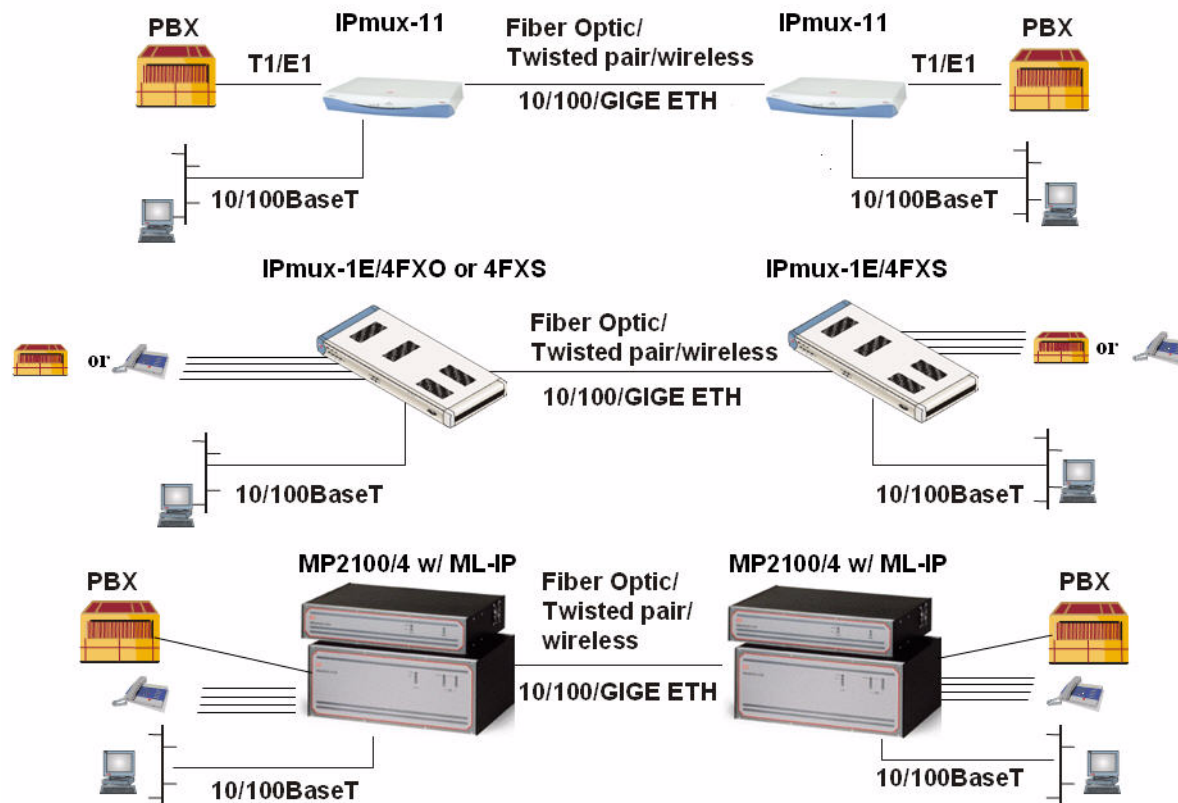
LAN AND SINGLE T1/E1/VOICE EXTENSION USING CANOPY BACKHAUL RADIOS

FIGURE 3-2 LAN AND SINGLE T1/E1/VOICE EXTENSION USING CANOPY BACKHAUL RADIOS
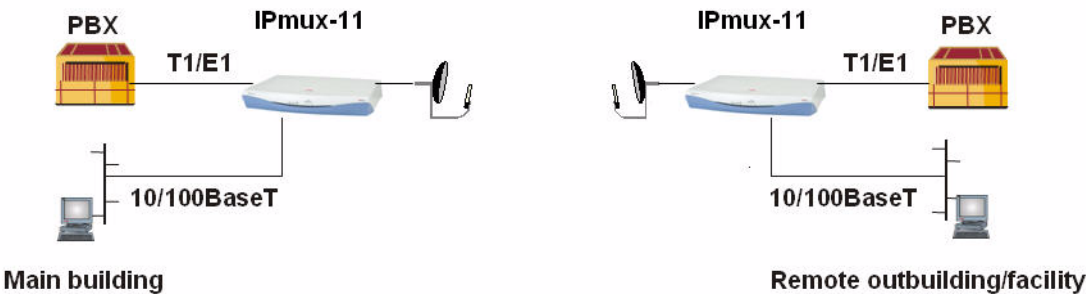
LAN & SINGLE T1/E1/VOICE EXTENSION USING CANOPY BACKHAUL RADIOS PARTS LISTING

TABLE 3-1 LAN AND SINGLE T1/E1/VOICE EXTENSION USING CANOPY BACKHAUL RADIOS PARTS LISTING

Item	Description	RPSD Part No	Qty
	MAIN SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 1 - T1 port, 1 - 10/100BT Ethernet WAN port, 2 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch, and 115 VAC Power Supply)	RRDN5122A	1
	REMOTE SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 1 - T1 port, 1 - 10/100BT Ethernet WAN port, 2 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch, and 115 VAC Power Supply)	RRDN5122A	1

LAN AND PBX/TELCO (POTS) ANALOG VOICE EXTENSION USING CANOPY BACKHAUL RADIOS

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FIGURE 3-3 IPMUX-1E/4FXO AND IPMUX-1E/4FXS
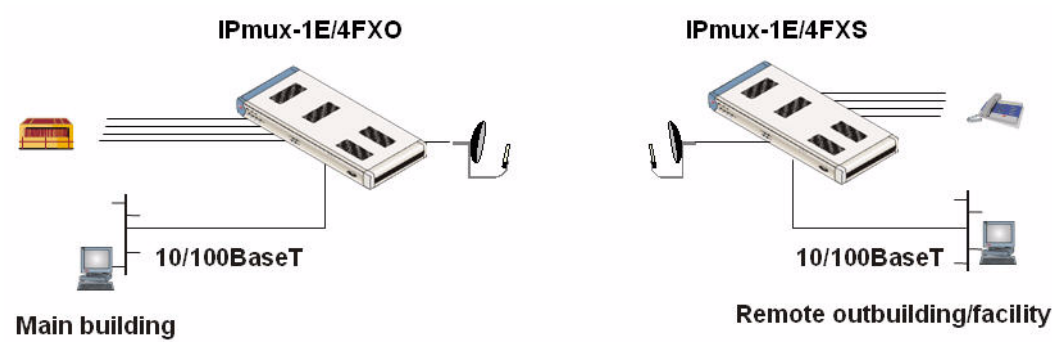
LAN AND PBX/TELCO (POTS) ANALOG VOICE EXTENSION USING CANOPY BACKHAUL RADIOS (UP TO 4 PORTS/VOICE CHANNELS) PARTS LISTING

TABLE 3-2 LAN AND PBX/TELCO (POTS) ANALOG VOICE EXTENSION PARTS LISTING

Item	Description	RPSD Part No	Qty
	MAIN SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 4 - FXO ports, 1 - 10/100BT Ethernet WAN port, 1 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN4425A	1
	REMOTE SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1

TABLE 3-2 LAN AND PBX/TELCO (POTS) ANALOG VOICE EXTENSION PARTS LISTING

Item	Description	RPSD Part No	Qty
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 4 - FXS ports, 1 - 10/100BT Ethernet WAN port, 1 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN4424A	1

LAN and PBX/Telco Analog Voice Extension/ "Ring Down Circuit" Using Canopy Backhaul Radios

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Figure 3-4 IPmux-1E/4FXS

LAN and PBX/Telco Analog Line Voice Extension/"Ring Down Circuit" Using Canopy Backhaul Radios (up to 4 Ports/Voice Channels) Parts Listing

Table 3-3 LAN and PBX/Telco Analog Line Voice Extension/"Ring Down Circuit" Parts Listing
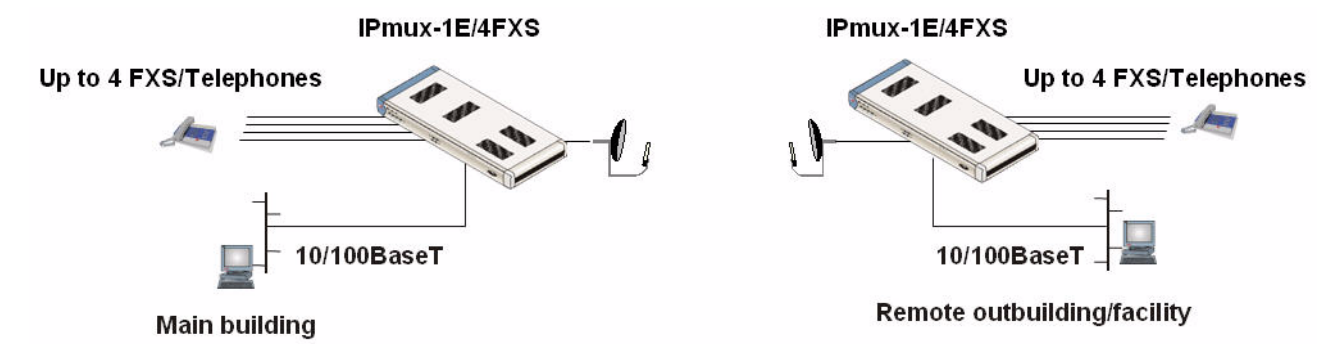
Item	Description	RPSD Part No	Qty
	MAIN SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 4 - FXS ports, 1 - 10/100BT Ethernet WAN port, 1 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN4424A	1
	REMOTE SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1

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TABLE 3-3 LAN AND PBX/TELCO ANALOG LINE VOICE EXTENSION/"RING DOWN CIRCUIT" PARTS LISTING

Item	Description	RPSD Part No	Qty
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 4 - FXS ports, 1 - 10/100BT Ethernet WAN port, 1 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN4424A	1

LAN AND PBX/TELCO (POTS) ANALOG VOICE LINE/CIRCUIT EXTENSION USING CANOPY BACKHAULS

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FIGURE 3-5 LAN & PBX/TELCO (POTS) ANALOG VOICE LINE/CIRCUIT EXTENSION
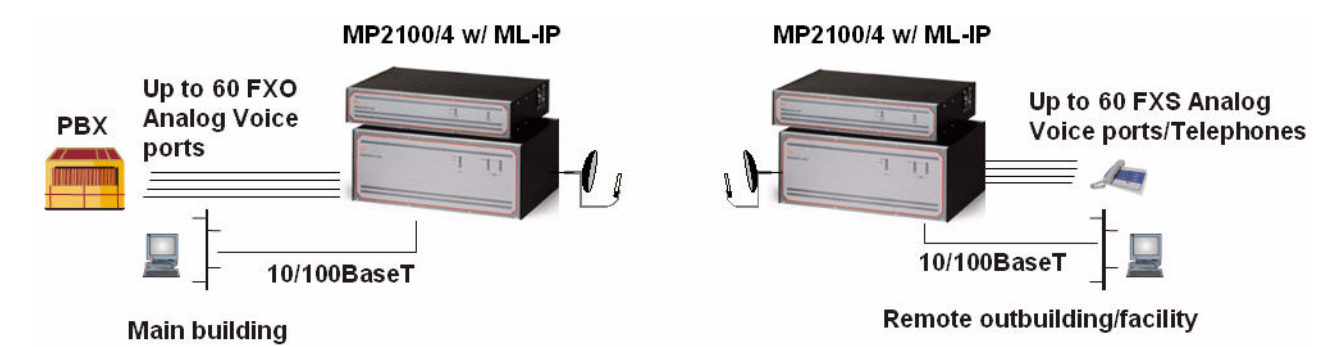
LAN AND PBX/TELCO (POTS) ANALOG VOICE LINE/CIRCUIT EXTENSION USING CANOPY BACKHAULS (24 PORTS/CHANNELS) PARTS LISTING

TABLE 3-4 LAN AND PBX/TELCO (POTS) ANALOG VOICE line/CIRCUIT EXTENSION PARTS LISTING

Item	Description	RPSD Part No	Qty
	MAIN SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: 5 slot chassis w/ 115 VAC Power Supply	RDN9991A	1
5	Ethernet Main link module with 1 10/100BT Ethernet WAN port and 1 - 10/100BT Ethernet User port (i.e. with a built in Ethernet Switch)	RRDN4411A	1
6	6 Port FXO voice module	RRDN4052A	1
	REMOTE SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1

TABLE 3-4 LAN AND PBX/TELCO (POTS) ANALOG VOICE LINE/CIRCUIT EXTENSION PARTS LISTING

Item	Description	RPSD Part No	Qty
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: 5 slot chassis w/ 115 VAC Power Supply and built-in Ringer (for FXS modules)	RRDN5238A	1
5	Ethernet Main link module with 1 10/100BT Ethernet WAN port and 1 - 10/100BT Ethernet User port (i.e. with a built in Ethernet Switch)	RRDN4411A	1
6	6 Port FXS voice module	RRDN4032A	1

ANALOG 2/4 (E&M) WIRE VOICE LINE/ CIRCUIT EXTENSION USING 2 SEPARATE CANOPY BACKHAUL LINKS

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FIGURE 3-6 ANALOG 2/4 (E&M) WIRE VOICE LINE/CIRCUIT EXTENSION

> **NOTE**
>
> Dual IP Main Link, Dual Power Supplies, and Dual Canopy Radio links (i.e. - 2 different frequency bands) provides your customer with redundant power and redundant main links - with an automatic switchover between links in the event of a primary link failure (24 E&M voice ports/channels).

ANALOG 2/4 WIRE (E&M) VOICE LINE/CIRCUIT EXTENSION USING CANOPY BACKHAULS (24 PORTS/CHANNELS) PARTS LISTING

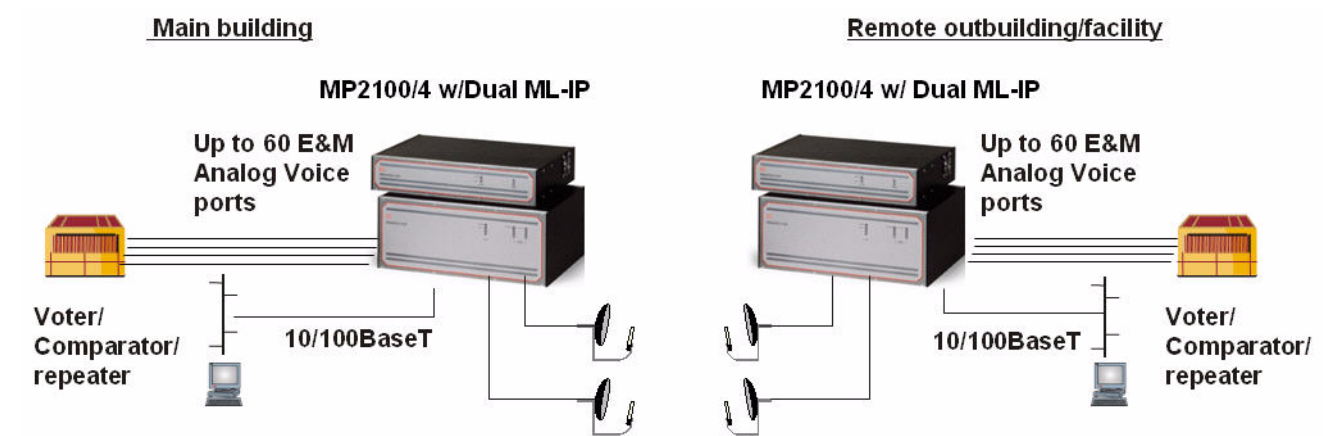**TABLE 3-5** ANALOG 2/4 WIRE (E&M) VOICE LINE/CIRCUIT EXTENSION – PARTS LISTING

Item	Description	RPSD Part No	Qty
	MAIN SITE - EQUIPMENT LIST		
1	5.2 GHz, Extended Range 10 Mbps Backhaul Radio (BH) w/ 110 VAC Power Supply & Reflector Kit	HK1085A	1
2	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1

TABLE 3-5 ANALOG 2/4 WIRE (E&M) VOICE LINE/CIRCUIT EXTENSION – PARTS LISTING

Item	Description	RPSD Part No	Qty
4	TDM over IP voice multiplexer: 12 slot chassis w/Redundant 115 VAC Power Supplies and Common Logic modules	RRDN4412A	1
5	Ethernet Main link module with 1 10/100BT Ethernet WAN port and 1 - 10/100BT Ethernet User port (i.e. with a built in Ethernet Switch)	RRDN4411A	1
6	6 Port E&M voice module (requires 1 CBL-VC16 cable per module)	RDN9956A	1
7	Octopus Cable for Megaplex E&M module - 50 pin Telco to 6 RJ45	RRDN4082A	1
	REMOTE SITE - EQUIPMENT LIST		
1	5.2 GHz, Extended Range 10 Mbps Backhaul Radio (BH) w/ 110 VAC Power Supply & Reflector Kit	HK1085A	1
2	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: 12 slot chassis w/Redundant 115 VAC Power Supplies and Common Logic modules	RRDN4412A	1
5	Ethernet Main link module with 1 10/100BT Ethernet WAN port and 1 - 10/100BT Ethernet User port (i.e. with a built in Ethernet Switch)	RRDN4411A	1
6	6 Port E&M voice module (requires 1 CBL-VC16 cable per module)	RDN9956A	1
7	Octopus Cable for Megaplex E&M module - 50 pin Telco to 6 RJ45	RRDN4082A	1

LAN and PBX-T1/T1 Land Line to Analog Voice Line/Circuit Extension

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Figure 3-7 LAN and PBX-T1/T1 Land Line to Analog Voice Line/Circuit
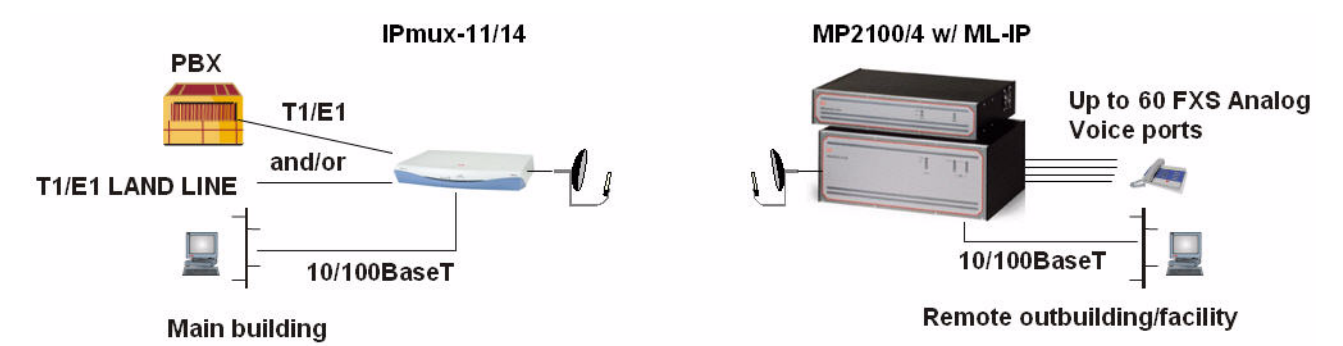
LAN & PBX-T1/T1 Land Line to Analog Voice Line/Circuit Extension Using Canopy Backhauls – 24 Ports/Channels Parts Listing

Table 3-6 LAN & PBX-T1/T1 Land Line to Analog Voice Line/Circuit Extension Parts Listing

Item	Description	RPSD Part No	Qty
	MAIN SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 1 - T1 port, 1 - 10/100BT Ethernet WAN port, 2 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch, and 115 VAC Power Supply)	RRDN5122A	1
	REMOTE SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1

TABLE 3-6 LAN & PBX-T1/T1 LAND LINE TO ANALOG VOICE LINE/CIRCUIT EXTENSION PARTS LISTING

Item	Description	RPSD Part No	Qty
4	TDM over IP voice multiplexer: Megaplex 5 slot chassis w/ 115 VAC Power Supply and built-in Ringer (for FXS modules)	RRDN5238A	1
5	Ethernet Main link module with 1 10/100BT Ethernet WAN port and 1 - 10/100BT Ethernet User port (i.e. with a built in Ethernet Switch)	RRDN4411A	1
6	6 Port FXS voice module	RRDN4032A	1

T1 CIRCUIT EXTENSION USING CANOPY RADIOS

FIGURE 3-8 T1 CIRCUIT EXTENSION USING CANOPY RADIOS
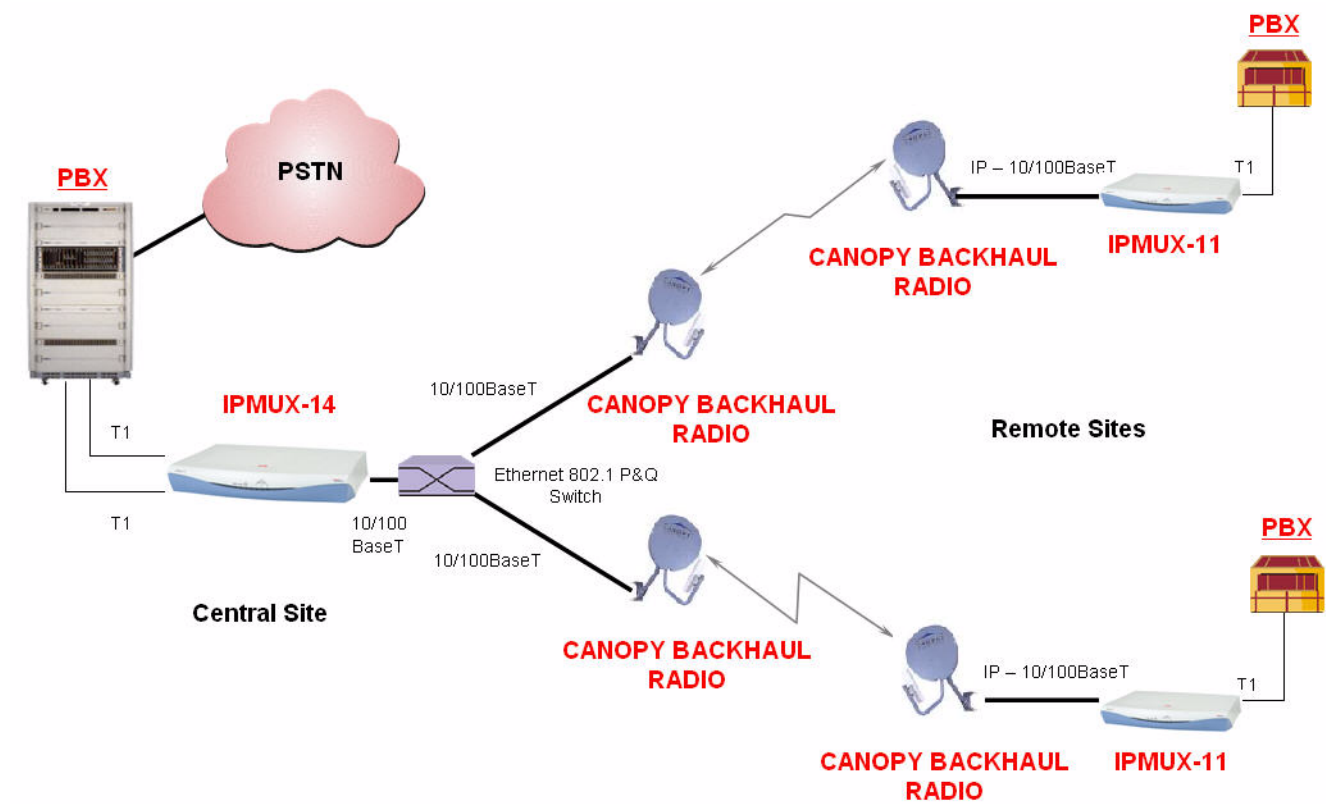
T1 CIRCUIT EXTENSION USING CANOPY RADIOS PARTS LISTING

TABLE 3-7 T1 CIRCUIT EXTENSION USING CANOPY RADIOS – PARTS LISTING

Item	Description	RPSD Part No	Qty
	MAIN SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	CMM Micro - Cluster Management Module w/ 110VAC Power Supply. Requires GPS Antenna microfilter/surge protector - RDG4059A	RDH4370A	1

3-15

TABLE 3-7 T1 CIRCUIT EXTENSION USING CANOPY RADIOS – PARTS LISTING

Item	Description	RPSD Part No	Qty
4	GPS Antenna microfilter/surge protector	RRX4059A	1
5	8-Port Ethernet & Power Surge Suppressor (NEMA enclosure).	RRDN4115A	1
6	Ethernet Surge Suppressor	RDH4208A	1
7	TDM over IP voice multiplexer: w/ 4 - T1 ports, 1 - 10/100BT Ethernet WAN port, 2 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN5234A	1
	REMOTE SITES - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 1 - T1 port, 1 - 10/100BT Ethernet WAN port, 2 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch, and 115 VAC Power Supply)	RRDN5122A	1

MULTI-SITE T1/ANALOG VOICE CIRCUIT EXTENSION USING CANOPY BACKHAUL RADIOS

FIGURE 3-9 MULTI-SITE T1/ANALOG VOICE CIRCUIT
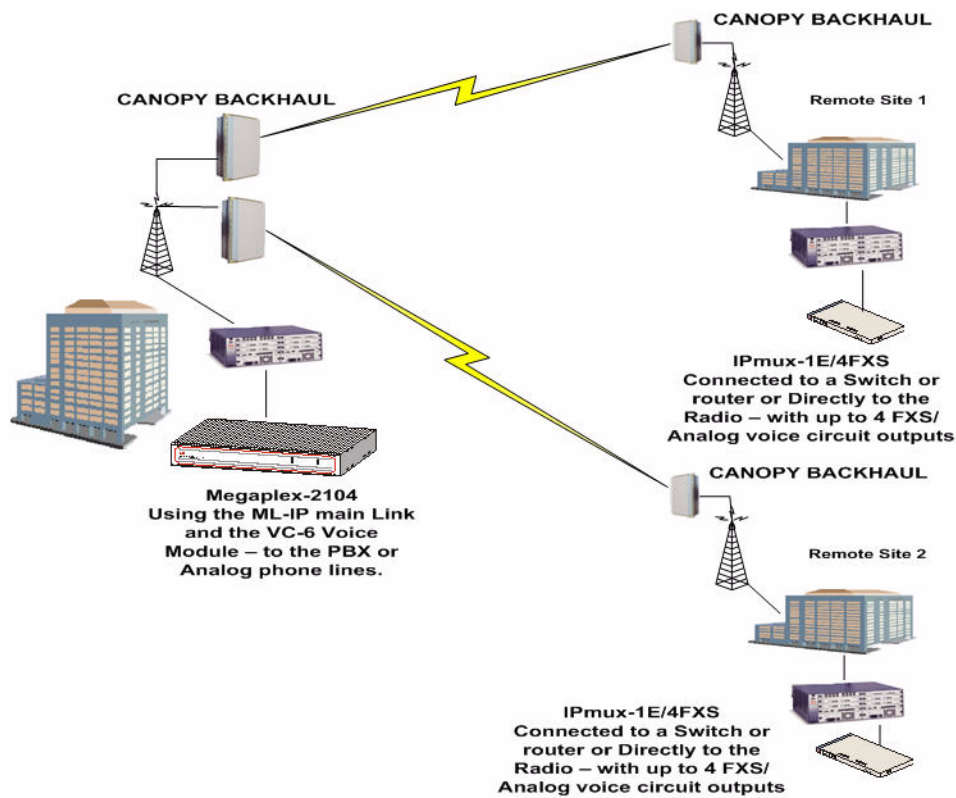
MULTI-SITE T1/ANALOG VOICE CIRCUIT EXTENSION USING CANOPY BACKHAUL RADIOS

TABLE 3-8 MULTI-SITE T1/ANALOG VOICE CIRCUIT EXTENSION USING CANOPY BACKHAUL RADIOS

Item	Description	RPSD Part No	Qty
	MAIN SITE - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1

TABLE 3-8 MULTI-SITE T1/ANALOG VOICE CIRCUIT EXTENSION USING CANOPY BACKHAUL RADIOS

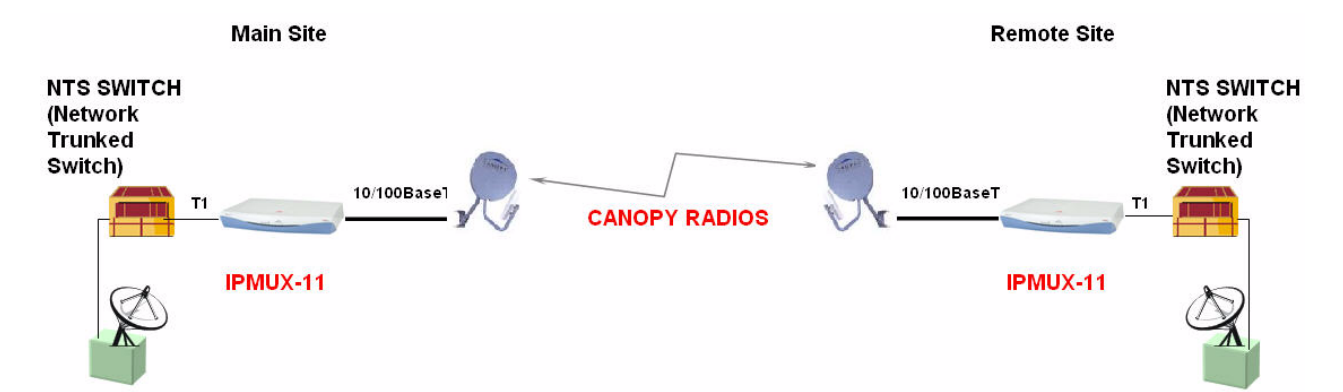| Item	Description	RPSD Part No	Qty
3	CMM Micro - Cluster Management Module w/ 110 VAC Power Supply. Requires GPS Antenna microfilter/surge protector - RDG4059A	RDH4370A	1
4	GPS Antenna microfilter/surge protector	RRX4059A	1
5	8-Port Ethernet & Power Surge Suppressor (NEMA enclosure)	RRDN4115A	1
6	Ethernet Surge Suppressor	RDH4208A	1
7	TDM over IP voice multiplexer: Megaplex 5 slot chassis w/ 115 VAC Power Supply	RDN9991A	1
8	Ethernet Main link module with 1 10/100BT Ethernet WAN port and 1 - 10/100BT Ethernet User port (i.e. with a built in Ethernet Switch)	RRDN4411A	1
9	6 Port FXO voice module	RRDN4052A	1
	REMOTE SITES - EQUIPMENT LIST		
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 4 - FXS ports, 1 - 10/100BT Ethernet WAN port, 1 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN4424A	1

MOTOROLA NTS SWITCH/T1 INTERCONNECT USING CANOPY BACKHAUL RADIOS

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FIGURE 3-10 MOTOROLA NTS SWITCH/T1

MOTOROLA NTS SWITCH/T1 INTERCONNECT USING CANOPY BACKHAUL RADIOS PARTS LISTING

TABLE 3-9 MOTOROLA NTS SWITCH/T1 INTERCONNECT USING CANOPY BACKHAUL RADIOS PARTS LISTING
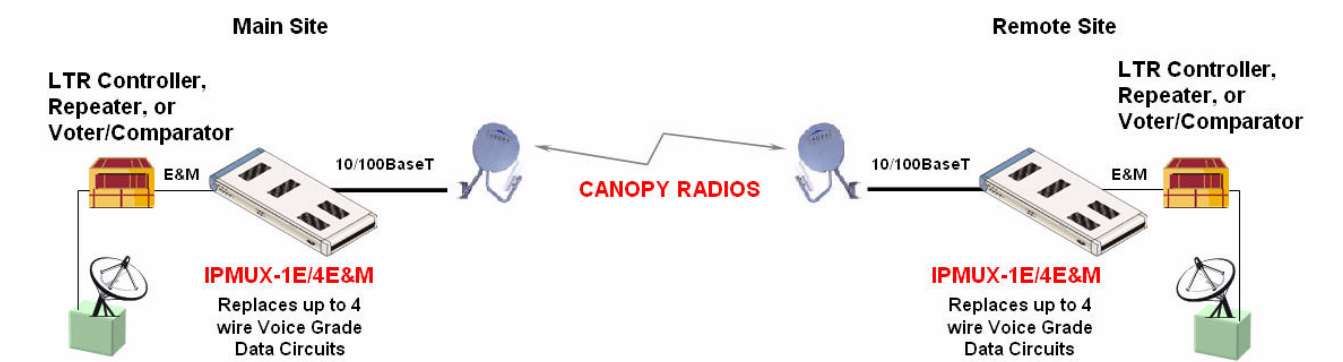
Item	Description	RPSD Part No	Qty
MAIN SITE - EQUIPMENT LIST			
1	5.7 GHz, 10 Mbps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	IPMUX-11/T1/UTP/UTP: w/ 1 - T1 port, 1 - 10/100BT Ethernet WAN port, 2 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch, and 115 VAC Power Supply)	RRDN5122A	1
REMOTE SITE - EQUIPMENT LIST			
1	5.7 Gaze, 10 Maps Backhaul Radio (BH) w/ Reflector Kit & 110 VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1

TABLE 3-9 MOTOROLA NTS SWITCH/T1 INTERCONNECT USING CANOPY BACKHAUL RADIOS PARTS LISTING

Item	Description	RPSD Part No	Qty
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	IPMUX-11/T1/UTP/UP: w/ 1 - T1 port, 1 - 10/100BT Ethernet WAN port, 2 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch, and 115 VAC Power Supply)	RRDN5122A	1

MOTOROLA BASE STATION/REPEATER/ COMPARATOR INTERCONNECT USING CANOPY BACKHAUL RADIOS

FIGURE 3-11 MOTOROLA BASE STATION/REPEATER/COMPARATOR

MOTOROLA BASE STATION/REPEATER/COMPARATOR INTERCONNECT USING CANOPY BACKHAUL RADIOS PARTS LISTING

**TABLE 3-10** MOTOROLA BASE STATION/REPEATER/COMPARATOR INTERCONNECT PARTS LISTING

Item	Description	RPSD Part No	Toy
	MAIN SITE - EQUIPMENT LIST		
1	5.7 Gaze, 10 Maps Backhaul Radio (BH) w/ Reflector Kit & 110VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 4 - E&M ports, 1 - 10/100BT Ethernet WAN port, 1 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN4426A	1
	REMOTE SITE - EQUIPMENT LIST		
1	5.7 Gaze, 10 Maps Backhaul Radio (BH) w/ Reflector Kit & 110VAC Power Supply	HK1026A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1

TABLE 3-10 MOTOROLA BASE STATION/REPEATER/COMPARATOR INTERCONNECT PARTS LISTING

Item	Description	RPSD Part No	Toy
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP voice multiplexer: w/ 4 - E&M ports, 1 - 10/100BT Ethernet WAN port, 1 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN4426A	1

MULTI-SITE T1/ANALOG VOICE CIRCUIT EXTENSION USING CANOPY AP/SM RADIOS

FIGURE 3-12 MULTI-SITE T1/ANALOG VOICE CIRCUIT EXTENSION
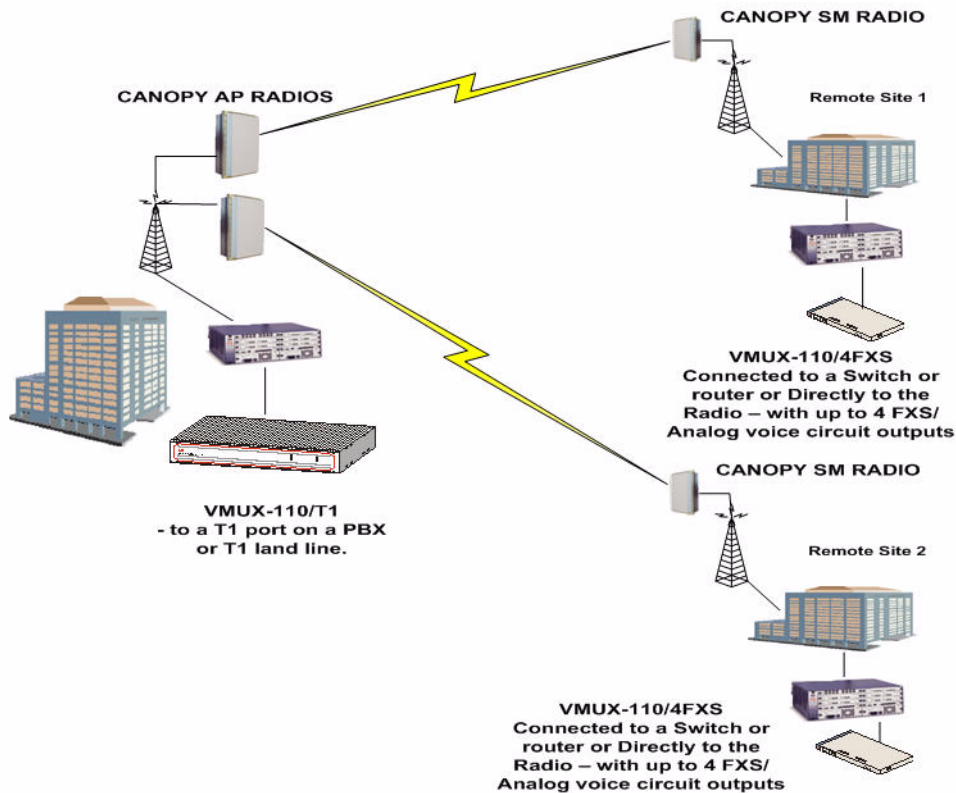
MULTI-SITE T1/ANALOG COMPRESSED VOICE CIRCUIT EXTENSION USING CANOPY AP AND SM RADIOS

TABLE 3-11 MULTI-SITE T1/ANALOG COMPRESSED VOICE CIRCUIT EXTENSION

Item	Description	RPSD Part No	Toy
	MAIN SITE - EQUIPMENT LIST		
1	5.7 Gaze, AP Advantage Access Point (AP) Radio & 110 VAC Power Supply	HK1128A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1

TABLE 3-11 MULTI-SITE T1/ANALOG COMPRESSED VOICE CIRCUIT EXTENSION

| Item	Description	RPSD Part No	Toy
3	CMM Micro - Cluster Management Module w/ 110VAC Power Supply. Requires GPS Antenna microfilter/surge protector - RDG4059A	RDH4370A	1
4	GPS Antenna microfilter/surge protector	RRX4059A	1
5	8-Port Ethernet & Power Surge Suppressor (NEMA enclosure).	RRDN4115A	1
6	Ethernet Surge Suppressor	RDH4208A	1
7	TDM over IP compressed voice multiplexer: with 1 T1 DTE port, 1 10/100BT Ethernet WAN port, and 2 - 10/100BT Ethernet User port (i.e. with a built in Ethernet Switch)	RRDN5236A	1
	REMOTE SITES - EQUIPMENT LIST		
1	5.7 GHz, AP Advantage Subscriber Module (SM) Radio & 110 VAC Power Supply	HK1136A	1
2	Universal Mounting Bracket (optional – may not be required for all applications)	RDN9721A	1
3	Ethernet Surge Suppressor (low RFI sites would require a single surge suppressor unit)	RDH4208A	1
4	TDM over IP compressed voice multiplexer: w/ 4 - FXS ports, 1 - 10/100BT Ethernet WAN port, 1 - 10/100BT User Ethernet port (i.e. with a built in Ethernet Switch), and 115 VAC Power Supply	RRDN5318A	1

SECURE GOVERNMENT / MILITARY NETWORKING OVER CANOPY WIRELESS ETHERNET

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                                                              :

- Extend secure networks over IP infrastructures

- Maintain integrity of T1/E1 encrypted voice and data

- Supports structured and unstructured T1/E1's
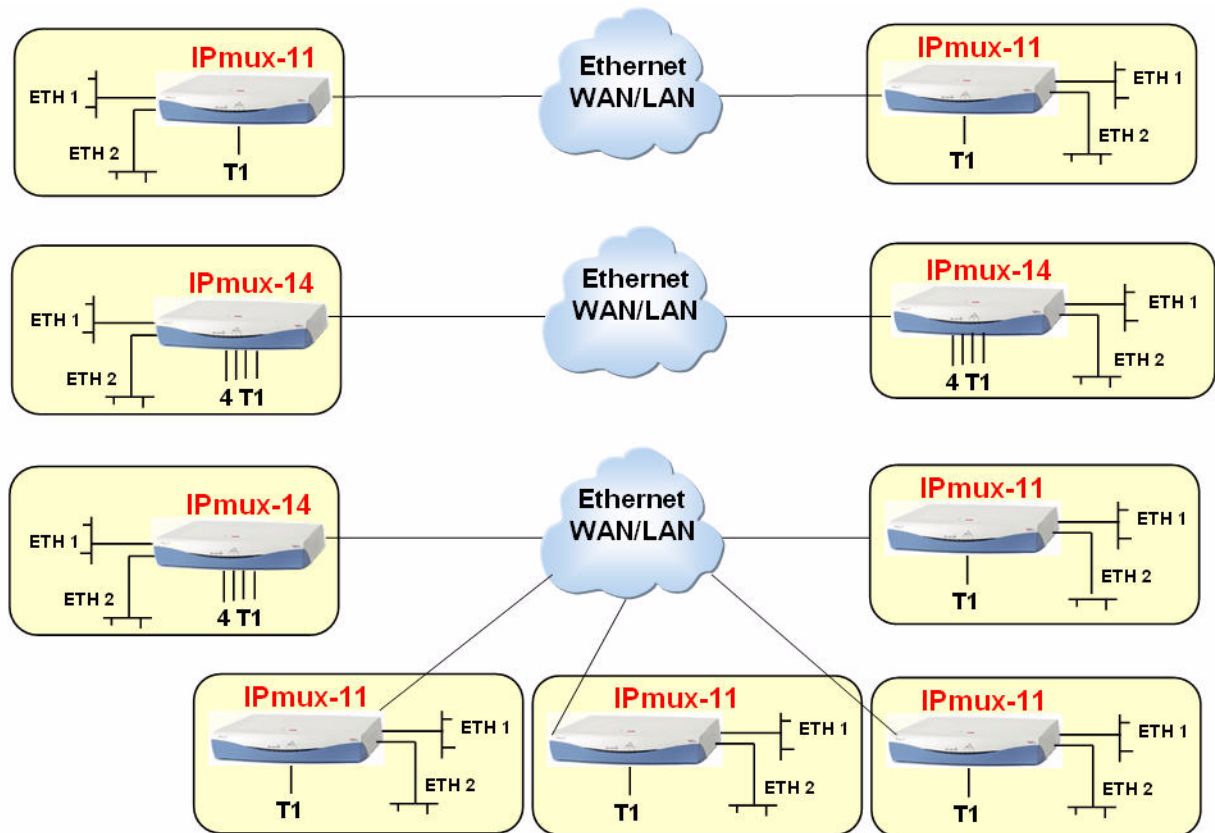
FIGURE 3-13 CANOPY WIRELESS ETHERNET (BEFORE)

FIGURE 3-14 CANOPY WIRELESS ETHERNET (AFTER)
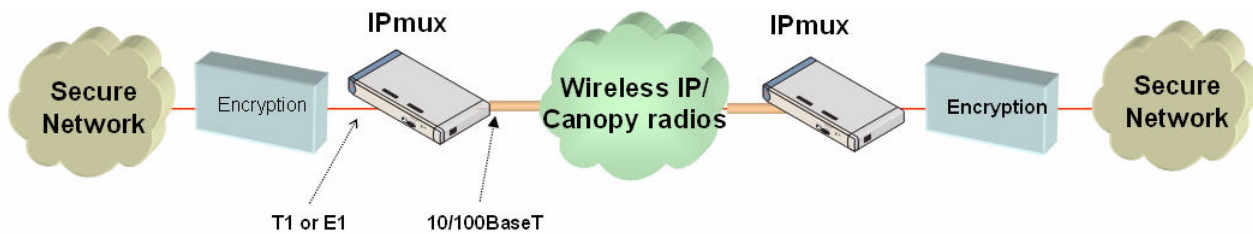
IPMUX-11 AND IPMUX-14 SOLUTIONS

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FIGURE 3-15 IPMUX-11 AND IPMUX-14 SOLUTIONS

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