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Ubigate iBG2016™

System Description

www.samsungnetwork.com

The purposes of Safety Concerns are to ensure user's safety and to prevent property losses.
Please read this document carefully for proper use.

This manual should be read before the installation and operation, and the operator should correctly install and operate the product by using this manual.

This manual may be changed for the system improvement, standardization and other technical reasons without prior notice.

If you have a question for the content of manual or want to obtain further information on the updated manual, please contact the homepage below.

Homepage: http://www.samsungdocs.com

GENERAL USER INFORMATION

Radio Frequency Interference

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to FCC Part 15 Rules.
These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own risk.

FCC Requirements

This equipment complies with FCC Part 68 Rules and requirements adopted by Administrative Council for Terminal Attachment (ACTA).

FCC Part 68

The FCC Part 68 label is located on the bottom of the chassis.
The label contains:

- Product Identifier Number
- FCC Registration Number
- Ringer Equivalence Number (REN)

NOTE

If requested, this information must be provided to your telephone company.

Unauthorized Modifications

Any change or modifications performed on this equipment that are not expressly approved in writing by SAMSUNG ELECTRONICS, CO., LTD. could cause non-compliance with the FCC rules and void the user's authority to operate the equipment.

Telephone Connection Requirement

A plug and jack is used to connect this equipment to the premises wiring and telephone network must comply with the FCC Part 68 rules and requirements adopted by the ACTA.
A compliant telephone cord and modular plug is provided with this product which is designed to connect to a compatible Standard Modular jack.
Connection to the telephone network should be made by using standard modular telephone jacks, type RJ-11C. The RJ-11C plug and/or jacks used must comply with the FCC Part 68 rules.

CIRCUIT TYPE	MODULE TYPE	FACILITY INTERFACE CODE	NETWORK JACK
LOOP START LINE	FXO-4M T1E1-2M T1E1-4	02LS2 04DU9.DN 04DU9.1KN 04DU9.1SN 04DU9.1SN (PRI) 04DU9.DN 04DU9.1KN 04DU9.1SN 04DU9.1SN (PRI)	RJ11C RJ48C RJ48C
DID LINE	FXS-4M, FXS-24 T1E1-2M T1E1-4	02RV2.T 04DU9.BN 04DU9.BN	RJ11C RJ48C RJ48C
E & M TIE LINE	E & M-2M T1E1-2M T1E1-4	TL11M 04DU9.BN 04DU9-BN	RJ45S RJ48C RJ48C

Ringer Equivalence Number

The REN is used to determine the number of devices to be connected to a telephone line. If the total allowable REN load is exceeded, the phone circuit may fail to ring. In most cases, the total REN for a telephone line should not exceed Five (5).
Contact Local Telephone Company, to be certain about the number of devices connected to a line, which is determined by the total REN.
For earlier products, the REN is separately shown on the label.

Incidence of Harm

The telephone company will notify you in advance about the temporary discontinuation of service, if this equipment is causing harm to the telephone network.
In case advance notification is not feasible, the telephone company will notify the customer as soon as possible and you will also be advised about your right to file a complaint with the FCC, if it is necessary.

Changes to Telephone Company Equipment or Facilities

The telephone company may make changes in its facilities, equipment, operations or procedures that could affect the operation of the equipment.
If this happens, the telephone company will provide advance notice in order for you to make necessary modifications to maintain uninterrupted service.

Service Center

If you need assistance during troubleshooting, please contact out local office SAMSUNG ELECTRONICS, CO., LTD. for repair or warranty information.
If the trouble is causing harm to the telephone network, the telephone company may request you to remove the equipment from the network until the problem is resolved.

Field Repairs

Only technicians certified on the Ubigate iBG2016 are authorized by SAMSUNG ELECTRONICS, CO., LTD. to perform system repairs.
Certified technicians may replace modular parts of a system to repair or diagnose trouble. Defective modular parts can be returned to SAMSUNG ELECTRONICS, CO., LTD. for repair.

General

Connection to party line service is subject to state tariffs. Contact the State Public Utility Commission, Public Service Commission or Corporation Commission for information.

Direct Inward Dialing (DID)

If the equipment is not operating as per the **Proper Answer Supervision** mentioned in FCC Part 68 rules, then it is a violation.
Rules of PROPER ANSWER SUPERVISION:

1. Always On the following DID calls, the Equipment returns Answer Supervision to the Public Switched Telephone Network (PSTN)
   - Answered by the called station.
   - Answered by the attendant.
   - Routed to a recorded announcement that can be administered by the Customer Premises Equipment (CPE) user.
   - Routed to a dial prompt.

2. Always This equipment returns answer supervision on all DID calls forwarded to the PSTN.
   Permissible exceptions are:
   - A call is unanswered.
   - A busy tone is received.
   - A reorder tone is received.

Equal Access Requirements

Through the use of access codes, this equipment is capable of providing user's access to interstate providers of operator services. Modification of this equipment by call aggregators to block access dialing codes is a violation of the Telephone Operator Consumers Act of 1990.

Electrical Safety Advisory

Parties responsible for equipment requiring AC power should consider including an advisory notice in their customer information suggesting them to use a surge arrestor. Telephone companies report that electrical surges, typically lightning transients, are very destructive to customer terminal equipment connected to AC power sources. This has been identified as a major nationwide problem.

Music on Hold Warning

In accordance with US copyright laws, a license may be required from the American Society of Composers, Authors and Publishers (ASCAP) or other similar organizations if copyright music is transmitted through the **Music on Hold** feature.
SAMSUNG ELECTRONICS, CO., LTD. hereby disclaims any liability arising out of failure to obtain such a license.

Direct Inward System Access (DISA) Warning

The lines used for the DISA feature must have the disconnected Supervision option provided by the telephone company.

As it is impossible to control who may access your DISA line it is suggested that you do not turn this feature on unless you intend to use it. If you do use this feature, it is good practice to frequently change pass codes and periodically review your telephone records for unauthorized use.

Safety Warnings

High touch current earth connection is essential before making telecommunication network connection.

Energy Hazard-careful treatment is needed.

Every wire for communication should be larger than 26 AWG.

Double pole/neutral fusing.

Underwriters Laboratories

The Ubigate iBG2016 system has been tested to comply with Safety Standards in the United States and Canada. This system is listed with Underwriters Laboratories. The cUL Mark is separately shown on the label.

Installation Safety Guidelines and Warnings

Safety Recommendations

The Safety Warnings that appear in this document (such as the one below) indicate a procedure that can harm you if not done correctly.

Electric hazard exists. Verify the power is turned off. Do not work on energized equipment. Working on energized equipment can result in serious electrical shock.

To avoid electric shock, do not connect Safety Extra-Low Voltage (SELV) circuits (found in LAN ports) to Telephone-Network Voltage (TNV) circuits (found in WAN ports).

This equipment must be installed and maintained by properly trained service personnel. Make sure the proper electrical service is available before plugging the unit and turning it on. Disconnect the telecommunication lines before unplugging the main power connector.

Class 1 Laser Product

The Ubigate iBG2016 is equipped with Small Form Pluggable (SFP) laser transceiver on some ports.

Invisible laser radiation may be emitted from disconnected fibers or connectors.
Do not stare into beams or view directly with optical instruments.

Cover Panels

Do not operate the Ubigate iBG2016 with missing blank faceplates and cover panels. These covers prevent exposure to hazardous voltages and currents inside the chassis. They are important to maintaining proper air flow through the chassis. They also prevent electromagnetic interference (EMI) that might disrupt other equipment.

Laser radiation and EMI are present when the router cover panel is open.

Electrostatic Discharge (ESD) Warning

Observe the following guidelines to minimize the potential for Electrostatic Discharge (ESD) damage, which can cause intermittent or complete component failures.

When handling Ubigate iBG2016 or its components, wear grounding wrist straps to avoid ESD damage to the equipment. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.

1. Always use an ESD wrist strap or ankle strap, and verify that it is in direct contact with your skin. Avoid contact between the component and your clothing as it causes ESD damage.

2. When handling any component that is removed from the chassis, verify that the equipment end of your ESD strap is attached to one of the ESD points on the chassis.

3. Use care when installing or uninstalling modules or interface cards. Tighten the captive installation screws to ensure a proper connection when inserting modules or interface cards.

4. When removing or installing a component, always place it component-side up on an antistatic surface, in an antistatic card rack. If you are returning a component, place it in an electrostatic bag before packing it.

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INTRODUCTION

Purpose

Ubigate iBG2016 System Description describes the general information for the Ubigate iBG2016 hardware description, software description, and additional modules etc.

Document Content and Organization

This manual is composed of four Chapters, two Annex, the Abbreviation, and the Index.

CHAPTER 1. Introducing the Ubigate iBG2016

- Ubigate iBG2016 Overview
- Product Specifications
- Ubigate iBG2016 Software Features and Licenses

CHAPTER 2. Hardware Overview

- Ubigate iBG2016 Chassis
- Ubigate iBG2016 Boot Sequence
- Ubigate iBG2016 Front Panel
- Ubigate iBG2016 Rear Panel
- Modules and Internal Option Cards Types
- Port Numbering
- Modules and Option Cards

CHAPTER 3. Software Overview

- Routing Engine and Packet Forwarding Engine
- Kernel
- Processes
- User Interfaces

CHAPTER 4. Voice Features

- Introduction to Voice Feature
- Key Features
- Voice Deployment Scenario

ANNEX A. Cable Specifications

Describes cable features.

ANNEX B. Open Source Announcement

Open source announcements for this product.

ABBREVIATION

Describes the acronyms used in this manual.

INDEX

Index provides main searching keywords to be found.

Conventions

The following types of paragraphs contain special information that must be carefully read and thoroughly understood. Such information may or may not be enclosed in a rectangular box, separating it from the main text, but is always preceded by an icon and/or a bold title.

WARNING

Provides information or instructions that the reader should follow in order to avoid personal injury or fatality.

CAUTION

Provides information or instructions that the reader should follow in order to avoid a service failure or damage to the system.

NOTE

Indicates additional information as a reference.

Information for Product and Technical Support

For questions regarding the product and technical supports:

http://www.samsungnetwork.com

Revision History

EDITION	DATE OF ISSUE	REMARKS
00	10. 2007.	First edition
01	05. 2008.	Added hot swap function description. Added ATOP-1 and ATOI-1
02	08. 2008.	Added VPN-SSL and LFP-20
03	12. 2009.	Added IVM-U1
04	03. 2010.	Modified Open Source Announcement
05	08. 2010.	Modified Open Source Announcement

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CHAPTER 1. Introducing the Ubigate iBG2016

Chapter 1 describes the Ubigate iBG2016 overview and specifications.

Ubigate iBG2016 Overview

Main Features, Functions and Benefits

The Ubigate iBG2016 is a modular Wide Area Network (WAN) router. It is a 1U rack-mount unit with redundant power supplies and slots for interchangeable interface modules.
The core of the router is a LAN/WAN and router. Optional IPSec VPN and SSL VPN option cards provide high-performance encryption and decryption services for the core router. The Ubigate iBG2016 also supports optional Ethernet switch/route subsystem and voice subsystem cards and interface modules. iBG2016 supports multi-Gigabit Ethernet Level-2 switching, Level-3 IP routing and VoIP processing.

Samsung's Integrated Switch Router

Ubigate iBG2016 integrates all the essential communication services-routing, switching, security and VoIP-into a single platform that can replace many separate network devices. In addition, versatility of many integrated features and a wide range of network modules provides simplicity of management and investment protection while giving SMBs room to grow with business expansions. For example, if an SMB wants to reduce the voice communications cost, it can easily do so by using the voice gateway available on the iBG2016.
Together with VoIP, variety of Quality of Service (QoS) features and an Ethernet module with Power-over-Ethernet ports will provide necessary infrastructure for Internet Protocol (IP) telephony.

Furthermore, Ubigate iBG2016 includes many ease-of-use management features to help SMBs to configure, monitor and troubleshoot without difficulty. Only Ubigate iBG2016 cost-effectively brings real benefits of network connectivity and convergence as well as network security to SMBs.

Performance and Scalability

- 300 Kpps Routing
- Maximum 1xDS3, 20 GbE ports, 4 FE UTP ports, and 1 FE SFP ports

Seamless Integration

Full routing, switching, voice and security in a single platform

Simple, yet Powerful Management

- Customers can manage all aspects of routing, switching, security and voice from a single web Graphic User Interface (GUI), as well using the powerful Command Line Interface (CLI).
- Read-only remote management enables service providers a quick view of the router for easy troubleshooting of Customer Premises Equipment (CPE).

Versatility

- WAN: Clear-channel/channelized T1/E1 and T3, Integrated Service Digital Network (ISDN), serial, High Speed Serial Interface (HSSI), Metro Ethernet and, frame relay, Point to Point Protocol (PPP), Multi Level Precedence and Preemption (MLPP)
- LAN: 100 Mbps or GbE Metro Ethernet, 10/100/1000 Mbps, Power over Ethernet (PoE), Virtual Local Area Network (VLAN), 802.1q
- QoS: DiffServ, Auto QoS, Hierarchical QoS, LF & I, Service-Level Agreement (SLA), Low-Latency Queuing (LLQ), Frame Relay (FR) PVC Queuing
- Voice: Session Initiation Protocol (SIP), H.323, Call Manger, Public Switched Telephone Network (PSTN) Fallback, Foreign Exchange Subscriber/Direct Inward Dialing (FXS/DID), Foreign Exchange Office/ Centralized Automated Message Accounting (FXO/CAMA), Receive and Transmit (E & M), ISDN, T1/E1

Rock-Solid, yet Flexible Security

IPSec, Generic Routing Encapsulation (GRE), Layer 2 Tunneling Protocol (L2TP), Triple Data Encryption Standard (3DES)/Advanced Encryption Standard (AES), Intrusion-Detection Systems (IDS), Intrusion-Prevention Systems (IPS), Anti Virus, Content Filtering

Branch Office Configuration Example

Employing full routing capabilities and enterprise-class switching capacity plus integrated security and Voice over Internet Protocol (VoIP), Ubigate iBG2016 eliminates the need for many separate network devices at the customer sites. Because Ubigate iBG2016 offers wide range of features and network interfaces, you will be able to introduce new value-added services such as hosted Internet Protocol Private Branch Exchange (IP PBX) and/or VPN without requiring additional devices at customer sites that need to be managed separately. In addition, remote management features of Ubigate iBG2016 allow you to graphically configure, monitor or troubleshoot Ubigate iBG2016 as a managed CPE device with ease.

With Ubigate iBG2016 on your side, you will boost your revenue while providing the right solution to your customers.

Customer name increase productivity for its mobile executives, improved contact center operations, and facilitated expansion and acquisitions

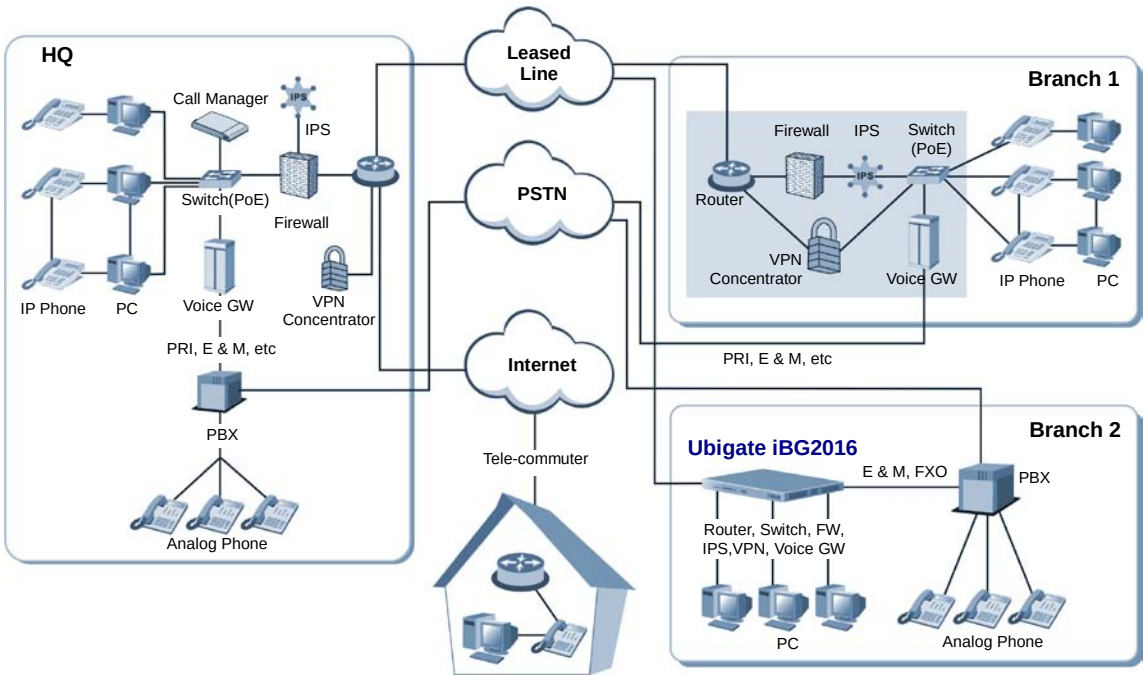

Figure 1.1 Branch Office Configuration Example

Deployment Scenario

The Ubigate iBG2016 is designed to provide WAN-connectivity to a small-to medium sized office. The Ubigate iBG2016 provides VPN/Firewall functionality for WAN interfaces, so users can build secure communication channels through the public Internet.

In addition to access router functionality, Ubigate iBG2016 provides Layer 2/3 Ethernet switching capability for internal traffic. Figure 1.2 shows a typical deployment scenario for the Ubigate iBG2016. As shown, Ubigate iBG2016 provides WAN interfaces such as T1, E1, T3, and metro Ethernet in order to support WAN connectivity. In addition, it is possible to equip an Ubigate iBG2016 with up to 58 10/100/1000 Ethernet ports that will provide Layer-2 and Layer-3 Ethernet switching functionality. Ubigate iBG2016 also offers Voice over Internet Protocol (VoIP) gateway and IP PBX capabilities.

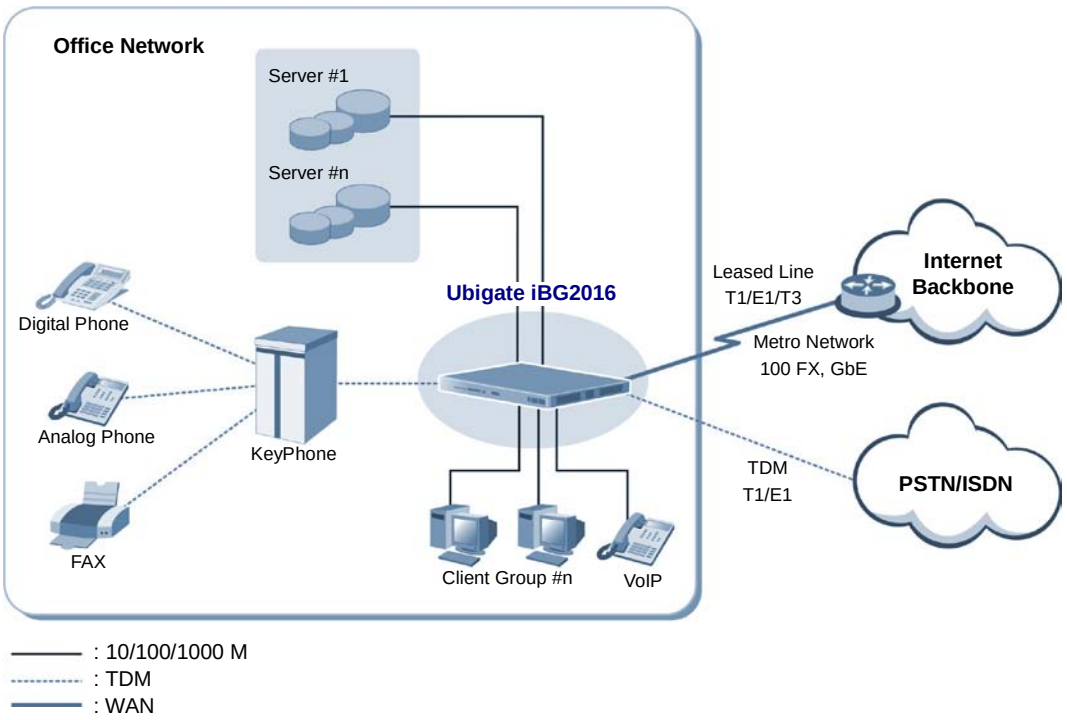

Figure 1.2 Ubigate iBG2016 Office Network Deployment Scenario Example

This allows the Ubigate iBG2016 to support IP Phones in addition to traditional analog and digital PBX telephone systems, enabling a single platform to provide converged voice, data, and video communications over IP networks, as well as over PSTN and other data network infrastructures, including Frame Relay

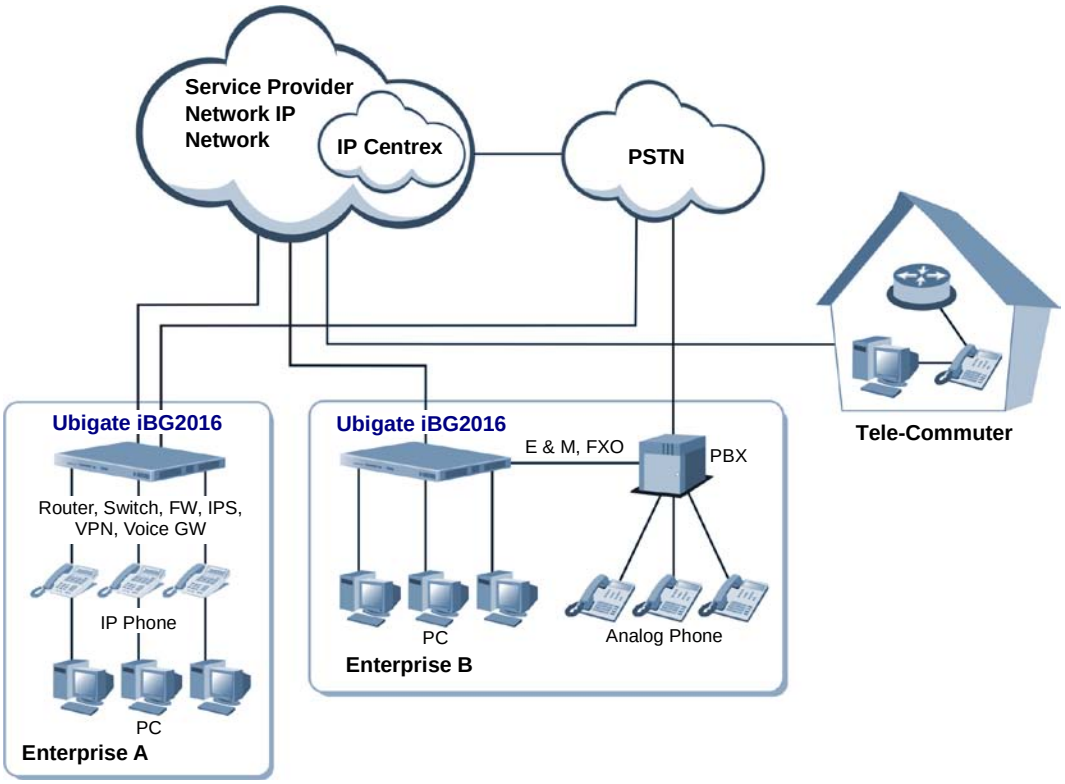

Figure 1.3 Ubigate iBG2016 Enterprise Network Deployment Scenario Example

New Service Offering Example

Basic Connectivity

If simple and reliable internet connectivity is the only requirement, your enterprise can accomplish it with one of many WAN interface cards.
Plus, the high-port density switching module eliminates the need for an additional, separate Ethernet switch. Furthermore, enterprise customers will have peace of mind knowing that one of the various modules will satisfy whatever need might arise in the future.

Secure Connectivity

The need to protect Enterprise networks has become an absolute requirement and connecting to the network without protection is unthinkable.
Ubigate iBG2016 includes Firewall/IPS and VPN acceleration modules for complete protection of both voice and data. Whatever the size of an enterprise and whatever the need is, an enterprise customer can safely connect branch offices to headquarters, protect both audio and video traffic and prevent malicious attacks.

Toll Bypassing

The ability to utilize your current data link to carry quality voice provides tremendous savings on voice communications.
With the voice gateway module in Ubigate iBG2016, you can easily and rapidly deploy a VoIP solution.

IP Telephony

In addition to toll savings, the real value of VoIP comes from value-added applications running on top of the communications infrastructure, which in turn helps you raise productivity significantly. The IP phones with a number of useful features and internal or external IP PBX that can be clustered and will provide you with the scalability to sustain your growth. Moreover, Ubigate iBG2016 will be compatible with most widely accepted media servers, giving you the power to pick and choose the best media server for your needs.

Complete Solution

With all these features implemented-Routing, Switching, Security and Voice-nothing comes close to Ubigate iBG2016 in terms of richness of features and meeting customer needs. Furthermore, Ubigate iBG2016 can perform at full wire-speed even when all features are enabled. Wherever and however it is deployed, Ubigate iBG2016 will satisfy any enterprise customer.

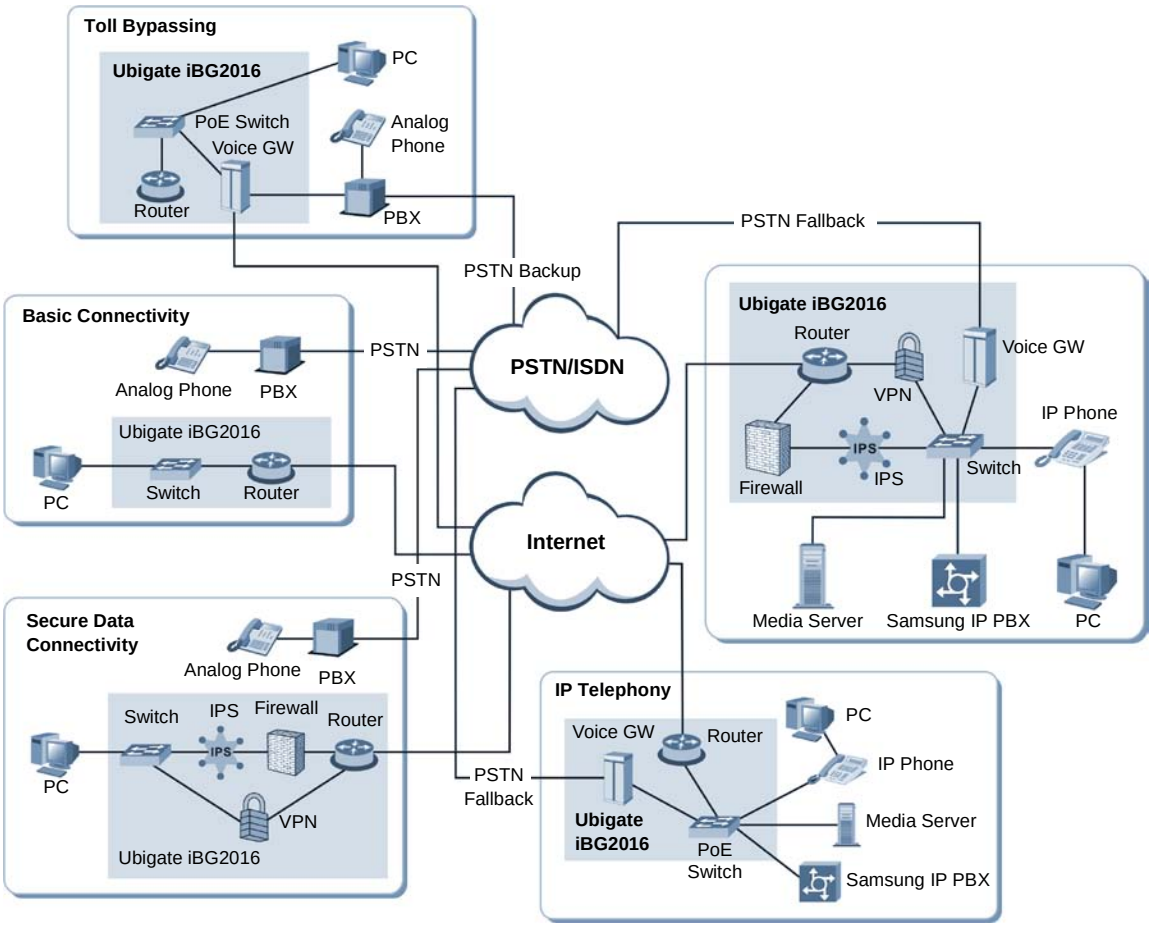

Figure 1.4 New Service Offering Example

Product Architecture

A description of the functional architecture of the Ubigate iBG2016 can be divided into two major categories: The Ubigate iBG2016 control plane and the data plane.
The control plane provides router management functions that configure, manage, and control the various modules within the router and the individual devices on those modules. The data plane provides the data paths to switch and route data packets through the router and to transform those packets as required for protocol conversion and security functions.

Control Plane Architecture

Management and control of the Ubigate iBG2016 is provided by the core processor on the main board. In addition to directly managing the devices on the main board, such as Double Data Rate Synchronous Dynamic Random Access Memory (DDR SDRAM), Flash, Real Time Clocks, etc., the processor communicates with all of the other modules in the Ubigate iBG2016 to manage their functions. For the modules that mount directly on the Main Board (IPSec VPN option card, SSL VPN option card, and VoIP option card) the processor communicates directly through the connector used for the slave module.
The processor communicates with the network modules and mini modules across the router backplane.
For bandwidth and reliability purposes, the Ubigate iBG2016 uses independent bus segments to each of the module slots.

Data Plane Architecture

The Ubigate iBG2016 uses a memory-based architecture in which the High-level Data Link Control (HDLC) Controllers, Ethernet Media Access Controls (MACs), and other packet processors use Direct Memory Access (DMA) to move packet data to and from a central buffer memory on the main board. The routing processor examines packet headers in memory, determines what to do with each packet, and links it to the appropriate output queue.

If IPSec VPN option card or SSL VPN option card is installed, packets may be linked to the security processor on the option card for encryption or decryption. As with the other controllers, the security processor uses DMA to move packet data into and out of the buffer memory for processing.

Network modules and mini modules that are part of the Ubigate iBG2016 provide T1/E1, serial, Digital Signal level-3 (DS3), HSSI, ISDN Basic Rate Interface (BRI), Fast Ethernet, and Gigabit Ethernet external interfaces to this subsystem.

The voice subsystem is optional, only being implemented if the VoIP option card is installed on the main board and appropriate analog or digital voice network modules and mini modules are installed. The VoIP option card includes a Digital Signal Processor (DSP) that is capable of processing up to 128 voice calls.

Network modules and mini modules that are part of the voice subsystem provide analog voice (both FXS/DID and FXO), E & M, T1 (D4, ESF, and ISDN PRI), E1 (CAS and ISDN PRI), DS3, and ISDN BRI external interfaces to this subsystem.

The Ethernet subsystem may be expanded through the addition of the Ethernet switch gigabit card and Ethernet network modules. These modules include Ethernet packet processors that support both level 2 switching and level 3 IP routing of Ethernet packets. Network modules may also include Ethernet switches to expand the number of available ports. In addition, each of the modules includes two high speed stacking links interfaces that are connected to the other network module/option board positions in the chassis.

The high speed stacking links provide very high bandwidth bidirectional connectivity between the modules, such that they all form a single logical Ethernet switch. Due to the Time Division Multiplexer (TDM) Switch in the voice subsystem and the packet processors and switches in the Ethernet subsystem, not all traffic has to pass through the router subsystem.

Local voice calls can be connected between voice ports without going through the VoIP processor. Likewise, Ethernet packets whose (switched or routed) destination port is a local port are handled entirely within the Ethernet subsystem.

Product Specifications

Ubigate iBG2016 Specifications

ITEM	Specification
Memory	- Typical: 512 MB - Maximum: 1 GB
Compact Flash Memory	- Typical: 256 MB - Maximum: 512 MB The CF memory card size can be changed without notice.
Boot ROM	2 MB
AC Power Supply (Use RPS provided by Samsung)	- Input Voltage: 100~240 V - Frequency: 50~60 Hz - Power Consumption: 180 W
High Temperature (Operating)	104°F (+40°C)
Low Temperature (Operating)	32°F (0°C)
High Temperature (Non-Operating)	158°F (+70°C)
Low Temperature (Non-Operating)	-13°F (-25°C)
Humidity (Operating)	5 to 95%, non-condensing
Dimension (H × W × D)	- Height: 1.75 inch (44.45 mm) - Width: 17.38 inch (441.5 mm) (Including rack-mounting brackets: 17.53 inch, 445.5 mm) - Depth: 16.5 inch (419.1 mm)
Weight	6.0 kg
Altitude	0 to 13,123 ft (0 to 4, 018 m)
Regulatory & Safety Compliance	- MIC Type Approval/EMC Registration - IEC 60950-1/EN 60950-1/UL 60950-1 - EN 55022/EN 55024/EN 61000-3-2/ EN 61000-3-3 - FCC Part 15 Class A - FCC Part 68

Interfaces

The following tables provide specifications for T1 WAN, Serial WAN, and Ethernet LAN interfaces.

E1 WAN Interface

Specifications	Descriptions
Receive line rate	2.048 Mbps ± 50 ppm (payload = 1.984 Mbps)
Line code	HDB3
Framing CRC	non-CRC (ITU G.704), and unframed
Input signal	DSX-1, 0 to -24 dB
Output signal build out	long-haul or short-haul
Impedance	75 or 120 ohm
Connectors	RJ-48C
Timing	Internal or network
Pulse density	ITU G.703

T1 WAN Interface

Specifications	Descriptions
Receive line rate	1.544 Mbps ± 32 ppm
Line code	B8ZS or AMI
Framing	D4 or ESF
Interface ESF FDL	- AT & T TR-54016-1986 - AT & T TR-54016-1989 - ANSI T1.403-1989
Input signal	DSX-1, 0 to -24 dB
Output signal build out	0, -7.5 dB, -5 dB
Equalization	0 to 655 ft. (DSX-1)
Impedance	100 ohm
Connectors	RJ-48C
Timing	Internal or network
Pulse density	AT & T TR-62411; HDLC Inversion, forced

Ethernet LAN Interface

Specifications	Descriptions
Data flow	Full-duplex or half-duplex
Connectors	RJ-45
Data speed	10/100/1000 Mbps, auto negotiating

Modules and Internal Option Cards

Ubigate iBG2016 supports several kinds of modules and internal option cards.

- Mini modules
- Network modules
- Internal option cards

The following table lists the Ubigate iBG2016 modules and internal option cards.

Name		Detailed Description
Internal Option Cards	VPN-A	IPSec VPN option card
	VPN-SSL	SSL VPN option card
	VoP-16	VoIP 16ch gateway card
	VoP-32	VoIP 32ch gateway card
	VoP-64	VoIP 64ch gateway card
	VoP-128	VoIP 128ch gateway card
	IVM-U1	Integrated Voice Mail option card
WAN Interface Modules	BRI-1ST	1-port ISDN BRI-S/T interface mini module
	BRI-2ST	2-port ISDN BRI-S/T interface mini module
	BRI-1U	1-port ISDN BRI-U interface mini module
	BRI-2U	2-port ISDN BRI-U interface mini module
	T1E1-1M	1-port channelized T1/E1 mini module
	T1E1-2M	2-port channelized T1/E1 mini module
	T1E1-4	4-port T1/E1 network module
	WTE-1SM	1-port serial network mini module
	WTE-2SM	2-port serial network mini module
	WTE-4S	4-port serial network module

(Continued)

Name		Detailed Description
WAN Interface Modules	HSSI-1	1-port HSSI network module
	WT3-1C	1-port channelized network module
	ATOP-1	1-port ADSL over POTS mini module
	ATOI-1	1-port ADSL over ISDN mini module
LAN Interface Modules	LMG-20	20-port GbE (UTP) network module
	LMF-20	20-port 10/100 FE (UTP) network module
	LMP-20	20-port 10/100 FE (UTP) PoE network module
	LFP-20	20-port layer-2 10/100 FE (UTP) PoE network module
Voice Modules	VCU-A	Network module which can carry two voice mini modules
	FXO-2M	2-port Analog FXO mini module
	FXO-4M	4-port Analog FXO mini module
	FXS-2M	2-port Analog FXS/DID mini module
	FXS-4M	4-port Analog FXS/DID mini module
	E & M-1M	1-port E & M module mini module
	E & M-2M	2-port E & M module mini module
	FXS-24	24-port Analog FXS/DID network module
	FXS-24 Extension Box	24-port analog voice channel connector module

Memory

The Ubigate iBG2016 supports the following types of memory:

- Double-Data-Rate Synchronous Dynamic Random Access Memory (DDR SDRAM): This type of memory stores the running configuration and routing tables. It also buffers packets at the network interfaces. The base configuration shipped from the factory is 512 MB of main memory. The Small Outline Dual In-line Memory Module (SODIMM) slot can be upgraded to maximum of 1 GB.
- Compact Flash memory card: The base configuration shipped from the factory is a 256 MB compact flash memory card, which can be upgraded to a maximum of 512 MB. The Ubigate iBG2016 supports one compact flash card slot. Compact flash is used to store application code images and system configurations. The compact flash memory card size can be changed without notice.

- Internal Flash Memory: Ubigate iBG2016 includes 2 MB of internal flash memory which is used to boot the router.

Power Supply

Basically Ubigate iBG2016's power supply module provides +12 VDC at 180 Watts (15 Amp at nominal voltage) with an AC input between 100 and 240 VAC. Ubigate iBG2016 also provides 3 external DC power inlets: 2 for 48 V PoE power supply and the other for +12 VDC redundant power supplies which can be used in case of AC power failure.

In order to equip the redundant power supply, prepare SPA160-IP if only one PoE DC power supply is needed. If more than 2 DC power supplies need to be equipped, use RPS780 which can accommodate one SPA180E and two SPA300Es.

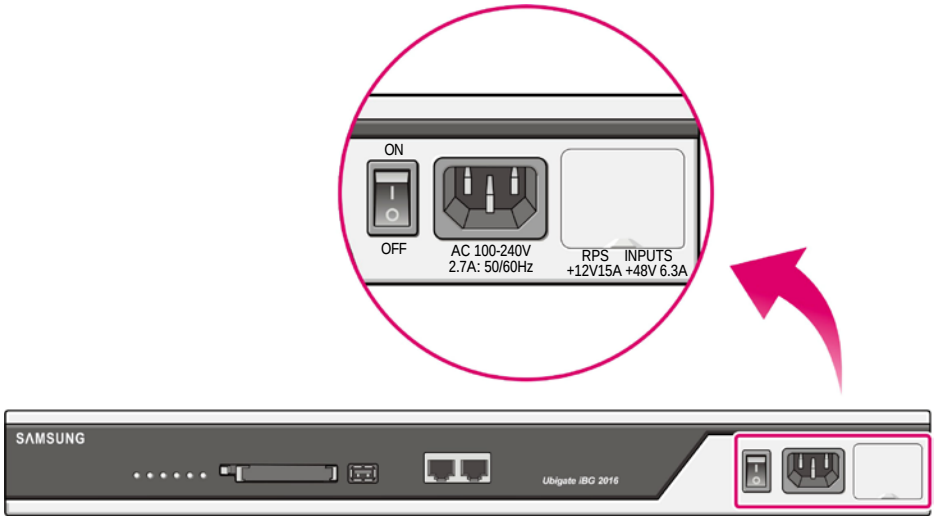

Figure 1.5 Power Supply

Ventilation

There are three fans on the right side of the system blow air inside and then air goes through the system out to the left side. On both sides, there are grids of holes where air comes in and goes out. When installing Ubigate iBG2016, ensure to make room around the system in order not to block air flow.

Figure 1.6 Ventilation

Real-Time Clock and NVRAM

The Ubigate iBG2016 Real Time Clock and Non-Volatile RAM (NVRAM) provide two basic functions to the router:

- It provides a real-time clock so that the Ubigate iBG2016 can maintain the correct date and time.
- It provides a small block (32 KB) of battery backed up static RAM (SRAM) storage.

Ubigate iBG2016 Software Features and Licenses

Switch/Router Features

Category	Features and Licenses	
L2/L3 LAN Switching	- L2/L3 Switching - IPv4/IPv6 Switching - Line-Rate at GbE	
Layer 2 Protocols	- VLAN (802.1q, Port, Protocol, Subnet, Policy Based) - GARP/GVRP - STP, Rapid STP, Multiple STP - Port Mirroring - Link Aggregation - 802.1x Authentication - IGMP Snooping	
WAN Protocols	- ISDN BRI/PRI, HDLC - FR/MLFR, PPP/MLPPP - PPP/MLPPP over ISDN - FR Congestion Management and Traffic Policing	
Routing Protocols	- Static Routing - OSPF v1/v2, RIP v1/v2, BGP4 - IGMP v1/v2 - PIM-SM, DVMRP - VRRP - Policy-Based Forwarding/Routing	
Quality of Service	DiffServ	- Classification (MF, Flow Label) - Marker (SrTCM/TrTCM) - Policing/Shaping - Queuing (CBQ, PQ) - Scheduling (Deficit RR) - Congestion Avoidance (WRED)
	- Bandwidth Guarantee, SLA - Hierarchical QoS - LF & I - Mapping of IP-QoS to Frame Relay - QoS for FR PVC - LLQ for IPSec Encryption Engine - Tunnel Encapsulation	

(Continued)

Category	Features and Licenses	
Load Balancing	- Per Flow (ECMP, LACP) - Per Packet	
Performance	Routing	- IPv4 Forwarding: 300 Kpps - IPv6 Forwarding: 180 Kpps - Max. Route Table Size: 64 K - Max. MAC Table Size: 16 K
	Switching	- 42 Gbps Switching Throughput (Full Duplex) - 60 Gbps Switching Capacity (Full Duplex)
Management	- Multilevel Administration Access (MLA) - SNMP v1/v2/v3, RMON (1, 2, 3, 9) - CLI, Telnet, NTP, tftp, Bootp, DHCP, SSHv2, SCP - Web based GUI, MIBs - Logging & Reporting, Diagnostic - True Flash File System - System Image rollback - Hot-Swap Handling	
AAA Client	- 802.1x - RADIUS - TACACS+	

Security Features

Category	Features and Licenses
Secure Connectivity	- IPSec for Site to Site - IPSec for Remote Access - hub-and-spoke support - IP Payload Compression (IPPC) - Encryption (DES, 3DES, AES) - L2TP, GRE - Data Integrity (MD5, SHA-1) - Authentication (XAUTH) - Key Management (Manual, IKE v1, PKI, Preshared, Auto Key Exchange) - NAT Traversal
Internal Security	- AAA, 802.1x - ACL - Policy based VLAN - MAC Address Filtering
Attack Defense	- Route mode - Packet Filtering - Stateful Packet Inspection - NAT (1:1, N:1, Reverse, Dynamic) - ALG (FTP, DNS, TFTP, RPC, SIP, HTTP (WEB), and SMTP) - Application Content filtering (Java, ActiveX) - Dos/DDoS Protection - IP/TCP fragment attack protection - IP Spoofing Protection - URL Filtering - DMZ - Behavior-based Detection - Stateful Signature Detection - Traffic/Protocol Anomaly Detection - Active Response (Drop Packet, Drop Connection)
Management	- Reporting - Logging - Online Signature Update (Weekly, Emergency)
Certification	- Firewall: ICSA - VPN: ICSA, FIPS 140-2

(Continued)

Category	Features and Licenses	
Performance	Firewall	- Performance: 270 Mbps - Concurrent Session: 64 K - New sessions setup rate: 700 session/Sec
	IPS	- Signature & Behavior based attack detection & Prevention: 1,000 - Performance: 130 Mbps
	IPSec VPN	- Performance: 180 Mbps - Tunnel: 1,000 - Tunnel Setup rate: 10/sec
	SSL VPN	- Performance: • 38 Mbps (Clientless Mode) • 80 Mbps (Port Forwarding Mode) • 30 Mbps (Full tunnel Mode) - Tunnel: 50

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CHAPTER 2. Hardware Overview

Chapter 2 describes the hardware overview.

The Ubigate iBG2016 is enclosed in a rack-mount 1U enclosure, designed for installation in a standard 19-inch and 23-inch rack. The unit is approximately 17.5” wide, 16.7” deep and 1.75” high. The chassis is enclosed at the front, except for status indicators and an air intake grill. All modules and all cabling, including power cables, are installed from the rear.

Ubigate iBG2016 Modularity

The Ubigate iBG2016 is designed as a modular router, with much of the router’s functionality defined by the installed modules. Except for the two internal option cards, all active circuitry of the Ubigate iBG2016 is on modules that may be installed from the rear of the unit. If any of these modules fails, it may be replaced without removing the unit from the rack and without modifying the rest of the router. Further, except for at least one power supply and the main board, all modules are optional.

Ubigate iBG2016 Routing and Switching Engine

The Routing and Switching Engine (Main Board) contains the central processor of the router; its core peripherals and memory; a Compact Flash connector; a number of external interfaces, including serial management ports, a SFP Gigabit Ethernet port, four Fast Ethernet ports, and a USB port; and three slots for mini modules.

VoIP, IPSec VPN, and SSL VPN option cards are small daughter boards that mount on the Main Board and provide enhanced functionality for the router. Up to four mini modules can be installed from the rear panel. They provide a selection of voice or WAN interface ports to the Ubigate iBG2016.
Mini modules may be installed into an operating system. Mini modules shall be inserted with cables removed.

Network modules provide a selection of high-capacity voice, WAN or Ethernet interface ports to the router. Network modules shall be inserted with cables removed.

Ubigate iBG2016 Chassis

The Ubigate iBG2016 is designed for mounting in a 19-inch or 23-inch rack. Different mounting brackets are available for the different rack widths.

The following figure is an isometric view of the router from the rear, with both the main chassis and the fan tray unit shown without the external enclosure.

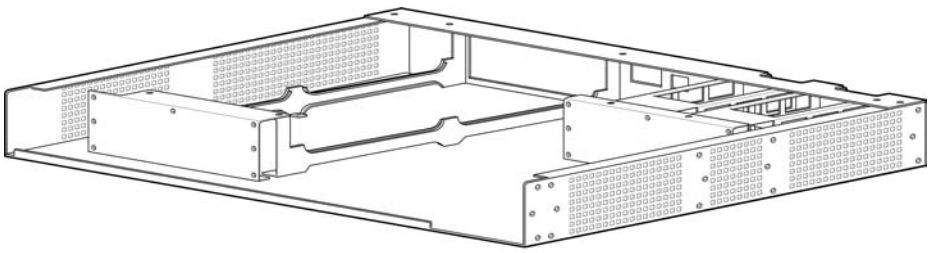


Figure 2.1 Isometric View

Ubigate iBG2016 Boot Sequence

All circuitry within the Ubigate iBG2016 (except the power supplies and fans) is reset to its initial state by the reset circuitry on the main board.
During normal operation, the reset circuitry monitors an internal power supply of the main board and, after it reaches normal operating levels, generates a reset pulse to the routing processor and all of the other circuitry on the main board.
The main board reset circuitry also includes a watchdog timer. The watchdog timer causes the Ubigate iBG2016 reset if the programmed interval elapses without the processor triggering the watchdog.

Ubigate iBG2016 boot is the sequence of software-driven events starting from the reset pulse to the loading and running of the application image. On reset, the processor starts executing instruction from a specific location in the boot ROM. This first software run is the boot loader. After CPU memory controller initialization, the boot loader locates, verifies, and runs a boot image located in CF memory. The boot image then continues with the necessary initialization to be able to decompress and move itself to RAM. Once moved to RAM, execution is given to boot software residing in RAM. At this point the more initialization of hardware and driver software is completed until application software can be loaded in to RAM from flash, or alternatively from a networked host. The application software prepares the Ubigate iBG2016 for packet flow through the interfaces at which time the Ubigate iBG2016 is fully up and running.
These are various software services that support the application software. These include the file Ubigate iBG2016, logging, Ubigate iBG2016 monitoring, downloaded image validation and flash update.

Ubigate iBG2016 Front Panel

The front panel of the Ubigate iBG2016 provides status of the router's performance and operation by using LEDs. Proper LED status is shown as following.

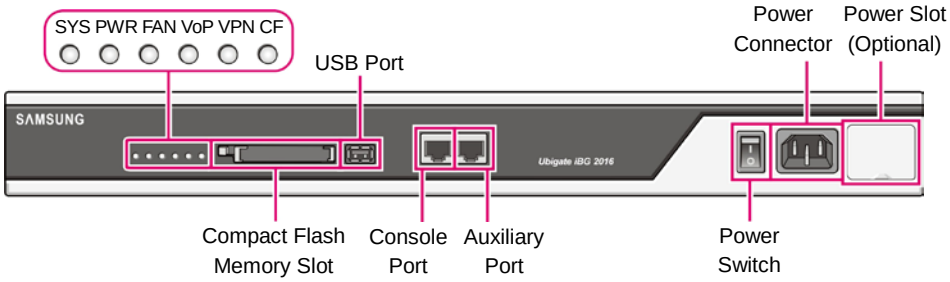


Figure 2.2 Ubigate iBG2016 Front View

Front LED Description

LED	Indication & Color	Description
SYS	Solid green	System is operating normally.
	Amber	Router is receiving power but malfunctioning.
	Off	Router is not receiving power.
PWR	Solid green	Power supply installed and operating normally.
	Amber	Power supply installed and powered off, or fault condition detected.
	Off	Power supply not present.
FAN	Solid green	Fan is operating properly
	Amber	Fan present with failure
VoP	Solid green	VoP or IVM card present and enabled.
	Amber or Red	VoP or IVM card present with failure.
	Off	VoP and IVM card not present
VPN	Solid green	Internal option card present and enabled.
	Amber or Red	Internal option card present with failure.
	Off	Internal option card not present
CF	Solid green	Compact Flash memory being accessed
	Off	Compact Flash memory not mounted or not being accessed.

Front Connector Description

Connector	Description
Compact Flash Memory Slot	Slot for Compact Flash Memory Card
USB Port	Supports USB 1.1 interface
Console Port	Serial port supporting local monitoring and configuring
Auxiliary Port	Serial port supporting remote monitoring
Power Switch	Power switch
Power Connector	AC power connector
Power Slot (Optional)	Optional external DC power supply inputs

Compact Flash Memory Card

The Compact Flash memory card is used to store application code images and system configuration related files.
The compact flash memory cards support 256 MB, and 512 MB capacities.
The compact flash memory card size can be changed without notice.

USB Port

The Universal Serial Bus (USB) port is USB 1.1 compliant. USB interface (Type A) configured as a host. USB flash memory module can be used to store an image or configuration file like a CF memory card. USB flash memory module is non-secure, but is available in 64 MB, 128 MB, or 256 MB capacities.

Console Port

The Console Ports is an RS-232, serial, asynchronous serial port that operates at up to 19200 bps. The Console Port is activated immediately after a reset and allows direct operator interaction with the Routing Processor using the Command Line Interface.

Auxiliary Port

The RJ-45 Auxiliary Ports is used for modem connection.

Ubigate iBG2016 Rear Panel

The Ubigate iBG2016 rear panel provides connections for networking.
The Ubigate iBG2016 rear panel provides connections for one Fast Ethernet SFP port and four 10/100 Fast Ethernet ports.

The Rear Panel has the following features.

Rear LED Description

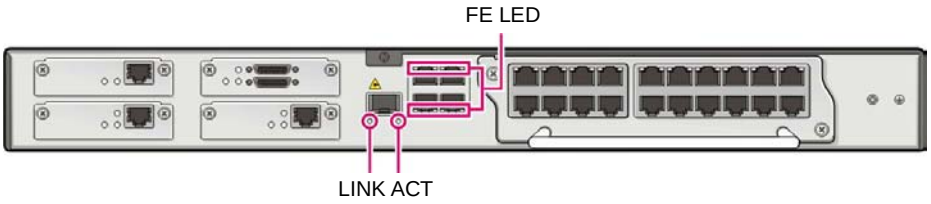


Figure 2.3 Ubigate iBG2016 Rear View (LED)

LED	Indication & Color	Description
LINK (SFP Port)	Solid Green	Link is established with speed 100 Mbps.
	Off	Link fail or not connected.
ACT (SFP Port)	Blinking Amber	Blinking Amber indicates transmit/receive activity with speed 100 Mbps.
	Off	No activity.
UTP FE Port Left LED	Solid Green	Link is established with speed 10/100 Mbps.
	Off	Link fail or not connected
UTP FE Port Right LED	Amber Blink	Blinking Amber indicates transmit/receive activity with speed 10/100 Mbps.
	Off	No activity.

Rear Connector Description

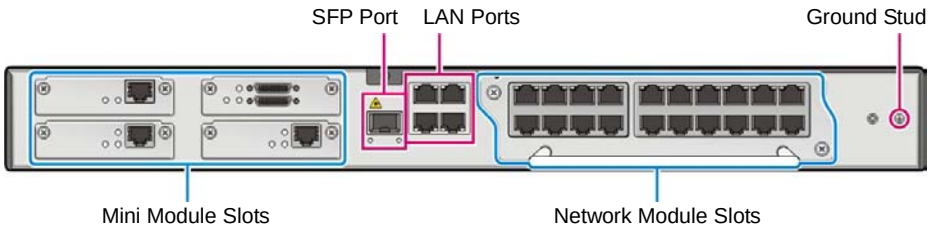


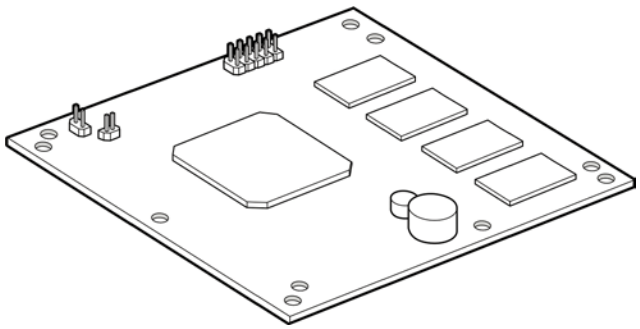
Figure 2.4 Ubigate iBG2016 Rear View (Connector)

Connector	Description
Mini Module Slots	Up to three mini modules supporting a variety of interfaces and one mini module supporting for voice only
SFP Port	Supports optional FE SFP module
LAN Ports	Supports Fast speed Ethernet interface
Network Module Slots	Slot for network module supporting a variety of Interfaces.
Ground Stud	Screw holes for grounding lug

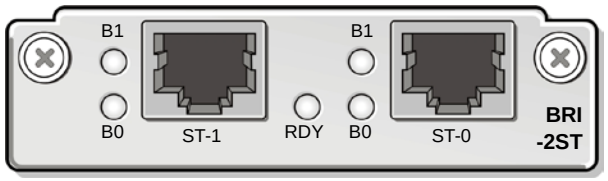
Modules and Internal Option Cards Types

This section describes the modules supported in Ubigate iBG2016 release 1.0, including internal option cards, mini modules that connect into dedicated slots in the chassis, and network modules which install into the expansion slot bay.

- Internal option card



- Mini module



- Network module

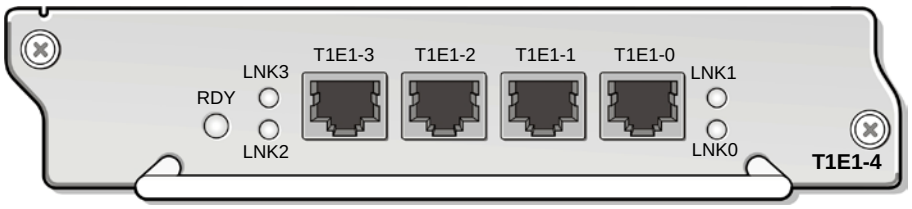


Figure 2.5 Internal Option Card and Network Modules

Port Numbering

This section describes the port number conventions used on the Ubigate iBG2016.

Ports on any network modules and mini modules are numbered from right to left starting with port number zero. If there is more than one row of ports on a given module, the bottom row is numbered first from right to left starting at port zero, then the next row up is numbered from right to left starting with the next port number based on the lower rows last (left most) numbered port.

Main Board Ports Numbering

There are five LAN interfaces on the main processing unit-one Gigabit Ethernet SFP port and four Fast ports. Then the Gigabit Ethernet ports follow the numbering rule and are numbered right to left bottom to top start with one.

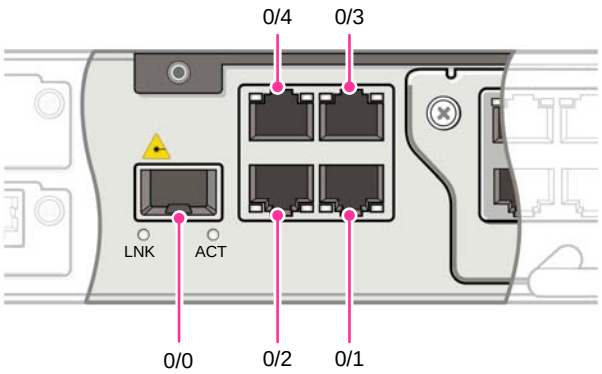


Figure 2.6 LAN Port Numbering

Network Modules Ports Numbering

The network module always resides in the slot #1. The 20-port LAN network module numbering is as follows:

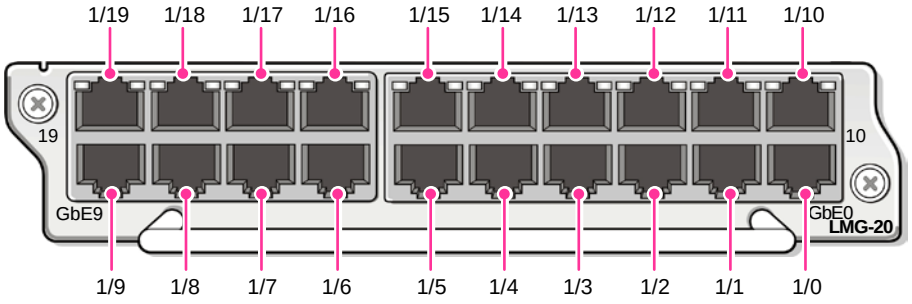


Figure 2.7 20-port Network Module Port Numbering

WAN network modules come in one port or four port configurations.
The port numbering is also from right to left starting at port number zero:

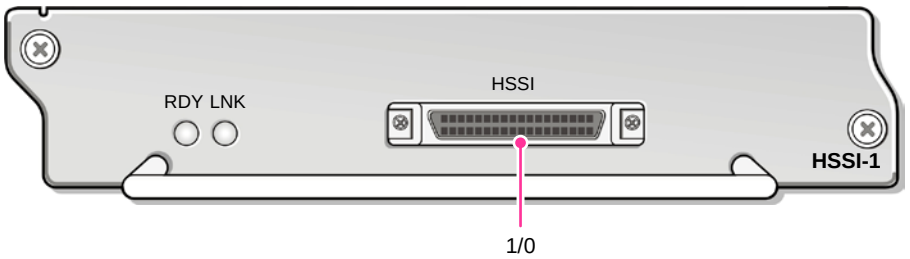


Figure 2.8 1-Port WAN Network Module Port Numbering

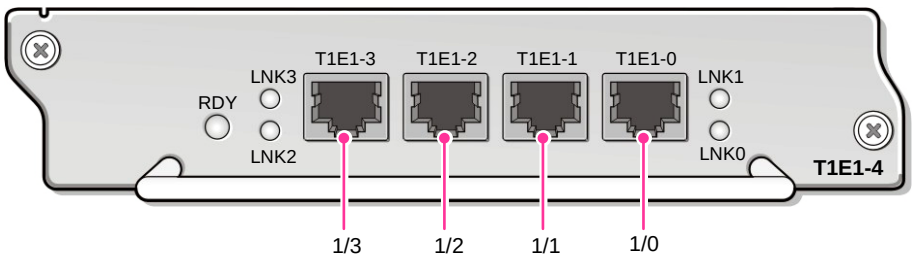


Figure 2.9 4-Port WAN Network Module Port Numbering

Voice carrier modules can have voice-only mini modules plugged into them. Here is an example of a voice carrier module in slot 2 with a 4-port mini module in sub-slot 0, and a 2-port mini module in sub-slot 1: (X = 1 or 2)

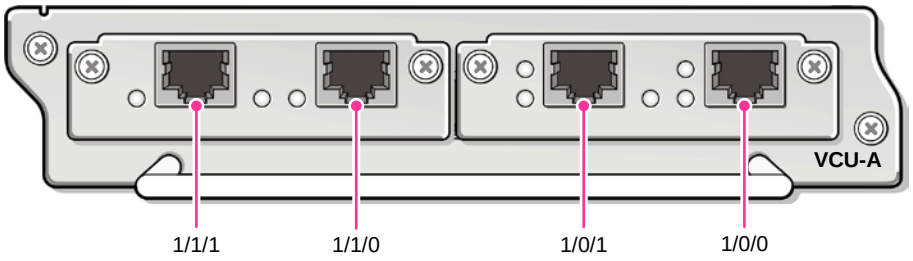


Figure 2.10 Voice Carrier and Mini Module Ports Numbering

Mini Modules Ports Numbering

Mini modules have one, two or four ports. Port numbering is from right to left starting with port number zero: (X = 0, 1, 2, or 3)

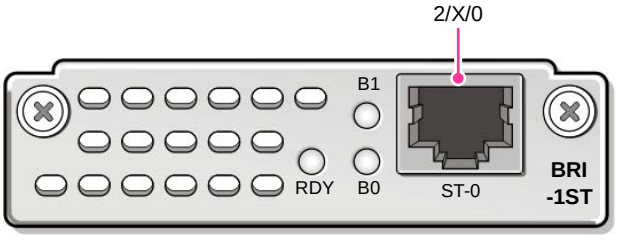


Figure 2.11 1-Port Mini Module Port Numbering

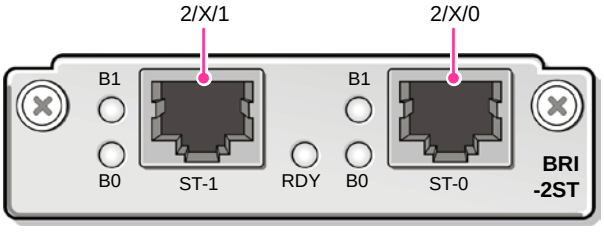


Figure 2.12 2-Port Mini Module Port Numbering

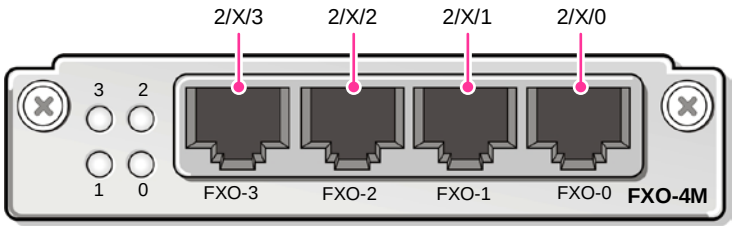


Figure 2.13 4-Port Mini Module Port Numbering

Port Numbering Examples

Port	Numbering	Corresponding Ports
Main board LAN Ports	0/1, 0/2, 0/3 and 0/4	Copper Gigabit Ethernet ports.
	0/0	Optical Gigabit Ethernet port
LAN Network Module Port	1/0 thru 1/19	The lower row of Ethernet ports numbered from right to left on the 20-port LAN network module in the network module slot.
WAN Network Module Port	1/0	Right most port on the WAN network module in the network module slot.
	1/3	Left most port of four ports on the WAN network module in the network module slot.
Mini Module Ports	0/0/0	Port zero on a mini module in sub slot zero.
	0/2/3	Port three on a mini module in sub slot two in main board in slot zero.

Modules and Option Cards

Internal Option Cards

VPN-A, VPN-SSL (IPSec VPN, SSL VPN Option Cards)

The IPSec VPN and SSL VPN option cards provide high-performance security processing for packets passing through the Ubigate iBG2016. It includes a security processor that is a part of the router subsystem. Like the VoIP option card, it is an internal card that mounts above the main board and must be installed onto the main board before it is inserted into the chassis. Because of the internal mounting of this card, it is not hot-swappable.

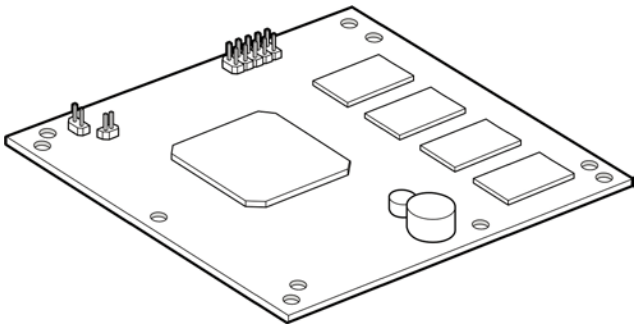


Figure 2.14 VPN-A, VPN-SSL Internal Option Card

VoP-16, VoP-32, VoP-64, VoP-128 (VoIP Option Cards)

The VoIP option card is the root of the voice subsystem and must be installed to have any voice features. It includes a VoIP processing DSP and a TDM switch. It is an internal card that mounts above the main board and must be installed onto the main board before it is inserted into the chassis. Because of the internal mounting of this card, it is not hot-swappable.

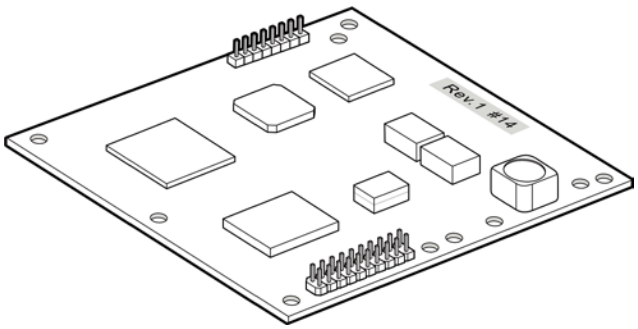


Figure 2.15 VoP-16, 32, 64, 128 Internal Option Cards

IVM-U1 (Integrated Voice Mail Option Card)

The IVM-U1 option card performs two main functions: VoIP function and VM (Voice Mail) function. Using this option card, iBG2016 can provide a voice gateway feature and voice mail feature. It must be installed on the dedicated slot of the main board before the main board is inserted into the chassis. IVM-U1 is not hot-swappable.

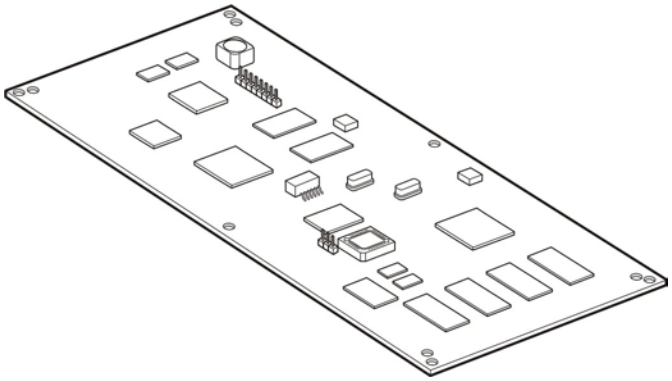


Figure 2.16 IVM-U1 Internal Option Card

WAN Interface Module

BRI-1ST (1-Port ISDN BRI S/T Mini Module)

This module provides one ISDN BRI S/T interface port, supporting two voice or data timeslots. Voice timeslots connect to the voice subsystem while data timeslots connect into the router subsystem.

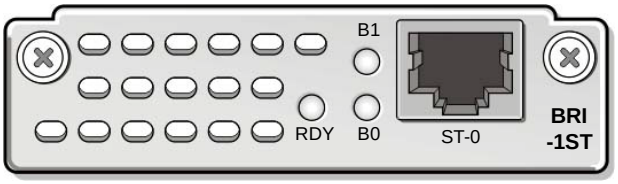


Figure 2.17 BRI-1ST Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	GREEN	The module passed it's self-test and is available to the router
	OFF	Reset, Power down, Removal state
ST-0 B0	GREEN	Active connection on the first B channel in port 0
	OFF	Disconnected on the first B channel in port 0
ST-0 B1	GREEN	Active connection on second B channel in port 0
	OFF	Disconnected on second B channel in port 0

BRI-2ST (2-Port ISDN BRI S/T Mini Module)

This module provides two ISDN BRI S/T interface ports, each supporting two voice or data timeslots. Voice timeslots connect to the voice subsystem while data timeslots connect into the router subsystem.

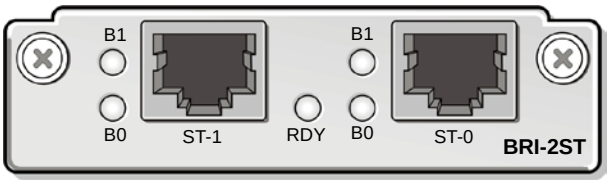


Figure 2.18 BRI-2ST Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	GREEN	The module passed it's self-test and is available to the router
	OFF	Reset, Power down, Removal state
ST-0 B0	GREEN	Active connection on the first B channel in port 0
	OFF	Disconnected on the first B channel in port 0
ST-0 B1	GREEN	Active connection on second B channel in port 0
	OFF	Disconnected on second B channel in port 0
ST-1 B0	GREEN	Active connection on the first B channel in port 1
	OFF	Disconnected on the first B channel in port 1
ST-1 B1	GREEN	Active connection on second B channel in port 1
	OFF	Disconnected on second B channel in port 1

BRI-1U (1-Port ISDN BRI U Mini Module)

This module provides one ISDN BRI U interface port, supporting two voice or data timeslots. The ISDN BRI U mini module interfaces to ISDN Basic Rate networks and supports two 64 Kbps B channels and a 16 Kbps d channel.
The ISDN BRI U mini module may be configured as either an LT (network end) or NT (CPE end). The ISDN BRI U mini module provides 2B1Q encoding

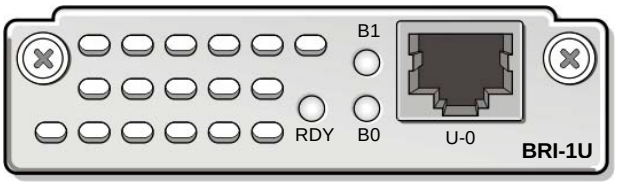


Figure 2.19 BRI-1U Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	GREEN	The module passed it's self-test and is available to the router
	OFF	Reset, Power down, Removal state
U-0 B0	GREEN	Active connection on the first B channel in port 0
	OFF	Disconnected on the first B channel in port 0
U-0 B1	GREEN	Active connection on second B channel in port 0
	OFF	Disconnected on second B channel in port 0

BRI-2U (2-Port ISDN BRI U Mini Module)

This module provides two ISDN BRI U interface ports, each supporting two voice or data timeslots. The ISDN BRI U mini module interfaces to ISDN basic rate networks and supports two 64 Kbps B channels and a 16 Kbps D channel.

The ISDN BRI U mini module may be configured as either an LT (network end) or NT (CPE end). The ISDN BRI U mini module provides 2B1Q encoding

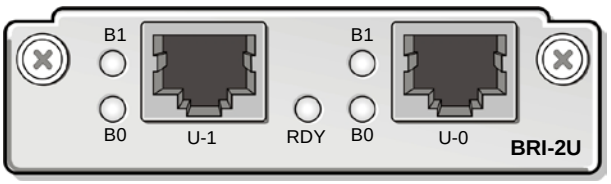


Figure 2.20 BRI-2U Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	GREEN	The module passed it's self-test and is available to the router
	OFF	Reset, Power down, Removal state
U-0 B0	GREEN	Active connection on the first B channel in port 0
	OFF	Disconnected on the first B channel in port 0
U-0 B1	GREEN	Active connection on second B channel in port 0
	OFF	Disconnected on second B channel in port 0
U-1 B0	GREEN	Active connection on the first B channel in port 1
	OFF	Disconnected on the first B channel in port 1
U-1 B1	GREEN	Active connection on second B channel in port 1
	OFF	Disconnected on second B channel in port 1

T1E1-1M (1-Port T1/E1 Mini Module)

This 1-Port T1/E1 mini module provides one T1 port, running at 1.544 Mbps and supporting 24 voice or data timeslots, or one E1 port, running at 2.048 Mbps and supporting 30 voice or data timeslots.
This module supports generic 1-port T1 or E1 trunk interfaces for voice, data, and integrated voice and data applications. The mini module provides basic structured and unstructured service for T1 or E1 networks.
The mini module can be used as trunk interfaces for voice and data services, as fractional n x 64-kbps service for WANs (Frame Relay or leased line), or for time-division multiplexing (TDM) drop-and-insert (voice and data integration) services.
The T1/E1 mini modules provide voice and data access to the PSTN domain through TDM ports, and include an integrated channel service unit/data service unit (CSU/DSU).

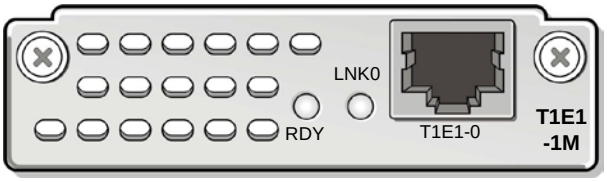


Figure 2.21 T1E1-1M Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Green	The mini module is operational and power on.
	Off	Indicates the port is Power down.
LNK 0	Green	Indicates the port is enabled. (Carrier Detect)
	Amber	Indicates an alarm condition exists on the remote end of one of the T1/E1 ports. On Remote End, detected alarm condition: - RDI (Remote Detect Indication) - AIS (Alarm Indication Signal).
	Red	Indicates an alarm condition exists locally on one of the T1/E1 ports. Locally, detected alarm condition: - LOS (Loss of signal) - OOF (Out-of-Frame)
	Off	Indicates that the port is not enabled, and no alarms detected on any port.

T1E1-2M (2-Port T1/E1 Mini Module)

This 2-Port T1/E1 mini module provides two T1 ports, each running at 1.544 Mbps and supporting 24 voice or data timeslots, or two E1 ports, each running at 2.048 Mbps and supporting 30 voice or data timeslots.
This module supports generic 1- or 2-port T1 or E1 trunk interfaces for voice, data, and integrated voice and data applications. The mini module provides basic structured and unstructured service for T1 or E1 networks.
The mini module can be used as trunk interfaces for voice and data services, as fractional n x 64-kbps service for WANs (Frame Relay or leased line), or for time-division multiplexing (TDM) drop-and-insert (voice and data integration) services.
The T1/E1 mini modules provide voice and data access to the PSTN domain through TDM ports, and include an integrated channel service unit/data service unit (CSU/DSU).

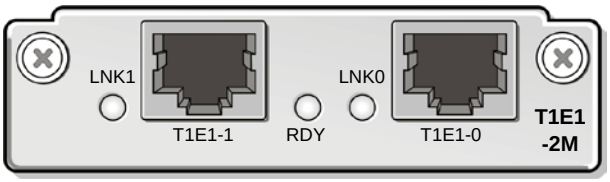


Figure 2.22 T1E1-2M Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Green	The mini module is operational and power on.
	Off	Indicates the port is Power down.
LNK 0 LNK 1	Green	Indicates the port is enabled. (Carrier Detect)
	Amber	Indicates an alarm condition exists on the remote end of one of the T1/E1 ports. On Remote End, detected alarm condition: - RDI (Remote Detect Indication) - AIS (Alarm Indication Signal).
	Red	Indicates an alarm condition exists locally on one of the T1/E1 ports. Locally, detected alarm condition: - LOS (Loss of signal) - OOF (Out-of-Frame)
	Off	Indicates that the port is not enabled, and no alarms detected on any port.

T1E1-4 (4-Port T1/E1 Network Module)

This module provides four T1 ports, each running at 1.544 Mbps and supporting 24 data timeslots, or four E1 ports, each running at 2.048 Mbps and supporting 30 data timeslots.

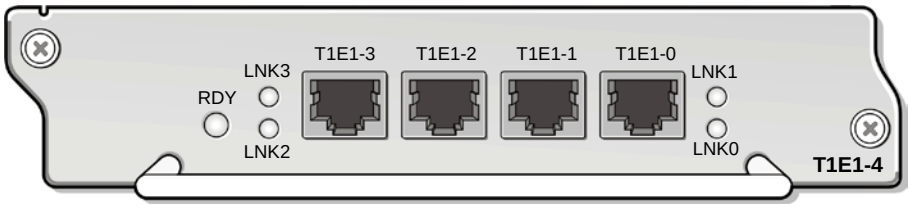


Figure 2.23 T1E1-4 Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Solid Green	Network module is operational and power on.
	Off	Indicates the port is Power down.
LNK 0 LNK 1 LNK 2 LNK 3	Green	Indicates the port is enabled. (Carrier Detect)
	Amber	Indicates an alarm condition exists on the remote end of one of the T1/E1 ports. On Remote End, detected alarm condition: - RAI (Remote Alarm Indication) - AIS (Alarm Indication Signal).
	Red	Indicates an alarm condition exists locally on one of the T1/E1 ports. Locally, detected alarm condition: - LOS (Loss of signal) - LOF (Loss of frame)
	Off	Indicates no alarms detected on any port.

WTE-1SM (1-Port Serial Mini Module)

This mini module provides one serial port, running in either DTE or DCE mode at a data rates up to 8.0 Mbps. The interface mode for the port may be independently selected as V.35, RS-232/V.28, RS-449/V.11, EIA-530, EIA-530A, or X.21/RS-422.

Figure 2.24 WTE-1SM Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Green	All diagnostics pass, and the network module is operational.
	Off	Power down or removal status.
LNK 0	Green	Green indicates normal operation. The module is connected to the external DSU, and the signals TA (DTE available) and CA (DCE available) are active.
	Red	Red indicates serial interface error. Mismatch between serial cable and interface type or operation mode.
	Amber	Loopback mode on
	Off	LED off indicates that the port is neither connected to the DSU nor in loopback mode.

WTE-2SM (2-Port Serial Mini Module)

This mini module provides two serial ports, each running in either DTE or DCE mode at a data rates up to 8.0 Mbps. The interface mode for each port may be independently selected as V.35, RS-232/V.28, RS-449/V.11, EIA-530, EIA-530A, or X.21/RS-422.

Figure 2.25 WTE-2SM Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Green	All diagnostics pass, and the network module is operational.
	Off	Power down or removal status.
LNK 0 LNK 1	Green	Green indicates normal operation. The module is connected to the external DSU, and the signals TA (DTE available) and CA (DCE available) are active.
	Red	Red indicates serial interface error. Mismatch between serial cable and interface type or operation mode.
	Amber	Loopback mode on
	Off	LED off indicates that the port is neither connected to the DSU nor in loopback mode.

WTE-4S (4-Port Serial Network Module)

This module provides four serial ports, each running in either DTE or DCE mode at a data rates up to 8.0 Mbps. The interface mode for each port may be independently selected as V.35, RS-232/V.28, RS-449/V.11, EIA-530, EIA-530A, or X.21/RS-422.

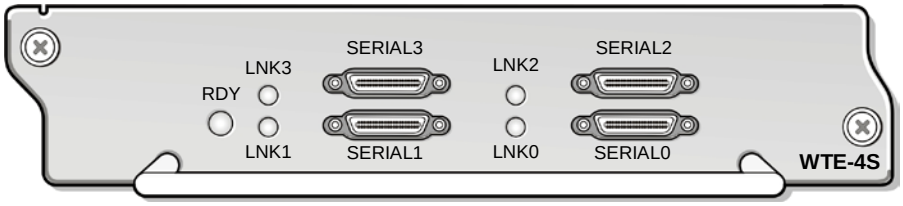


Figure 2.26 WTE-4S Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Green	All diagnostics pass, and the network module is operational.
	Off	Power down or removal status.
LNK 0 LNK 1 LNK 2 LNK 3	Green	Green indicates normal operation. The module is connected to the external DSU, and the signals TA (DTE available) and CA (DCE available) are active.
	Red	Red indicates serial interface error. Mismatch between serial cable and interface type or operation mode.
	Amber	Loopback mode on
	Off	LED off indicates that the port is neither connected to the DSU nor in loopback mode.

HSSI-1 (High-speed Serial Interface Network Module)

This module provides a single HSSI DTE or DCE serial port that operates at up to 52.0 Mbps.

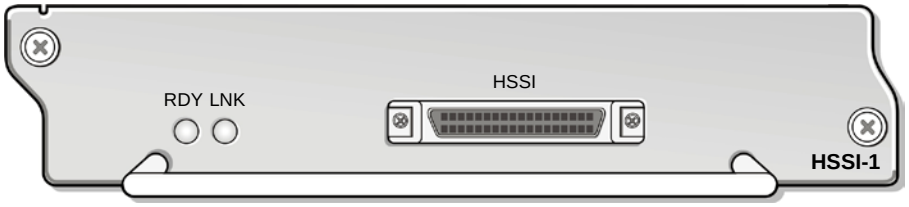


Figure 2.27 HSSI Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Solid-green	The solid-green indicate that the module has passed its self-test and is available to the router.
	Off	Indicates the port is Power down.
LNK	Green	Green indicates normal operation. The module is connected to the external DSU, and the signals TA (DTE available) and CA (DCE available) are active.
	Red	Red indicates no ST (send time) alarm in DCE mode.
	Amber	Loop back mode on (LA, LB, LC)
	Off	LED off indicates that the port is neither connected to the DSU nor in loopback mode.

WT3-1C (Channelized DS3 Network Module)

This module provides a single Digital Signal level-3 (DS3) port, operating at 44.736 Mbps. The DS3 serial data is channelized as either 28 independent T1 links or as 21 independent E1 links. Each T1 or E1 link is further channelized into 24 or 32 timeslots, respectively.
The module connects into the router subsystem.

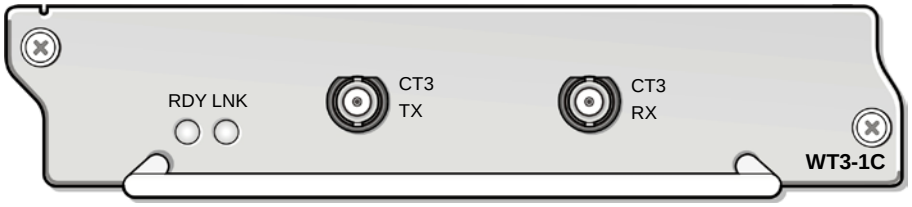


Figure 2.28 WT3-1C Module

LED	Indication & Color	Description
RDY	Solid-green	The solid-green indicate that the module has passed its self-test and is available to the router.
	Off	In the status of power-down or card-remove.
LNK	Green	Port is online with no alarms or failures. CD
	Amber	Port is online with alarms or remote failures. AIS, RDI/RAI
	Red	Port is active with a local alarm; failure detected. LOS, OOF
	Off	Port is not enabled.

ATOP-1 (1-Port ADSL Over POTS Mini Module)

This mini module provides ADSL high-speed digital data transfer between a single CPE subscriber and the central office.

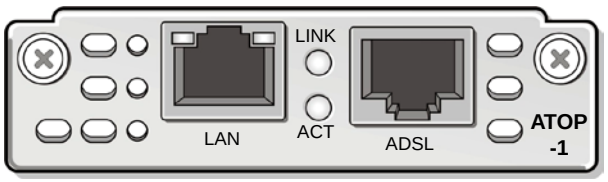


Figure 2.29 ATOP-1 Mini Module

The following table explains the LEDs states in detail.

ADSL Port LEDs

LED	Indication & Color	Description
LINK	Solid Green	Indicates that the Link is established
	Blinking Green	Indicates that the Link is being established
	Off	Indicates that the port is not enabled
ACT	Solid Green	Indicates that the transmit/receive is not active
	Blinking Green	Indicates that the transmit/receive is active
	Off	Indicates that the port is not enabled

LAN Port LEDs

LED	Indication & Color	Description
Link	Solid Green	Link is established with speed 10/100 Mbps.
	Off	Link failure or no connection.
Activity	Blinking Orange	Blinking orange indicates transmit/receive activity with speed 10/100 Mbps.
	Off	No activities.

ATOI-1 (1-Port ADSL Over ISDN Mini Module)

This mini module provides ADSL high-speed digital data transfer between a single CPE subscriber and the central office.

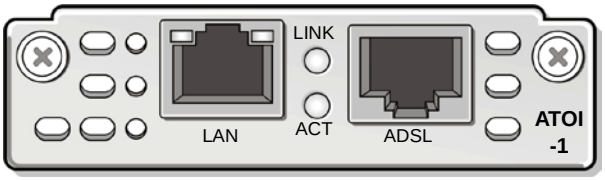


Figure 2.30 ATOI-1 Mini Module

The following table explains the LEDs states in detail.

ADSL Port LEDs

LED	Indication & Color	Description
LINK	Solid Green	Indicates that the Link is established
	Blinking Green	Indicates that the Link is being established
	Off	Indicates that the port is not enabled
ACT	Solid Green	Indicates that the transmit/receive is not active
	Blinking Green	Indicates that the transmit/receive is active
	Off	Indicates that the port is not enabled

LAN Port LEDs

LED	Indication & Color	Description
Link	Solid Green	Link is established with speed 10/100 Mbps.
	Off	Link failure or no connection.
Activity	Blinking Orange	Blinking orange indicates transmit/receive activity with speed 10/100 Mbps.
	Off	No activities.

LAN Interface Modules

LMG-20 (20-Port Gigabit Ethernet Network Module)

This module provides 20 10/100/1000 Base-T Ethernet ports and installs in one of the bottom expansion slots.

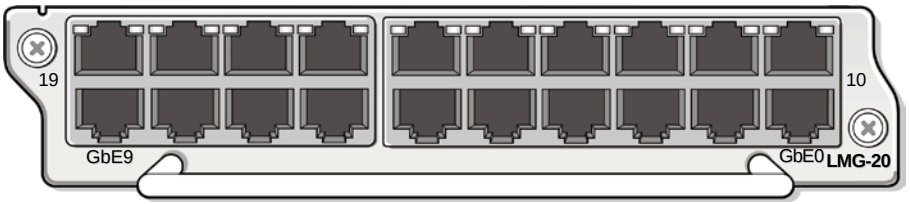


Figure 2.31 LMG-20 Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
Bi-color LED	Solid Green	Link is established with speed 10/100 Mbps.
	Blinking Green	Blinking Green indicates transmit/receive activity with speed 10/100 Mbps.
	Solid Amber	Link is established with speed 1 Gbps.
	Blinking Amber	Blinking Amber indicates transmit/receive activity with speed 1 Gbps.
	Led Off	Link Fail or No connect.

LMF-20 (20-Port Fast Ethernet Network Module)

This module provides 20 10/100 Base-T Ethernet ports and installs in one of the bottom expansion slots.

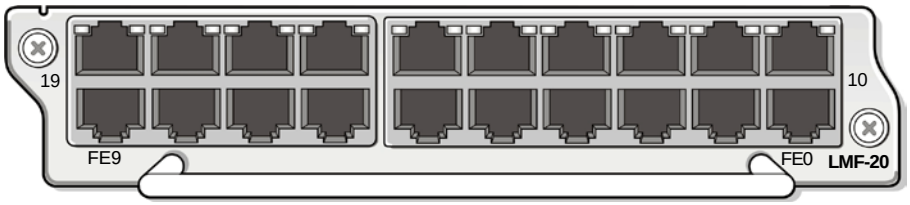


Figure 2.32 LMF-20 Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
(Link & Activity)	Solid Green	Link is established with speed 10/100 Mbps.
	Blinking Green	Blinking green indicates transmit/receive activity with speed 10/100 Mbps.
	Off	Link Fail or no connect.

LMP-20 (20-Port PoE Fast Ethernet Network Module)

This module provides 20 10/100 Base-T Ethernet ports each capable of supporting PoE (Power over Ethernet) devices. Install this module in one of the bottom expansion slots.

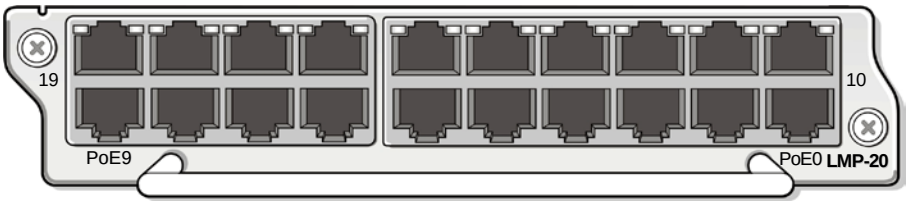


Figure 2.33 LMP-20 Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
(Link & Activity)	Solid Green	Link is established with speed 10/100 Mbps.
	Blinking Green	Blinking Green indicates transmit/receive activity with speed 10/100 Mbps.
	Off	Link Fail or no connect.

LFP-20 (20-Port Layer-2 PoE Fast Ethernet Network Module)

This module provides layer-2 Ethernet switching functionality along with PoE through each port. Install this module in one of the bottom expansion slots.

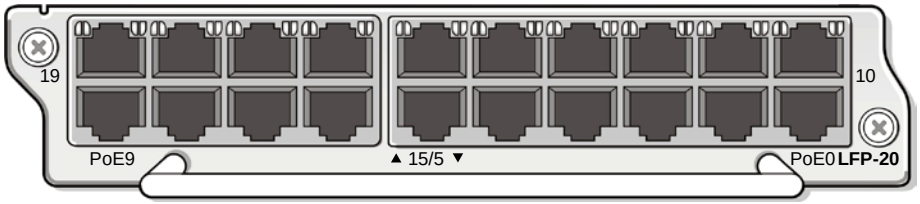


Figure 2.34 LFP-20 Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
Link	Green	Link is established with speed 10/100 Mbps.
	Off	Link fail or no connection is established.
Activity	Amber	Blinking amber indicates transmit/receive activity with speed 10/100 Mbps.
	Off	No traffic is passing through the port.

Voice Modules

VCU-A (Voice Carrier Network Module)

This module installs as a network module and can hold any pair of mini modules. Thus, it can be used to add additional FXO, FXS/DID, E & M, T1/E1 or ISDN mini modules to the system. The maximum number of voice mini modules supported by a Ubigate iBG2016 system is six (four mini module slots, one network modules with two voice mini modules).

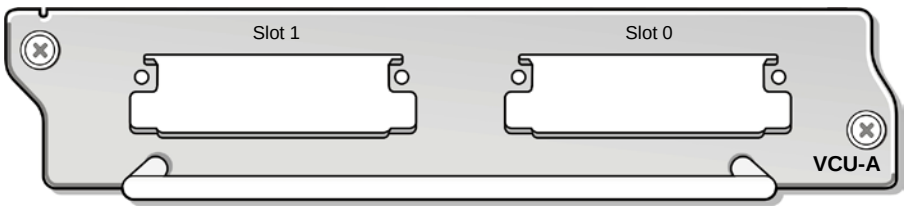


Figure 2.35 VCU-A Network Module

FXO-2M (2-Port Analog FXO Mini Module)

This module provides two analog voice channel ports for connections to Plain Old Telephone Services (POTS) telephones. The voice channels connect to the voice subsystem.

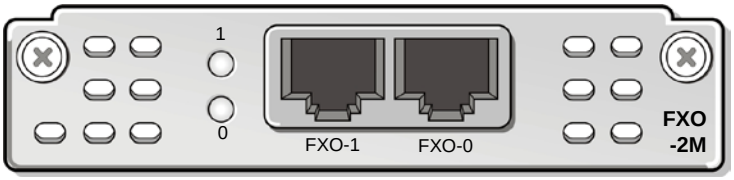


Figure 2.36 FXO-2M Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
0 1	Green	The port 0/1 connection is active.
	Amber	The port 0/1 connection is abnormal or initial state.
	Red	The port 0/1 connection is in alarm status.
	Off	The port 0/1 activity is occurring.

FXO-4M (4-Port Analog FXO Mini Module)

This module provides four analog voice channel ports for connections to Plain Old Telephone Services (POTS) telephones. The voice channels connect to the voice subsystem.

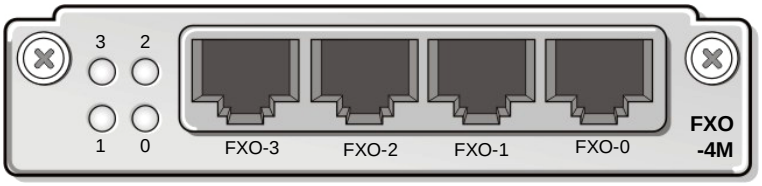


Figure 2.37 FXO-4M Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
0 1 2 3	Green	The port 0/1/2/3 connection is active.
	Amber	The port 0/1/2/3 connection is abnormal or initial state.
	Red	The port 0/1/2/3 connection is in alarm status.
	Off	The port 0/1/2/3 activity is occurring.

FXS-2M (2-Port Analog FXS/DID Mini Module)

This module provides two analog voice channel ports for connections to PBX station lines or FXS/DID lines from a central office of the Public Switched Telephone Network (PSTN). The voice channels connect to the voice subsystem.

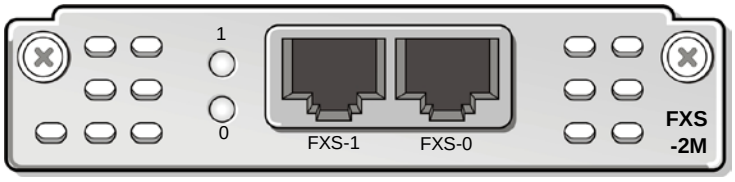


Figure 2.38 FXS-2M Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
0 1	Green	The port 0/1 connection is active.
	Amber	The port 0/1 connection is abnormal or initial state.

FXS-4M (4-Port Analog FXS/DID Mini Module)

This module provides four analog voice channel ports for connections to PBX station lines or FXS/DID lines from a central office of the Public Switched Telephone Network (PSTN). The voice channels connect to the voice subsystem.

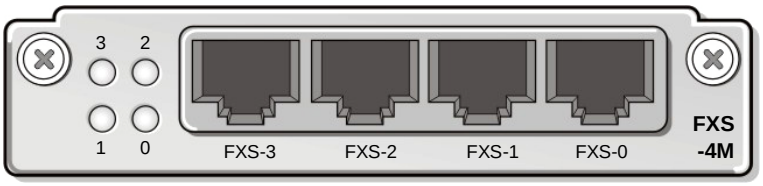


Figure 2.39 FXS-4M Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
0	Green	The port 0/1/2/3 connection is active.
1 2 3	Amber	The port 0/1/2/3 connection is abnormal or initial state.

E & M-1M (1-Port E & M Mini Module)

This module provides internetworking functions for POTS, and trunk interfaces. The E & M (Ear and Mouse) voice mini module is a mini module that mates with the main board and/or the voice carrier module. The E & M interface module is a mini module that slide into the voice network module.
The E & M mini module used:
Mainly between PBXs or other network-to-network telephony switches.
There are four main parameters defining the different analog E & M implementations:

- E & M Interface Types and Wiring Arrangement (Type I, II, III and V)
- Audio Implementation (two-wire/four-wire)
- Start Dial Supervision Signaling (immediate, wink and delay)
- Address Signaling (pulse, DTMF)

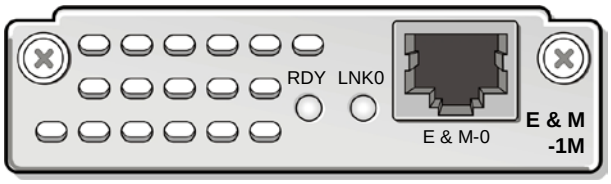


Figure 2.40 E & M-1M Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Green	The module passed it's self-test and is available to the router.
	Off	Reset, Power down, Removal state.
LNK0	Green	The port 0/1 connection is active.
	Amber	The port 0/1 connection is abnormal or initial state.
	Red	The port 0/1 connection is in alarm status.
	Off	No port 0/1 activity is occurring.

E & M-2M (2-Port E & M Mini Module)

This module provides internetworking functions for POTS, and trunk interfaces. The E & M voice mini module is a mini module that mates with the main board and/or the voice carrier module. The E & M interface module is a mini module that slide into the voice network module.
The E & M mini module used:
Mainly between PBXs or other network-to-network telephony switches.
There are four main parameters defining the different analog E & M implementations:

- E & M Interface Types and Wiring Arrangement (Type I, II, III and V)
- Audio Implementation (two-wire/four-wire)
- Start Dial Supervision Signaling (immediate, wink and delay)
- Address Signaling (pulse, DTMF)

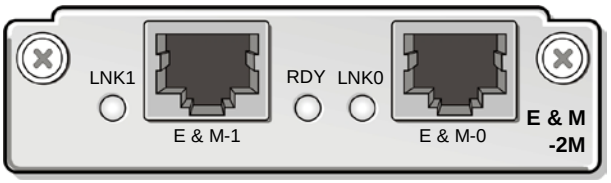


Figure 2.41 E & M-2M Mini Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	Green	The module passed it's self-test and is available to the router.
	Off	Reset, Power down, Removal state.
LNK0 LNK1	Green	The port 0/1 connection is active.
	Amber	The port 0/1 connection is abnormal or initial state.
	Red	The port 0/1 connection is in alarm status.
	Off	No port 0/1 activity is occurring.

FXS-24 (24-Port Analog FXS/DID Network Module)

This module provides 24 analog voice channel ports for connections to POTS telephones. The voice channels connect to the voice subsystem.
(Actually, FXS-24 provides only 12 ports, and it will be increased 24 ports by FXS-4E Sub-Board. One FXS-4E sub-board provide 4 ports)

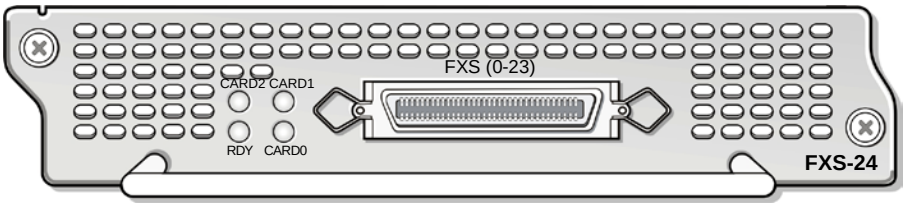


Figure 2.42 FXS-24 Network Module

The following table explains the LEDs states in detail.

LED	Indication & Color	Description
RDY	GREEN	All diagnostics pass, and the network module is operational.
	OFF	Reset, Power down or removal status.
CARD0 CARD1 CARD2	Solid Green	Internal Extension Card Present
	Off	Internal Extension Card not Present

FXS-24 Extension Box

This module provides 24 port analog voice channel connector between FXS-24 module and telephones. It has 24 RJ-11 connector in the front side and 1 champ connector in the rear side.

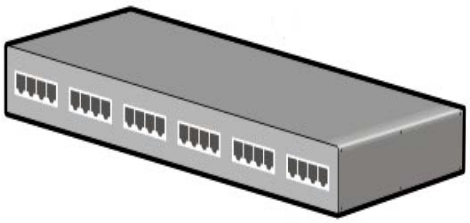


Figure 2.43 FXS-24 Extension Box

CHAPTER 3. Software Overview

Chapter 3 describes the Software overview.

Routing Engine and Packet Forwarding Engine

The router subsystem is a software-based one and can support a variety of routing protocols. Packet headers may be examined and modified as required to support routing between links supporting different protocols.
Received packets are moved into the main memory by the source interface using DMA. The routing processor on the main board examines each packet header in the main memory, makes the routing decision, modifies the packet as required, and connects the packet into the transmit queue for the appropriate destination. The destination interface then copies the packet from main memory using DMA and transmits the packet.
Packet data is stored in data buffers that are separate from the descriptor structures used by the source and destination DMA controllers. This allows the processor to get a packet ready for transmission without copying it from one buffer to another.

To support both switching and routing functionality for Ethernet packets, the Ubigate iBG2016 includes an Ethernet subsystem connecting various modules in the Ubigate iBG2016. The major components are:

- A Gigabit Ethernet Switch on the Main Board provides switched connectivity between the Routing Processor, the Ethernet Switch Gigabit module, the four RJ45 Fast Ethernet ports and one Small Form Factor Pluggable (SFP) optical Gigabit Ethernet port.

Kernel

The operating system is a Real-Time Operating System (RTOS). It provides services for the application software such as multi-tasking, inter-task communications, interrupt and memory management. In addition, it provides a framework for the I/O and file systems.

Processes

Management Process

The management plane consists of Command Line Interface (CLI), Simple Network Management Protocol (SNMP), and the Web-based management interface of the Ubigate iBG2016. See the User Interface section for descriptions of the CLI and Web-based management interface.

SNMP Architecture

To allow network management systems to remotely manage Ubigate iBG2016 products, SNMP v1/v2/v3-as defined by RFC 1157 and version 2 (also called as v2c) as defined by RFCs 1903 is supported. The Structure of Management Interface-SMIv1 and SMIv2-as defined by RFC 1155 and 1902 are supported.

MIB Information

A number of feature specific RFC Standard Management Information Base (MIB)s and Enterprise MIBs is implemented. The listed the respective MIBs that are implemented.

Community-based Authentication

Community-based SNMP v2 is supported, i.e., SNMP v2c. This SNMP framework associates each message with a ‘community’ as defined in SNMP v1**[RFC 1157]**.

User-Based Security Model (USM)

The User-Based Security Model (USM) for SNMP v3 **[RFC2574]** is supported.

To protect data integrity, USM uses MD5 and the Secure Hash Algorithm as keyed hashing algorithms for digest computation. This directly protects against data modification attacks, indirectly provides data origin authentication, and defends against masquerade attacks.

USM uses loosely synchronized monotonically increasing time indicators to defend against certain message stream modification attacks. Automatic clock synchronization mechanisms based on the protocol are specified without dependence on third-party time sources and concomitant security considerations.

USM uses the Data Encryption Standard (DES) in the cipher block chaining (CBC) mode to protect against disclosure.

View-Based Access Control Model (VACM)

The view-based access control model for SNMP **[RFC2575]**, which controls access to management information, is supported.

For security reasons, it is often beneficial to restrict the access rights of some groups to only a subset of the management data in the management domain. To provide this capability, access to a context is through an MIB view, which details a specific set of managed object types within that context.

Traps

All applicable standard and enterprise Traps is implemented. The trap support also follows the AgentX architecture. The sub-agents will generate traps whenever necessary and forward it to the master-agent using AgentX protocol. The master-agent will form a TRAP Packet Data Unit (PDU) and forward it to the pre-configured Network Management Station/Trap receiving station.
The Ubigate iBG2016 product supports more than one traphost to send traps to.

RMON

Remote Network Monitoring (RMON-1) is supported for LAN (Ethernet) interfaces as prescribed by RFC 1757. RMON groups 1, 2, 3 and 9 are supported.

The following are the groups supported:

- The Ethernet Statistics Group
  The Ethernet statistics group contains statistics measured by the probe for each monitored Ethernet interface on this device. This group consists of the etherStatsTable.
- The History Control Group
  The history control group controls the periodic statistical sampling of data from various types of networks. This group consists of the historyControlTable.
- The Ethernet History Group
  The Ethernet history group records periodic statistical samples from an Ethernet network and stores them for later retrieval. This group consists of the etherHistoryTable

Chassis Process

The chassis manager is responsible for detecting and the power-on initialization of the pluggable/removable modules. This software manages the status of the removable modules and notifies the application software when a change occurs. On Ubigate iBG2016 power-up, the chassis manager determines which slots have modules inserted and then applies power to those slots. If a module is subsequently removed, the chassis manager receives an interrupt and notifies the application software the module is no longer in the Ubigate iBG2016. The chassis manager maintains the state and status of module in the pluggable slots.

Hot Swap

The hot swap feature is to enable a craft person to replace one module with another module (of the same type) without affection to the other system operations. For example, 4-port T1/E1 module can be replaced by another 4-port T1/E1 module but not by 4-port serial module.
This feature reduces the administrative overhead considerably, for configuration of each interface on the module and reconfiguration when a same type module is reinserted. A voice and WAN (except HSSI, CT3) module can be removed from a system and reinserted while the system is powered. For this case, data path for other non related active modules will not be impacted. Also, upon completion of this operation, the previous module configuration is to be restored.
A hardware interrupt is generated upon removal and insertion of a module. Thus, hot swap function allows the system to determine when a change occurs in the unit's physical configuration and indicate status to the user.

This feature is supported by following modules.

Type	Module Name
WAN Module	- T1E1-2M, T1E1-4 - WTE-2SM, WTE-4S - BRI-2U, BRI-2ST
Voice Module	- FXS-4M, FXS-24 - FXO-4M

(Continued)

Type	Module Name
Voice Module	- E & M-2M - VCU-A
Security Module	ISM

The module must be in administrative down (shutdown) state before being removed. The swapping module must be the same type card and inserted to the same slot.

Routing Protocol Process

This section describes the routing protocol process of the Ubigate iBG2016, including descriptions of:

- L2 Control Protocols, consisting of Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP), Link Aggregation Control Protocol (LACP), GARP VLAN Registration Protocol (GVRP), GARP Multicast Registration Protocol (GMRP), and Internet Group Management Protocol (IGMP) Snooping
- Unicast Protocols, consisting of Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), and Routing Information Protocol (RIP).
- Multicast Protocols, consisting of Protocol Independent Multicast-Sparse Mode (PIM-SM), Distance Vector-Multicast Routing Protocol (DV-MRP).
- WAN Protocols, consisting of PPP, Frame Relay, High-level Data Link Control procedure (HDLC) and ISDN

Layer2 Protocols

The Layer2 module consists of 3 major components, each running as a task:

- xSTP for Spanning Tree Protocol, this task includes VLAN Bridge module, Generic Attribute Registration Protocol (GARP)/GARP Multicast Registration Protocol (GMRP)/GARP VLAN Registration Protocol (GVRP) modules and Internet Group Management Protocol (IGMP) Snooping module.
- LACP for the link aggregation protocol
- Authentication Daemon (AUTHD) for 802.1x port authentication protocol

xSTP consists of Bridge and VLAN modules, GVRP and GMRP protocols, IGMP Snooping module, STP or RSTP or MSTP state machine and the communication modules to exchange messages with other components. RSTP covers STP functionality and MSTP covers RSTP functionality. Thus one Spanning Tree Protocol runs at the same time. xSTP is named for the common Spanning Tree Protocol and identifies one the these protocols.

Layer 2 Protocol	Description
Bridge	LAN bridging allows extension of LAN by supporting connection of multiple LAN segments. MAC addresses of the datagram that flow through bridges are examined to build a table of known destinations. If the destination of a datagram is on the same segment as the source of the datagram, the bridge drops the datagram because forwarding is not required. However, if the destination is on another segment, the bridge transmits the datagram on that segment only. If the bridge does not know the destination segment, it transmits the datagram on all segments except the source segment (a technique known as flooding). Bridge Module is the elementary module in L2 Control Modules, which keep the Bridge, port and VLAN information. Each port and VLAN could be bound to a specific Bridge through a CLI command.
VLAN	The VLAN Module manages the table and information for 802.1q, 802.1p and 802.1v. In addition, Subnet-based and policy-based VLAN are implemented in Ubigate iBG2016.
GVRP	GVRP provides the 802.1Q-compliant VLAN pruning and dynamic VLAN creation on 802.1Q trunk ports. GVRP module exchanges VLAN configuration information with other GVRP switches, prune unnecessary broadcast and unknown unicast traffic, and dynamically create and manage VLANs on switches connected through 802.1Q trunk ports.
Multicast	Two multicast modules are implemented for Layer2 Multicast in Ubigate iBG2016, GMRP and IGMP Snooping. These protocols can not be enabled at the same time. One or more links to be aggregated together to form a Link Aggregation Group (LAG), such that a MAC Client can treat the Link Aggregation Group as if it were a single link. This allows for faster connections between switches managed as a single connection.

(Continued)

Layer 2 Protocol	Description
GMRP	GMRP provides a mechanism that allows bridges and end stations to dynamically register group membership information with the MAC bridges attached to the same LAN segment and for that information to be disseminated across all bridges in the Bridged LAN that supports extended filtering services. A switch can exchange multicast group information with other GMRP switches, prune unnecessary broadcast traffic, and dynamically create and manage multicast groups.
IGMP Snooping	IGMP snooping module can passively snoop on IGMP packets to learn the IP Multicast group membership. IGMP snooping module supports IGMP v1, v2 and v3.
Additional L2 Functions	Port Mirroring, Broadcast Storm Suppression and 802.3x Flow Control are implemented simply with the proper CLIs and NPF APIs.
LACP	LACP runs as a task for link aggregation control protocol and management. One or more links to be aggregated together to form a Link Aggregation Group (LAG), such that a MAC Client can treat the Link Aggregation Group as if it were a single link. This allows for faster connections between switches managed as a single connection, load sharing and load balancing among the individual links within a logical connection, and a failure mechanism that allows a link to stay up at a reduced peak rate even if some of the physical ports go out of service.
AUTHD	AUTHD task runs for 802.1x port authentication control protocol and management. 802.1x-Port Authentication offers an effective framework for authenticating and controlling user traffic to a protected network. 802.1X ties the Extensible Authentication Protocol (EAP) to both the wired and wireless LAN media and supports multiple authentication methods, such as token cards, Kerberos, one-time passwords, certificates, and public key authentication. Variable authentication methods support with EAP (EAP-MD5, TLS, TTLS, PEAP) is dependent on the support of the client and the authentication server. RADIUS was primarily used by ISPs who authenticated username and password before the user got authorized to use the ISP's network. 802.1X does not specify what kind of back-end authentication server must be present, but RADIUS is the ‘de-facto’ back-end authentication server used in 802.1X.

Dual Stack

The primary functions performed by the Dual Stack (DS) involves providing the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) support through socket interfaces to various applications in Ubigate iBG2016 for both IPv4 and IPv6 and to support Smart Forwarder in layer-3 packet forwarding. The DS maintains the Forwarding Information Base for layer-3 routing performed at the CPU. The DS also provides support for implementing link layer functions such as ARP/NDP for Ethernet interfaces.

Unicast Routing

Interior Gateway Protocols such as RIP, Routing Information Protocol next generation (RIPng), OSPF, and OSPFv3 are supported in the Ubigate iBG2016 software.

BGP

The Border Gateway Protocol (BGP) enables the sharing of routing data between multiple Autonomous Systems (AS) and domains to establish efficient, loop-free routes. It determines the best paths in networks and performs optimal routing between multiple autonomous systems. When peer routers enter into capability negotiation, if only one side supports graceful restart capability, the session is not terminated.
BGP uses the Transmission Control Protocol (TCP) as its transport protocol. Any two routers that communicate through a TCP connection with each other to exchange routing information are known as peers or neighbors.

Multicast Routing Protocols

The Ubigate iBG2016 multicast routing protocols are implemented as a modular architecture and each protocol is implemented as a separate protocol module.
The following Multicast routing modules are supported.

Multicast Routing Protocols	Description
IGMPv2: Internet Group Membership Protocol	The Internet Group Management Protocol (IGMP) is used between IP hosts and IP routers. IP Host reports their multicast group membership to the neighboring multicast routers expressing their desire to receive multicast traffic destined for the group. Multicast routers use IGMP to learn, for each of their attached physical networks, which groups have members. IGMP should be enabled on both hosts and routers that want to receive multicast traffic.
MLDv1: Multicast Listener Discovery	The Multicast Listener Discovery Protocol (MLDv1) is used by IPv6 routers to discover the presence of multicast listeners (i.e., nodes that wish to receive multicast packets) on their directly attached links, and to discover, specifically which multicast addresses are of interest to those neighboring nodes.
PIM-SM and PIM-SMv6: Protocol Independent Multicast-Sparse Mode	Protocol Independent Multicast (PIM) protocols route multicast packets to multicast groups. PIM is protocol independent because it can leverage whichever unicast routing protocol is used to populate unicast routing table. PIM-SM tries to send multicast data only to networks that have active receivers. This is achieved by having a common Rendezvous Point (RP) known to the senders and receivers and forming shared trees from the RP to the receivers. PIM-SMv6 is similar to the PIM-SM protocol but it is for Ipv6 networks.
DVMRP: Distance Vector Multicast Routing Protocol	Distance Vector Multicast Routing Protocol (DVMRP) is a multicast routing protocol that provides an efficient mechanism for connectionless datagram delivery to a group of hosts across an inter-network. It is a distributed protocol that dynamically generates IP multicast delivery trees using a technique called Reverse Path Multicasting. The Multicast routing protocol modules (DVMRP, PIM-SM and PIM-SMv6) are each separate protocol modules running as clients to the Network Services Module (NSM).

WAN Protocols

Ubigate iBG2016 uses network modules (up to 2) and mini modules (up to 3) for providing WAN connectivity. These modules are typically support T1 (E1) or T3 (E3) speeds. The protocols such as PPP and Frame Relay (including their multilink variations) are implemented in the Ubigate iBG2016 to provide link layer connectivity.

WAN protocols interface with the (T1/E1 and T3/E3 framers through their device drivers) and with the VLAN/IP software forwarding engines in the Ubigate iBG2016 CPU subsystem. Also, the ISDN subsystem interfaces with these modules to provide physical channels. WAN protocol stack architecture is based on the STREAMS, which is a general-purpose mechanism to implement communication services.

WAN Protocols	Descriptions
Frame Relay	Frame Relay (FR) is one of the widely used transport protocols for Wide Area Networking (WAN) community. The objective of including FR is to provide WAN connectivity to both remote routers and FR switches. The protocol stack can provide both RFC1490 based multi-protocol encapsulation as well as PVC switching. Also, standard frame relay congestion management procedures based on frame relay traffic parameters-Bc, Be and CIR- (ingress policing, egress shaping/rate limiting) are supported. The following LMI types are supported-LMI Rev 1, Stratacom/Cisco LMI, T1.617 Annex D, Q.933 Annex A and alternately, the LMI can be disabled (None). Apart from these, fragmentation and inverse ARP is supported over FR PVCs.
HDLC	High-Level Data Link Control (HDLC) is a bit-oriented synchronous data link layer protocol developed by the International Organization for Standardization (ISO). The original ISO standards for HDLC were: - ISO 3309-Frame Structure - ISO 4335-Elements of Procedure - ISO 6159-Unbalanced Classes of Procedure - ISO 6256-Balanced Classes of Procedure The current standard for HDLC is ISO 13239, which replaces all of those standards. HDLC provides both connection oriented and connectionless service. HDLC can be used for point to multipoint connections, but is now used almost exclusively to connect one device to another, using what is known as Asynchronous Balanced Mode (ABM). The other modes are Normal Response Mode and Asynchronous Response Mode.

(Continued)

WAN Protocols	Descriptions
PPP	The Point-to-Point Protocol (PPP) provides a standard method for transporting multi-protocol datagram over point-to-point links. These links provide full-duplex simultaneous bi-directional operation and are assumed to deliver packets in order.
	PPP is comprised of 3 main components: A method for encapsulating multi-protocol datagram. In Ubigate iBG2016, PPP is used on the links that use HDLC-like framing (on the WAN side over T1/T3 physical interfaces). The details of the encapsulations can be found in RFC1662 and RFC2516. A Link Control Protocol (LCP) for establishing, configuring and testing the data-link connection. The details of this can be found in RFC 1661. A family of Network Control Protocols (NCPs) for establishing and configuring different network layer protocols. There is a NCP for each network protocol for example, IPCP for IP networks. Optionally, before PPP NCP is established, peers may need to authenticate themselves and any failure during this can result in the link termination. There are two authentication protocols: Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP). In addition to the above, PPP will also interface with AAA for username/password validations. The PPP is the most ubiquitous WAN protocol today for internet access and/or leased line connectivity to a remote office. When the bandwidth requirements go beyond a single T1 (and DS3 being expensive or unavailable) multilink PPP can be used to create a bigger bandwidth pipe. Both Frame Relay and PPP use a common multilink library because of its efficiency.

(Continued)

WAN Protocols	Descriptions
ISDN	The WAN interfaces are typically connected using leased lines with interface such as T1/E1. There are chances that the T1/E1 links goes down due to various reasons thereby resulting in the loss of wan connectivity. The wan connectivity comes up only when the T1/E1 links are restored. Hence there is a need to have an alternate connectivity till the T1/E1 links are restored. When the primary connectivity (T1/E1) links go down, ISDN can be used as a secondary connection. ISDN can be used as dial up connection to connect to Internet or remote server for certain amount of time until the primary T1/E1 links are restored. ISDN can also exist as an independent interface to provide remote connectivity to Headquarters and/or for Internet connectivity very similar to the other interfaces like T1/E1. In certain countries the ISDN connections are not very expensive that they can be used as the primary connections as well.
	The ISDN interface can be a mini module or a network module in Ubigate iBG2016. The ISDN modules are - 2-port ISDN BRI-S/T - 2-port ISDN BRI-U T1/E1 (mini and network module) with PRI support. The Ubigate iBG2016 will support T1 and E1 interfaces (ISDN PRI). ISDN BRI and PRI user-side protocols shall be supported to provide interconnection of the Ubigate iBG2016 System to PSTNs. Ubigate iBG2016 can also act as a network side element.

Interface Process

The interface manager software contains WAN and LAN interface status and control functionality. This includes the CLI functions to control physical interfaces such as creating WAN bundles or setting Ethernet interface, and refers to the data structures to track the configuration, state of WAN, and LAN interfaces. It includes storage and retrieval from/to NVRAM of the current configuration of the interfaces. Each interface type has its own set of CLI commands for controlling the interface.

Forwarding Process

This section describes the packet forwarding functions performed by the CPU subsystem of the Ubigate iBG2016. The packet forwarding functions in the CPU is performed by the Smart Forwarder (SF) module in conjunction with the Dual TCP/IP Stack, Device Drivers and PSS modules. While the Smart Forwarder performs most of the forwarding functions, the Dual Stack is responsible for forwarding of packets with IP options received from both the PSS subsystem and from the Smart Forwarder. Smart Forwarder receives packets from the various LAN, WAN and MAN interfaces and performs layer 2, layer 3 SF also receives packets from the Dual Stack to be forwarded to LAN, Main board GbE, Management, WAN or MAN interfaces.

The major sub components of the Smart Forwarder are:

- Layer 2 Forwarding component: This component performs layer 2 forwarding functions.
- Layer 3 Forwarding component: This component performs IPv4 unicast, IPv4 multicast, IPv6 unicast and IPv6 multicast forwarding functions.
- Firewall/VPN component: This component performs the firewall and IPSec based VPN functions in conjunction with Layer 3 Forwarding component.
- ACL component: This component performs ACL based stateless firewall function for packets received on the WAN/MAN and Main board GbE interfaces.
- QoS component: This component performs the QoS functions for packets received from WAN/MAN interfaces as well as packets transmitted to WAN/MAN interfaces.
- Tunneling component: This component performs the GRE, IPIP and IPv6 tunneling functions.

User Interfaces

Command Line Interface

The Command Line Interface (CLI) forms the link between the end user and the features of the device with a text-based interface. Users can issue commands that need to be executed on the Ubigate iBG2016.
The CLI provider's editor support for easy command editing/navigation, command history, and command completion.
You are presented with a command prompt when logged into the Ubigate iBG2016.
Each command is terminated by a new line (Enter key). The command string is passed on to the parser for syntax and semantic check. If the command has syntax error, the parser prints an error message and returns to prompt.
If the command is syntactically correct, the parser calls the target function defined in the CDF file. The function is executed and return value is displayed back at the prompt. It can be an error message or a confirmation message of the operation. Some commands can return a value zero and the parser displays the prompt again without any message.
The CLI supports Emacs editor keystrokes. This is provided to facilitate correction/editing commands while entering commands.

This is restricted to single line editing. Some example keystrokes include:

- CTRL-A: Takes the cursor to beginning of line
- CTRL-E: Takes the cursor to end of line (last character)

The CLI maintains the list of user entered commands. You can get the list of previously executed commands by entering 'UP-ARROW'. The CLI stores a maximum of 100 commands. This is a configurable value.

CLI Privilege Levels

The CLI supports four levels of privileges. PRIVILEGE_ADMIN is the highest and PRIVILEGE_NORMAL being lowest.

The order of privileges is:

- PRIVILEGE_ADMIN 1
- PRIVILEGE_CONFIGURE 2
- PRIVILEGE_TEST 3
- PRIVILEGE_NORMAL 4

CLI Omnipresent Commands

The CLI supports omnipresent commands. The user at any level can execute these commands. These commands include: display, clear, save, show, ping, telnet, trace, mtrace, write, dir, erase. For details refer to the Command Reference.

Web GUI (HTTP Server)

The Web GUI (iBG-DM) is an additional interface that is supported on the Ubigate iBG2016 product. This allows end users to monitor and configure the device. The GUI is targeted at Novice and Intermediate users only.
The supported browser is Internet Explorer 5.5+.

iBG-DM support web based management tool that allow you to configure LAN and WAN interfaces, routing, VoIP, Network address Translation (NAT), firewalls, Virtual Private Networks (VPNs) and other features on the router. Also iBG-DM provide simple fault, performance, security management functions.
The figure below shows network diagram using iBG-DM.

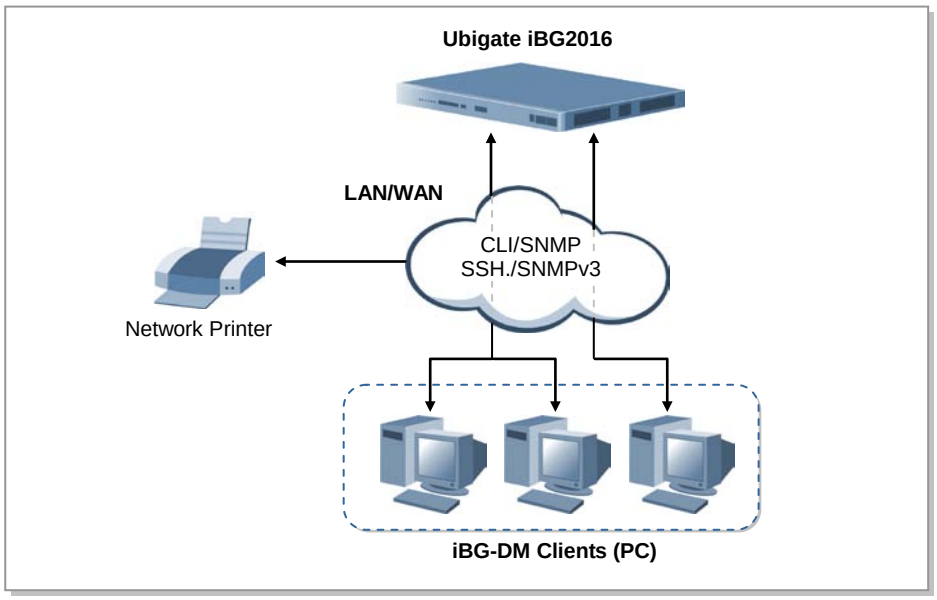


Figure 3.1 iBG-DM Management Network Diagram

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CHAPTER 4. Voice Features

This chapter describes an overall voice feature that Ubigate iBG2016 provides.

Introduction to Voice Feature

Ubigate iBG2016 is a high-performance enterprise access router that provides a VoIP gateway. A VoIP gateway provides real-time, two-way voice communications between the packet network and circuit network.

Network Architecture

The Ubigate iBG2016 network architecture is shown in figure 4.1.

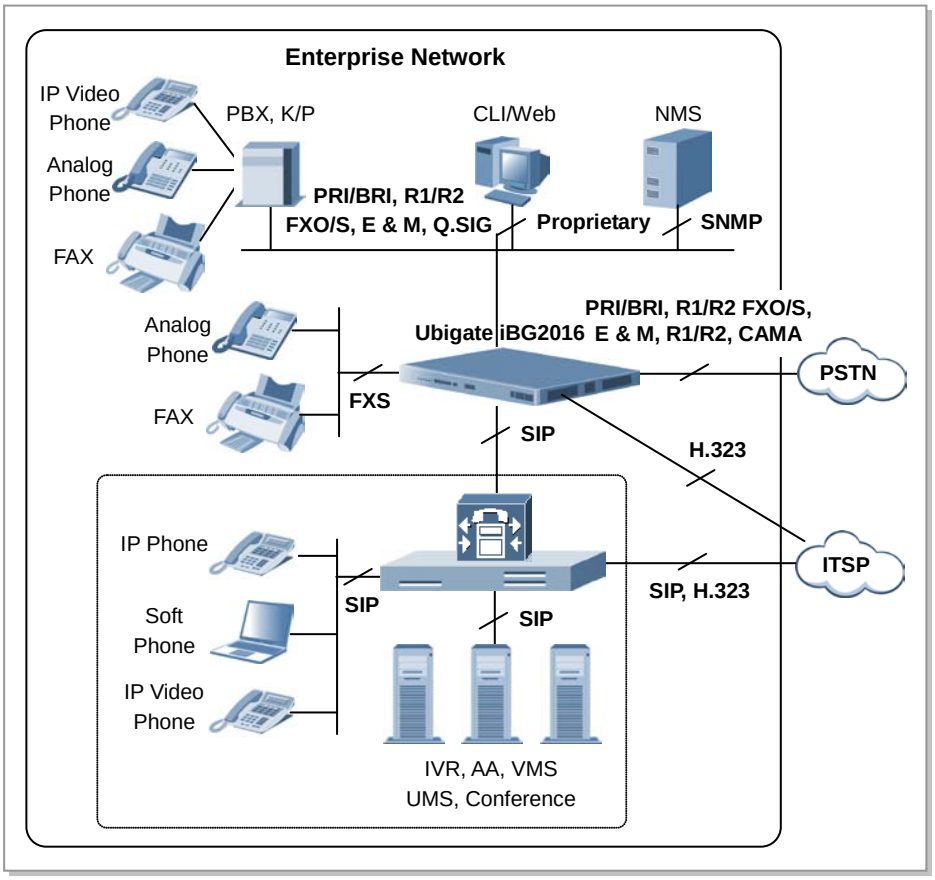

Figure 4.1 Ubigate iBG2016 Network Diagram

The external entities that interwork with Ubigate iBG2016 over a network are as follows:

Ubigate iBG2016

Ubigate iBG2016 acts as the interface between a traditional voice network and the IP network. It interfaces with traditional voice networks (PBX and PSTN) through digital trunk interfaces, such as T1/E1, ISDN PRI/BRI, and Q.SIG, and analog trunk interfaces, such as FXS (DID), FXO, CAMA and E & M. Ubigate iBG2016 terminates the PSTN/ISDN and analog trunk signals and acts as a VoIP gateway, converting the TDM to IP packets and vice versa. It communicates with iPX using standard protocols, such as SIP.

IP PBX (Ubigate iPX)

IP PBX performs call processing functions and interfaces with Ubigate iBG2016 over the packet network using VoIP protocols, such as SIP. IP PBX provides basic VoIP call services and a number of supplementary and application services by interworking with other application servers.

IP Phone/Soft Phone

IP phone provides a generic voice call service over IP network. IP phone, to support the basic call and supplementary call services, interfaces with Ubigate iPX using standard RFC3261 based SIP Protocol with some other extensions.

Analog Phone/FAX

Analog phone is the terminal providing a generic voice call service using the legacy analog line. FAX is the terminal providing a fax service using the legacy analog line.

PBX, KTS

PBX and key phone systems are voice hardware connecting in-house extension calls or external calls using legacy analog and digital trunks instead of the IP Network.

CLI/Web

This is the OAM interface provided by Ubigate iBG2016 that controls various OAM functions in Ubigate iBG2016 after accessing Ubigate iBG2016 through CLI or the Web from a desktop or laptop computer.

NMS

The Network Management System (NMS) is used to manage Ubigate iBG2016 and iPX network devices.

IVR/AA/VMS/UMS/Conference Server

This hardware provides various services, such as VMS, IVR, AA, and Conference, which are not provided by iBG2016 and iPX.

Interface Between Network Entities

The interface specifications for interworking with network entities are as follows:

Ubigate iBG2016-iPX Interface

Ubigate iBG and iPX use the Session Initiation Protocol (SIP) for call signaling. They use standard RFC3261-based SIP, with extensions.
Samsung proprietary headers are used for VoIP services.
For management, a TCP/IP-based proprietary protocol is used in between to load subscriber profiles, feature and access-code information, and additional information for survivability.

Ubigate iBG2016-PSTN Interface

This is the interface used for interworking between existing PSTN and voice calls.
E & M, PRI, BRI, FXO, FXS/DID, R1, R2, and CAMA are used as signaling methods; T1, E1, Analog Trunk and Analog Line are used as physical layers.

- Analog I/F: FXO, FXS, DID, E & M
- Digital I/F: T1 CAS E & M/FXO/FXS, T1 R1, E1 R2 MFC/DTMF, ISDN-PRI/BRI (S/T, U)

Ubigate iBG2016-Analog Phone Interface

This is the interface used by Ubigate iBG2016 to provide voice calls to generic analog phones. FXS is used.

Ubigate iBG2016-PBX Interface

This is the interface iBG2016 uses to interwork with legacy PBX. PRI, BRI, R1, R2, FXO, E & M, Q.SIG, and DID are used as signaling methods. T1, E1, Analog Trunk, and Analog Line are used as the physical layers.

- Analog I/F: FXS, FXO, E & M
- Digital I/F: T1 CAS FXS/FXO/E & M, E1 R2 MFC/DTMF, ISDN-PRI/BRI (S/T, U), ISDN-Q.SIG

Ubigate iBG2016-CLI/Web Interface

This is the interface iBG2016 uses to interwork with CLI and Web Client to provide OAM functions. It uses the TCP/IP-based proprietary interface developed by Samsung.

Ubigate iBG2016-NMS Interface

The NMS uses this interface for integrated control of multiple iBG2016's. The interface uses the SNMP protocol and proprietary Samsung MIB.

Operation Mode

When Ubigate iBG2016 operates as an SIP gateway, it can work in iPX interworking mode, in which it interworks with SIP networks via Ubigate iPX, or in stand-alone mode (or toll bypass mode), in which it directly interworks with other SIP gateways with or without an SIP server. When connectivity with Ubigate iPX fails, iBG automatically switches to survivable telephony mode to provide basic and limited call supplementary services without Ubigate iPX. The detailed operation mode is described below.

Call-Server (Ubigate iPX) Interworking Mode

In iPX interworking mode, Ubigate iBG2016 registers in Ubigate iPX, and iPX manages multiple IP phones and iBG2016's. Generally, iBG2016 delivers voice calls to iPX via the SIP protocol. Ubigate iPX can decide to route a call to other iBG2016's, IP phones, or SIP/H.323 servers.

The generic network configuration in iPX interworking mode is shown in figure 4.1. Figure 4.2 shows Ubigate iPX controlling the corporate VoIP network in a headquarters. Multiple Ubigate iBG2016's reside in individual branch offices. In addition, multiple IP phones exist in the headquarters and each branch. The company's iBG2016's and IP phones are registered in iPX, and iPX controls the overall routing of the internal and external calls.

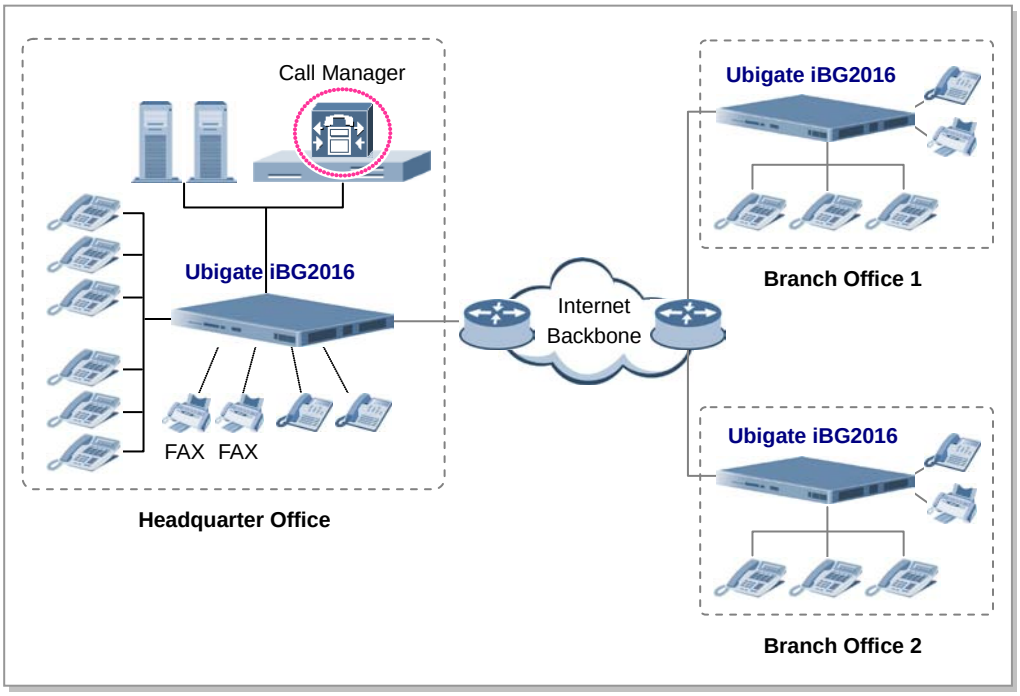

Figure 4.2 Example of iPX Interworking Mode Network Configuration

Survivable Telephony Mode

In call-server (iPX) interworking mode, all voice calls over the VoIP network are generally controlled by Ubigate iPX. All originating and terminating calls (IP and analog phones) will be unavailable if iPX fails (for example, because of link failure) or access to iPX is blocked. To respond to this status, Ubigate iBG2016 continuously monitors its connection to iPX. When it detects iPX failure, it automatically switches to survivable telephony mode in which iBG2016 can provide voice services independently.

In survivable telephony mode, the voice services in iPX interworking mode are limited.

Stand-alone mode (or Toll Bypass mode)

In stand-alone mode, Ubigate iBG2016 provides SIP trunks for other SIP entities and can interwork with standard SIP servers, such as registrar, proxy, and redirect servers.
In this mode, iBG2016 makes decisions for all call processing and routing.

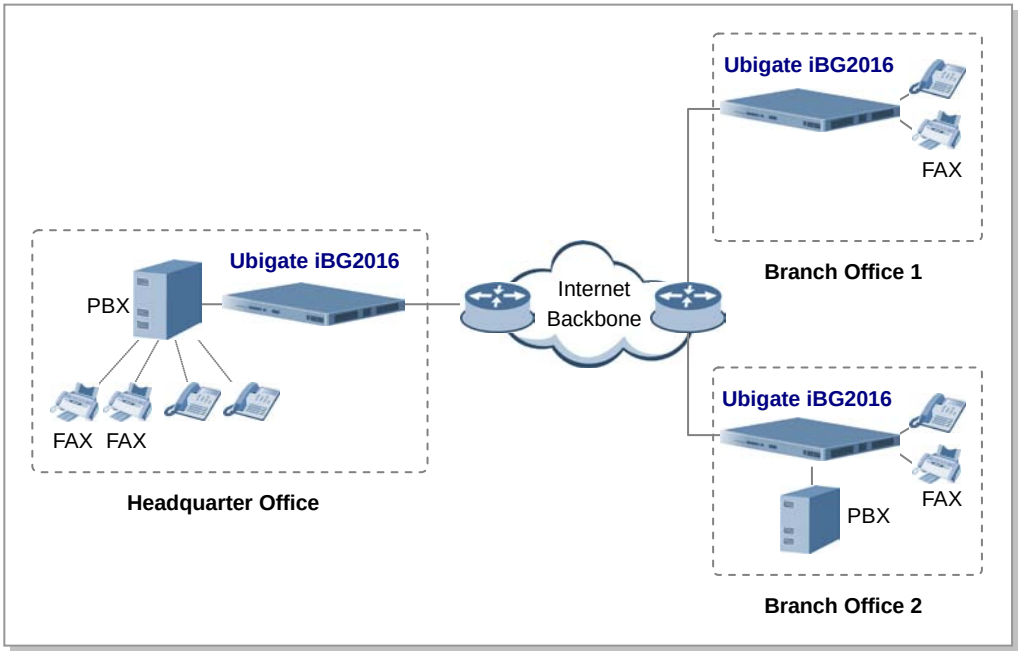

Figure 4.3 Example of Stand-alone mode network configuration

Figure 4.3 illustrates stand-alone mode network configuration.
In this configuration, Ubigate iPX and IP phones do not exist.
The internal calls of the headquarters and branch office 2 are controlled by the PBXs on each network. Outgoing calls to other branches are transmitted using the VoIP network through Ubigate iBG2016's.

Key Features

This section presents the key features of Ubigate iBG2016 voice capability.

VoIP Gateway

The VoIP gateway delivers voice calls between PSTN and IP networks. Ubigate iBG2016 acts as the interface between a traditional voice network and the IP network. It interfaces with the traditional voice networks (PBX and PSTN) through T1/E1/ISDN-PRI interfaces and analog trunk interfaces, such as DID, E & M, and FXO. Ubigate iBG2016 terminates PSTN/ISDN and analog trunk signals and acts as an interface with the IP network by interworking with SIP proxy, SIP registrar, SIP gateway, SIP terminal, H.323 gatekeeper, H.323 gateway, and others.

SIP Signaling Support

Ubigate iBG2016 supports the standard RFC3261-based SIP protocol and a number of extensions/drafts to provide SIP-based VoIP services.
Some of the protocols Ubigate iBG2016 supports are described below.

Direct Connection

Direct connection enables call processing without an SIP server. It is used when there is no Ubigate iPX or proxy server directly connected to the network.
To route calls, Ubigate creates SIP trunks that include all VoIP entities.

Indirect Connection via SIP Proxy Server

Indirect connection allows Ubigate iBG2016 to act as an SIP gateway for Ubigate iPX or an SIP proxy server.
With this indirect connection, Ubigate iBG2016 registers with the Ubigate iPX or SIP registrar, and outbound calls route to the server.

H.323 Signaling Support

Ubigate iBG2016 acts as an H.323 gateway and interworks with other H.323 network entities residing on the network.

H.323 Gateway Mode

In H.323 gateway mode, Ubigate iBG2016 serves as a gateway in a zone managed by H.323 Gatekeeper.
When Ubigate iBG2016 operates in H.323 gateway mode, it performs general GK registration procedures using RRQ.
A gatekeeper identifies iBG2016 as a gateway to be managed in a zone, and iBG2016 provides the H.323 gateway characteristics necessary for call signaling.

H.323 Direct Mode

Direct mode enables call processing without H.323 registration. It is used when signaling is performed directly between gateways without passing through a gatekeeper.

PSTN Signaling Support

Ubigate iBG2016 acts as a VoIP gateway for interconnecting between legacy PSTN and VoIP networks. To interwork with PSTN seamlessly, iBG2016 supports various types of PSTN signaling that have been in use for several decades.

Ubigate iBG2016 supports the following PSTN signaling.

- Analog FXS: loop-start, ground-start
- Analog E & M: wink, immediate, delay
- Analog FXO: loop-start, ground-start
- Analog DID (Direct Inward Dial)
- ISDN BRI Q.931: network side, user side
- T1-CAS E & M: wink, immediate, delay
- T1-CAS FXO: ground start, loop start
- T1-CAS FXS: ground start, loop start
- E1-CAS R2: MFC, DTMF
- T1/E1 ISDN PRI Q.931: user side, network side
- T1/E1 Q.SIG
- T1 R1

Ubigate iBG2016 supports the following R2 country variants.

- Australia
- Brazil
- China
- East Europe
- Hong Kong
- India
- ITU, Korea
- Thailand
- Mexico

Ubigate iBG2016 supports the following ISDN country variants.

- AT & T 4ESS (User Side-PRI, Network Side-PRI)
- AT & T 5ESS (User Side-PRI/BRI-Network Side-PRI/BRI)
- ETSI (User & Network Side-PRI/BRI)
- Australian Telecom (User Side-PRI/BRI and Network Side-PRI)
- National ISDN-1 (User Side-BRI)
- NTT (User & Network Side-PRI/BRI)
- Northern Telecom DMS-100 (User Side & Network Side-PRI/BRI)
- Northern Telecom DMS-250 (User Side & Network Side-PRI)
- National ISDN-2 (User & Network Side-PRI)
- Q.SIG (PRI)

Voice Codecs

Ubigate iBG2016 acts as a VoIP gateway that converts the TDM to packets, and vice versa, and supports the following voice codecs:

- ITU-T G.711-Pulse code modulation (PCM) of voice frequencies
- ITU-T G.711 Appendix I-A high quality low-complexity algorithm for packet loss concealment with G.711
- ITU-T G.711 Appendix II-A comfort noise payload definition for ITU-T G.711 use in packet-based multimedia communication systems.
- ITU-T G.723.1-Dual rate speech coder for multimedia communications transmitting at 5.3 and 6.3 Kbit/s
- ITU-T G.723.1 Annex A-Speech coders: Silence compression scheme
- ITU-T G.726-40, 32, 24, 16 Kbit/s adaptive differential pulse code modulation (ADPCM)
- ITU-T G.729-Coding of speech at 8 Kbit/s using conjugate-structure algebraic-code-excited linear-prediction (CS-ACELP)
- ITU-T G.729 Annex A-Reduced complexity 8 Kbit/s CS-ACELP speech codec
- ITU-T G.729 Annex B-A silence compression scheme for G.729 optimized for terminals conforming to Recommendation V.70

Security

Ubigate iBG2016 ensures voice security by providing functions, such as TLS and sRTP.
TLS ensures SIP signaling security and sRTP media security.

TLS

TLS can provide hop-by-hop security for SIP messages transceived to or from a network entity.

sRTP (Secure RTP)

sRTP is for encoding and transceiving end-to-end RTP data over an IP network to prevent conversation wiretapping.

Call Routing and Digit Manipulation

Call Routing

Incoming calls passing through Ubigate iBG2016 can be routed to the PSTN, such as port and trunk group, or to the VoIP network, such as the H.323 session target or SIP session target. Routing control is the procedure used to determine the route calls take from various destinations. The final route is determined based on various settings, such as dial plan, preference, and hunt scheme.

Digit Manipulation

Ubigate iBG2016 allows digit manipulation of a dial string before it passes the dial string to the telephony device.

Digits Stripping and Prefixes

Digit stripping and prefixes make digit deletion and insertion possible before sending outbound POTS peers.
For digit stripping, Ubigate iBG2016 deletes the left-justified digits that explicitly match the destination pattern when iBG2016 matches a dial string to an outbound POTS dial peer.
For prefixes, iBG2016 may add specific digits to the front of the dialed string before it is forwarded to the telephony interface.

Forward Digits

Ubigate iBG2016 defines the number of digits and then forwards them to the telephony interface. It controls the number of digits stripped before the dialed string is passed to the telephony interface.

Digit Translation

Digit translation rules are used to manipulate the calling number (ANI) or called number (DNIS) digits for a voice call or to change the numbering type of a call.
Translation rules are used to convert a telephone number into a different number before the call is matched to an inbound dial peer or before the call is forwarded by the outbound dial peer.

Call Block

Ubigate iBG2016 provides call blocking based on the calling or called number.

Access Group

An access group is associated with an incoming VoIP call so that the terminating gateway can initiate appropriate services, such as number translation and incoming call control.
An access group consists of one or multiple access lists. Each access list is configured by IP address style.

Trunk Group

A trunk group is a logical grouping of interfaces with the same signaling characteristics. The trunk group can be configured as the target of an outbound dial peer.

Trunk Group Hunt Scheme

Ubigate iBG2016 provides trunk hunt schemes for outgoing calls.
A hunt scheme is a selection procedure for choosing an interface or voice port. A trunk group with several trunk group members uses a hunt scheme to select an idle channel for routing an outgoing call. Several hunt schemes are supported, as follows.

Block/Unblock

If a trunk group is blocked or unblocked, each voice port is also blocked or unblocked because a trunk group is a set of voice ports. That is identical to the result of a busyout-forced operation on each voice port.

If a trunk group is blocked, Ubigate iBG2016 attempts to block a call as follows:

- For POTS signaling (R2-MFC) that supports a block mechanism, iBG2016 sends a block message.
- For POTS signaling (FXS, FXO, E & M, and T1-CAS) that does not support a block mechanism, iBG2016 plays a fast busy tone for an inbound call attempt or changes the line status to seized.
- For ISDN signaling, iBG2016 shuts down the ISDN signaling stack, by default, or sends a release message with a specific fail code.

Multiple Trunk Group per Dial Peer

Multiple trunk group support permits up to 12 trunk groups to be provisioned as a target in a POTS dial peer. Because the dial peer can have more than one target destination, this capability reduces the number of dial peers that need configuration.
During a call setup request for an outbound call, the software searches for an idle channel in an outbound dial peer, using a list of trunk groups. The trunk groups are searched sequentially by priority. If no idle channel is available in the highest priority trunk group, the next priority trunk group is searched. When a channel is found, the trunk group member containing the channel is used for the outbound call. If the call setup returns a glare condition and the software attempts a call retry, the search for another idle channel starts from the beginning of the list of multiple trunk groups.

Call Admission Control (CAC)

Voice call admission control (CAC) is one of the techniques used to maintain reasonable voice quality. For real-time, delay-sensitive traffic, such as voice, it is better to deny network access when there is congestion than to allow traffic onto the network to be dropped and delayed.
CAC is a deterministic and informed decision made before a voice call is established and is based on whether the required network resources are available to provide suitable QoS for the new call.

Local CAC

Local CAC mechanisms affect the outgoing Ubigate iBG2016. The CAC decision is based on nodal information, such as the maximum call status.

Ubigate iBG2016 provides CAC based on the system-wide maximum call number. CAC based on the system-wide maximum call number permits iBG2016 to deny incoming calls exceeding a preconfigured threshold, allowing the selection of a system-wide maximum call value. This feature helps ensure the quality of service of existing calls and reliability of system processes by preventing system overload caused by excessive incoming calls. The feature rejects new calls, with minor disruptions for system users. Administrators of iBG2016 set the threshold at which new calls are rejected.

Ubigate iBG2016 provides CAC based on the maximum call number per dial peer.

Ubigate iBG2016 also provides CAC based on the physical DS0 limitation.

Resource-based CAC

Resource-based CAC mechanisms operate on the outgoing Ubigate iBG2016. The CAC decision is based on nodal information, such as the state of the CPU, memory, and DSP channel load level.

Ubigate iBG2016 provides CAC based on CPU utilization.
CAC based on CPU utilization permits iBG2016 to deny incoming calls exceeding a preconfigured threshold, allowing the selection of a system CPU load level value. This feature helps ensure the quality of service of existing calls and reliability of system processes by preventing system overload caused by excessive incoming calls. The feature rejects new calls, with minor disruptions for system users.
Administrators of iBG2016 set the threshold at which new calls are rejected. This CPU load threshold can be set anywhere from 20% to 90%.

Ubigate iBG2016 provides call admission control based on memory utilization.
CAC based on memory utilization permits iBG2016 to deny incoming calls exceeding a preconfigured threshold, allowing the selection of a system memory load level value. This feature helps ensure the quality of service of existing calls and reliability of system processes by preventing system overload caused by excessive incoming calls. The feature rejects new calls, with minor disruptions for system users.
Administrators of iBG2016 set the threshold at which new calls are rejected. This memory load threshold can be set anywhere from 20% to 90%.

Ubigate iBG2016 provides call admission control based on DSP utilization.
CAC based on DSP channel utilization permits iBG2016 to deny incoming calls exceeding a preconfigured threshold, allowing the selection of a system DSP channel load level value. This feature helps ensure the quality of service of existing calls and reliability of system processes by preventing system overload caused by excessive incoming calls. The feature rejects new calls, with minor disruptions for system users.
Administrators of iBG2016 set the threshold at which new calls are rejected. This DSP load threshold can be set anywhere from 20% to 100%.

Voice Services

FAX

Ubigate iBG2016 supports FAX pass-through and SIP/H.323 T.38 FAX relay.

T.38

Ubigate iBG2016 negotiates fax relay transmission by exchanging capability information in session description protocol (SDP) messages and H.323 messages.
T.38 Annex D procedures are used for the changeover from VoIP to fax mode during a call.
For SIP, a normal VoIP call is initially established using SIP INVITE requests. The DSP of iBG2016 must be informed that it can support T.38 mode when it is switched to voice mode. During the call, when the DSP of iBG2016 detects fax flags, iBG2016 initiates a SIP INVITE mid-call to signal the desire to change the media stream.

FAX Pass-through

Ubigate iBG2016 does not distinguish between a fax call and voice call.
Fax communication between two fax machines is carried entirely in-band over a voice call.
Fax up-speed is similar to pass-through in that the fax call is carried in-band over the voice call.
The difference is that, when using up-speed, iBG2016 is to some extent aware of the fax call. Although relay mechanisms are not employed, with up-speed, the gateways recognize a CED fax tone and automatically changes the voice codec to G.711, if necessary, and turn off echo cancellation (EC) and voice activity detection (VAD) for the duration of the call.

DTMF Relay

The reliable DTMF relay feature provides reliable digit relay between different Ubigate iBG2016's or between iBG2016 and iPX when a low-bandwidth codec is used.

RFC2833

Ubigate iBG2016 supports RFC 2833 for reliable DTMF relay.
The iBG2016 relaying DTMF tones provides a standardized means of transporting DTMF tones in real-time transport protocol (RTP) packets, according to section 3 of RFC 2833.

DTMF events through SIP signaling

Ubigate iBG2016 supports the NOTIFY method for DTMF relay.
The SIP event notification mechanism uses the NOTIFY method to signal when certain telephony events take place. In order to send DTMF signals using the NOTIFY method, the gateway notifies the subscriber when DTMF digits are signaled by the originator. The notification contains a message body with a SIP response status line.

Ad-hoc Conference

Ad-hoc conferencing provides the conferencing resources of the DSP contained in an Ubigate iBG2016 unit, providing high voice quality for supplementary services, such as 3-way iPX conferencing.

For ad-hoc conferencing, iBG2016 interworks with iPX using SIP, and the service is controlled by iPX.

Private Line Automatic Ringdown (PLAR)

Ubigate iBG2016 provides PLAR (Private Line Automatic Ringdown) and OPX (off premises extension).

PLAR

PLAR circuits have statically configured endpoints and do not require users to dial to connect calls. PLAR provides a mechanism to create a switched VoIP call without digit dialing.

PLAR OPX

OPX allows remote users on Foreign Exchange Station (FXS) ports to appear to PBX as physical extensions. Ubigate iBG2016 offers toll-bypass VoIP services without providing dial tones or changing existing dial plans. OPX allows stations at remote sites to appear to a PBX as physically connected stations.

LVBO (Local Voice Busy Out)

LVBO provides Ubigate iBG2016 with the ability to monitor the state of various network interfaces, LANs and WANs, and busy back the trunk to the PSTN interface if any of the monitored links fail.

If an ISDN line enters an LVBO state, a specific fail code is sent regarding the ISDN Inbound Call Attempt to indicate a busyout status.

For LVBO, the PSTN (FXS, FXO, E & M, and T1/E1 CAS) signaling line operates in the following way:

- If a call enters an analog FXS, a fast-busy tone is sent to indicate that the relevant line is busy.
- Regarding the inbound call attempt, such as FXO, E & M, T1-CAS FXS/FXO/E & M, and T1-R1, Ubigate iBG2016 enables a remote office to see that the relevant line is in busyout status.
- Since a block message exists for E1-R2, a block message is sent to a remote office to block the call attempt by a remote office; an unblock message is sent when the LVBO status is released, putting the line in idle status.

Supplementary Services

Ubigate iBG2016 provides the following supplementary services for the iPX interworking mode, survivable telephony mode, and stand-alone mode.

iPX Interworking Mode

When running in iPX interworking mode, Ubigate iBG2016 provides the supplementary services under iPX control.

- Calling Line Identification (CLID)
- Call Forward-All

- Call Forward-Busy
- Call Forward-NoAnswer
- Call Hold and Retrieve
- Call Park
- Call Pickup Group
- Call Pickup Direct
- Call Pickup Universal
- Call Restriction by User
- Call Waiting and Retrieve
- Call Transfer-Blind
- Call Transfer-Consultative
- Call Forwarding to VMS-All
- Call Forwarding to VMS-Busy
- Call Forwarding to VMS-NoAnswer
- Call Back Busy Subscriber
- Call Override
- Call Intrusion
- Privacy
- Wake-up Call
- Do Not Disturb (DND)
- Absentee Service (ABS)
- Conference calls
- Ad-hoc conference
- Group Call
- Distinctive Ring
- Music On Hold Service
- Malicious Call
- Follow Me

Survivable Telephony Mode

When running in survivable telephony mode, Ubigate iBG2016 provides the following supplementary services to FXS and IP phone subscribers; these services interwork with iPX via iPX.

- Calling Line Identification (CLID)
- Call Forward-All
- Call Forward-Busy
- Call Forward-NoAnswer
- Call Hold and Retrieve
- Call Pickup Group
- Call Pickup Direct
- Call Pickup Universal
- Call Waiting and Retrieve
- Call Transfer-Blind
- Call Transfer-Consultative
- Distinctive Ring

Stand Alone Mode

When running in a stand-alone mode, Ubigate iBG2016 provides the following supplementary services to interconnected FXS subscribers.

- Calling Line Identification (CLID)
- Call Hold and Retrieve
- Call Pickup Group
- Call Pickup Direct
- Call Pickup Universal
- Call Waiting and Retrieve
- Call Transfer-Blind
- Call Transfer-Consultative
- Distinctive Ring

E911 Support

Ubigate iBG2016 supports Enhanced 911 (E911). E911 is an emergency telephone system capable of automatically displaying the callback number (and in some cases the location) of a person who dials emergency call numbers (911) to request emergency help from public safety agencies.
The North American emergency E911 phone system consists of a voice network built largely outside the normal public switched telephone network (PSTN) on which common voice traffic rides. They are treated especially because they are routed differently within PSTN. Calls to emergency services are routed based on the calling number, not the called number. The calling number is checked against a database of emergency service providers that cross-references the service providers for the caller's particular location. When this information is known, the call is then routed to the proper public service answering point (PSAP), which, in turn, dispatches services to the caller's location.

High Availability of Voice Feature

As enterprises extend their IP telephony and high-value application deployments from central sites to remote offices, one of the factors considered vital in deployment is the ability to cost-effectively provide backup redundancy functions at the remote branch office. However, the size and number of these small-office sites precludes most enterprises from deploying dedicated call-processing servers, unified messaging servers, or multiple WAN links to each site to achieve the high availability required.

Ubigate iBG2016 provides a high availability voice solution, as illustrated in table below.

-	Local Call Server Through LAN	Remote Call Server Through WAN
WAN Link Fail (Call Server Alive)	PSTN Fallback - Analog call → PSTN - VoIP call → PSTN - Controlled by Call Server	Survivable Telephony - Analog call → PSTN - VoIP call → PSTN - Controlled by Ubigate iBG2016 (Call Server is down)
Call Server Down (WAN Link Alive)	Survivable Telephony - Analog call → PSTN, IP N/W - VoIP call → PSTN, IP N/W - Controlled by Ubigate iBG2016	Survivable Telephony - Analog call → PSTN, IP N/W - VoIP call → PSTN, IP N/W - Controlled by Ubigate iBG2016

PSTN Fallback

Ubigate iBG2016 monitors the status of the IP network (WAN).
When WAN failure is detected, it automatically redirects calls to the PSTN.
When the WAN link is restored, call routing reverts back to the IP network.
This feature is called PSTN fallback and allows an end user to have a reasonable guarantee of call completion.

Survivable Telephony

Ubigate iBG2016 provides survivable telephony functionality, which is very important for remote branch offices connected over WAN links.
When a WAN link fails, and it is no longer possible to communicate with the call server (Ubigate iPX), it is then impossible to make a VoIP call.
In this case, Ubigate iBG2016 acts as a local PBX and SIP server, providing voice services for analog and IP phones.
While providing voice services, iBG2016 continuously monitors the call server or WAN for its service status. Once the call server has been restored, iBG2016 switches back to iPX interworking mode.
In survivable telephony mode, it can route outbound calls to the PSTN or VoIP network- SIP trunks, if available.

When Ubigate iBG2016 switches to survivable telephony mode, active calls within a branch are not affected by WAN or call server failure. They will last for the duration of the call.
In survivable telephony mode, iBG2016 provides the following services:

- Local extension IP phone dialing to/from IP phone
- IP phone to/from PSTN calls (VoIP trunks, if available)
- IP phone to/from analog device calls

It is recommended that all Ubigate iBG2016's in remote offices maintain direct links to the PSTN for backup callout capability. This is particularly important for maintaining emergency calling capability.

Voice Deployment Scenario

In this section, various service scenarios handled by the Ubigate iBG2016 VoIP system are presented.

PSTN Toll Bypass

Ubigate iBG2016 provides voice and fax toll bypass capabilities as shown in Figure 4.4. In this scenario, a telephony device attached to a PBX or key phone system connects to iBG2016 through an analog or digital trunk connection.

When iBG2016 is in iPX interworking mode, a call is established across the network by iBG2016 and iPX. The iPX communicates across the IP network using SIP or H.323. Packets are then routed over the IP network to their destination where the reverse operation is performed, completing the call over the IP network and bypassing the traditional toll network, PSTN.

When iBG2016 is in stand-alone mode, a call is established across the IP network between iBG2016's, without iPX.

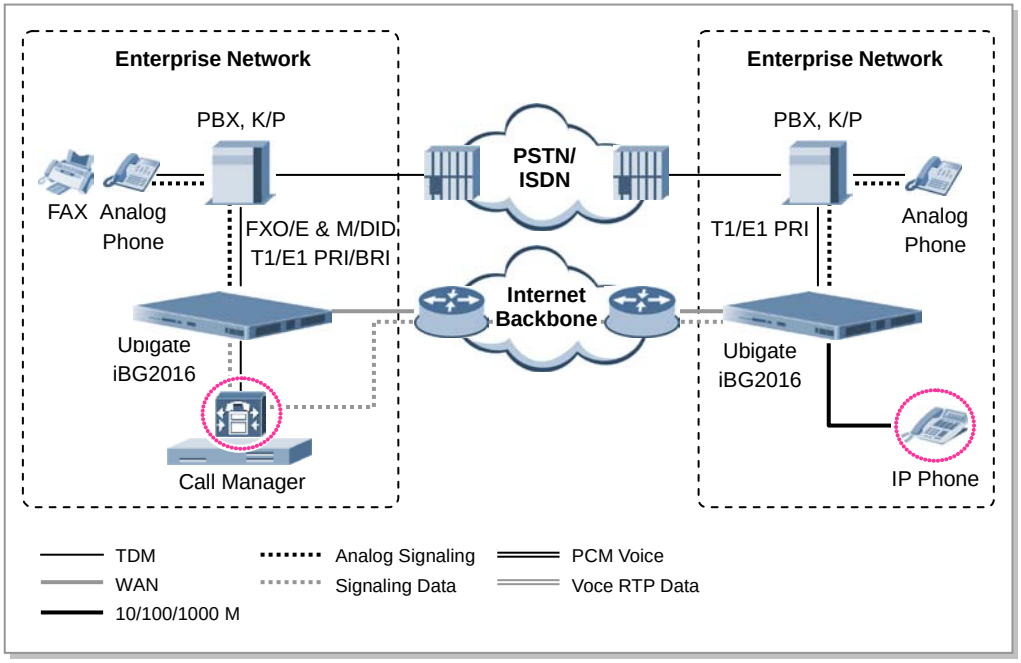

Figure 4.4 Toll Bypass for Voice and Fax services

IP Phones

Figure 4.5 illustrates a second scenario involving an IP phone connected to Ubigate iBG2016. The SIP phone communicates directly with iPX using the SIP protocol that passes through iBG2016. The iPX's communicate with each other across the IP network via SIP to establish and maintain the call.
The packets are then routed across the IP network from IP phone to IP phone, completing the connection. The second requirement for IP phones connected to iBG2016 is the connection of iBG2016 to the PBX or PSTN, enabling the IP phones to make calls to traditional phones. In this case, the IP phones communicate with the iPX and, in turn, the iPX establishes the call to the PBX or PSTN through iBG2016. The packets from the IP phone are then routed through DSP and delivered to the PBX or PSTN via analog or digital trunk lines.

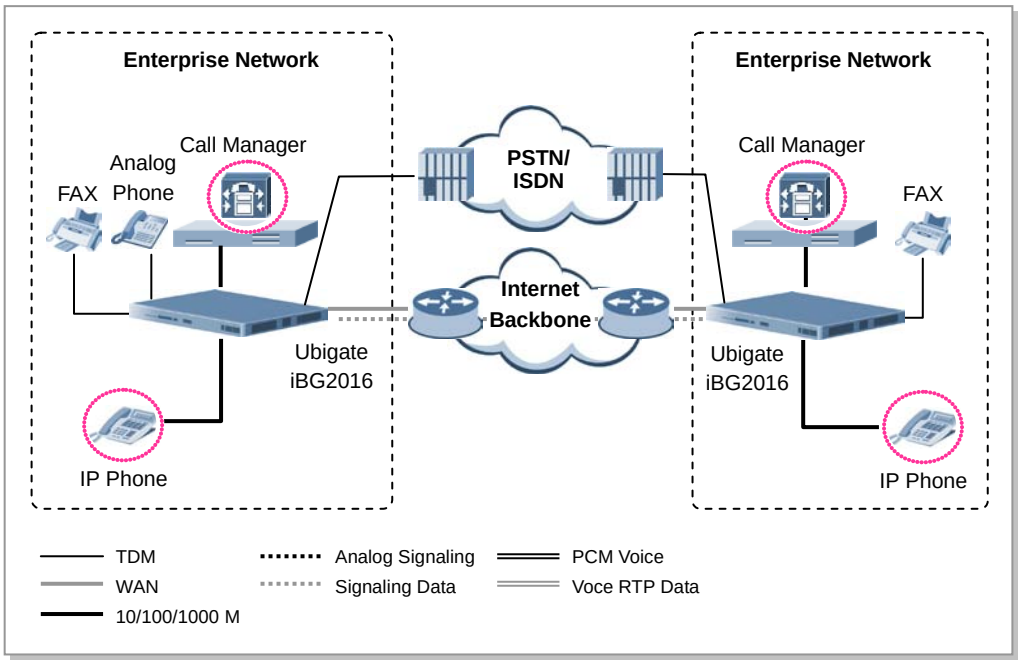

Figure 4.5 Connection to IP Phone, Analog Phone and FAX

Management System

Ubigate iBG2016's are controlled using several management systems or a command line interface (CLI), as shown in Figure 4.6. There is an integrated graphical user interface (GUI) that allows users to configure iBG2016's.
CLI is a text line interface permitting users to configure and view the status of individual, connected systems.
The network management system uses the simple network management protocol (SNMP) to communicate with iBG2016's. The SNMP 'get' and 'set' commands can be used to configure either system and retrieve current configuration and status information. These management systems can be located anywhere in the IP network.

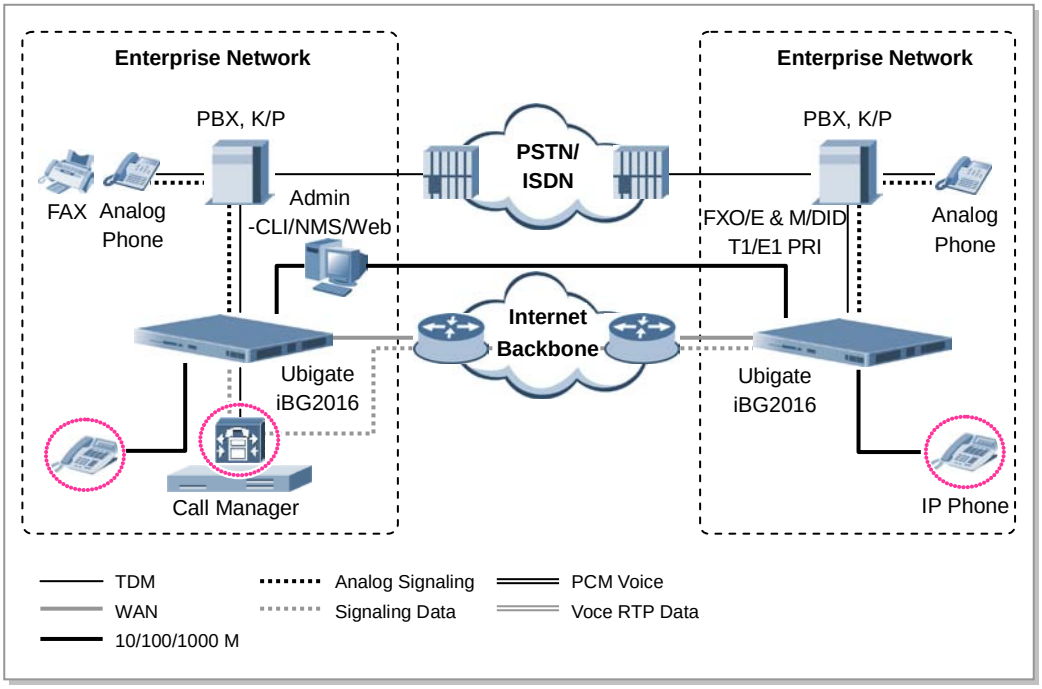

Figure 4.6 Management using CLI/GUI/NMS

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ANNEX A. Cable Specifications

Console Port Cable

Cable Shape

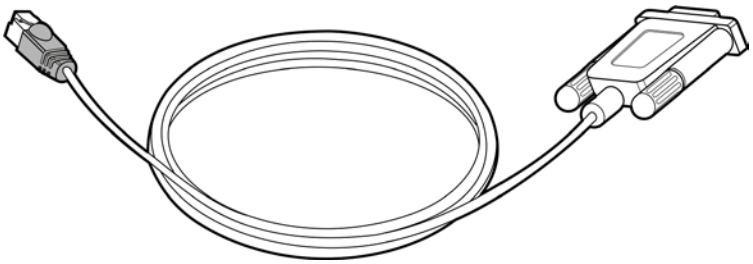

Figure A.1 Console Port Cable

Cable Signaling and Pinout

Console Port (RJ-45)	Console Device (DB-9)	Console Port (RJ-45)	Console Device (DB-9)
Pin	**Signal**	**Pin**	**Signal**
1	RTS	8	CTS
2	DTR	6	DSR
3	TxD	2	RxD
4	GND	5	GND
5	GND	5	GND
6	RxD	3	TxD
7	DSR	4	DTR
8	CTS	7	RTS

Auxiliary Port Cable

Cable Shape

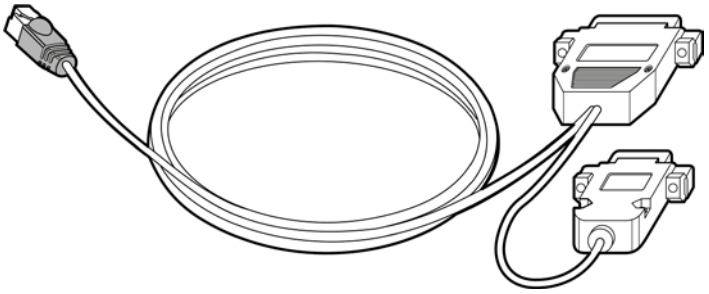

Figure A.2 Auxiliary Port Cable

Cable Signaling and Pinout

Auxiliary Port (DTE)		Modem		
RJ-45 Pin	Signal	DB-9 Pin	DB-25 Pin	Signal
1	RTS	7	4	RTS
2	DTR	4	20	DTR
3	TxD	3	2	TxD
4	GND	5	7	GND
5	GND	5	7	GND
6	RxD	2	3	RxD
7	DSR	6	8	DCD
8	CTS	8	5	CTS

BRI-1U, BRI-2U Mini Module Cable

Cable Shape

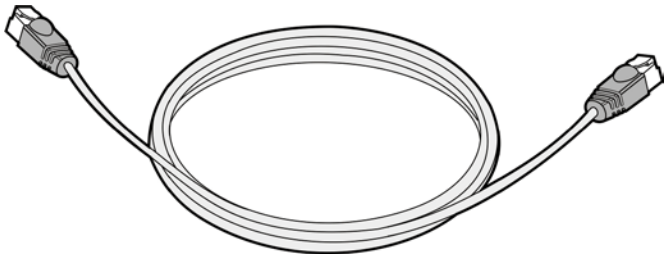

Figure A.3 BRI-1U, BRI-2U Mini Module Cable

Cable Signaling and Pinout

8 Pin[1)]	Function
3	No connection
4	Signal-Tip
5	Signal-Ring
6	No connection

1) Pins 1, 2, 7 and 8 are not used.

BRI-1ST, BRI-2ST Mini Module Cable

Cable Shape

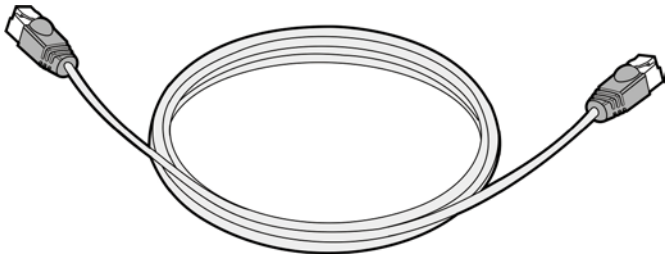

Figure A.4 BRI-1ST, BRI-2ST Module Cable

Cable Signaling and Pinout

8 Pin[1)]	TE[2)]	NT[3)]	Polarity
3	Transmit	Receive	+
4	Receive	Transmit	+
5	Receive	Transmit	–
6	Transmit	Receive	–

1) Pins 1, 2, 7 and 8 are not used.
2) TE refers to terminal terminating layer 1 aspects of TE1. TA, and NT functional groups (this applies to the ISDN BRI S/T WIC).
3) NT refers to network terminating layer 1 aspects of NT1 and NT2 functional groups.

LMG-20, LMF-20, LMP-20 Module Cable

Cable Shape

- Cable Length: 6/10 feet
- Standard, Straight-Through Wiring (both ends are the same)
- 10/100/1000 Base-T interfaces

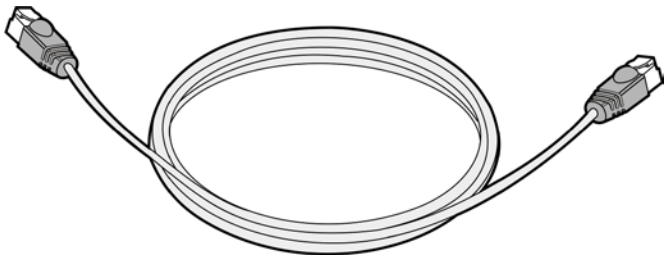

Figure A.5 LMG-20, LMF-20, LMP-20 Module Cable

Cable Signaling and Pinout

RJ45 Pin #	Wire Color (T568A)	1000 Base-T Signal
1	White/Green	BI_DA+
2	Green	BI_DA-
3	White/Orange	BI_DB+
4	Blue	BI_DC+
5	White/Blue	BI_DC-
6	Orange	BI_DB-
7	White/Brown	BI_DD+
8	Brown	BI_DD-

T1E1-4, T1E1-1M, T1E1-2M Module Cable

Cable Shape

- RJ-48C to RJ-48C Cable

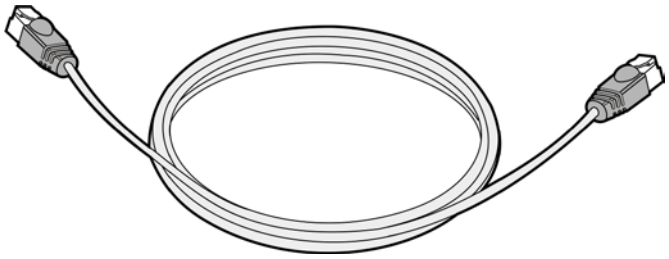

Figure A.6 T1E1-4, T1E1-1M, T1E1-2M Module Cable

Cable Signaling and Pinout

RJ-11 connector		RJ-11 connector	
Pin	**Signal**	**Signal**	**Pin**
1	RXPING	TXRING	4
2	RXTIP	TXTIP	5
4	TXRING	RXRING	1
5	TXTIP	RXTIP	2

HSSI-1 Module Cable

Cable Shape

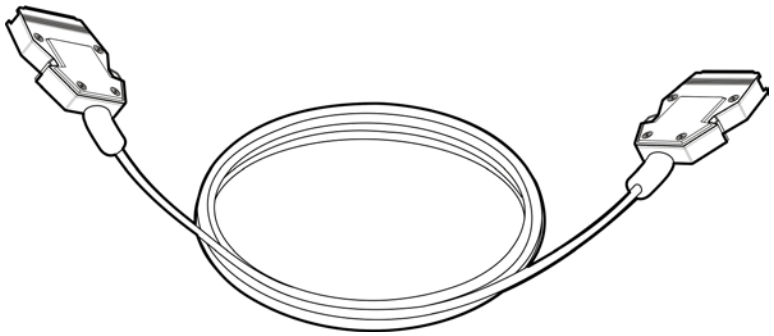

Figure A.7 HSSI-1 Module Cable

Cable Signaling and Pinout

Signal	Pin No. + Side (Router End)	Direction[1)]	Pin No. - Side (DSU End)
SG (Signal Ground)	1	-	26
RT (Receive Timing)	2	←	27
CA (DCE Available)	3	←	28
RD (Receive Data Reserved)	4	←	29
LC (Loopback circuit C)	5	←	30
ST (Send Timing)	6	←	31
SG (Signal Ground)	7	-	32
TA (DTE Available)	8	→	33
TT (Terminal Timing)	9	→	34
LA (Loopback Circuit A)	10	→	35
SD (Send Data)	11	→	36
LB (Loopback Circuit B)	12	→	37
SG (Signal Ground)	13	-	38
5 (Ancillary to DCE)	14-18	→	39-43
SG (Signal Ground)	29	-	44
5 (Ancillary from DCE)	20-24	←	45-49
SG (Signal Ground)	25	-	50

1) Router is + side (DTE). DSU is - side (DCE).

HSSI-1 Module Cable (Null Modem Case)

Cable Shape

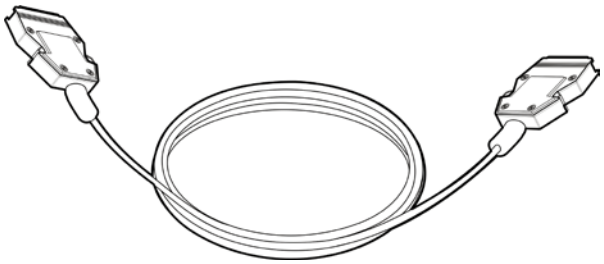

Figure A.8 HSSI-1 Module Cable (Null Modem Case)

Cable Signaling and Pinout

Signal	From Pins	Direction[1)]	To Pins	Signal Name
RT (Receive Timing)	2, 27	→	9, 34	TT (Terminal Timing)
CA (DCE Available)	3, 28	→	8, 33	TA (DTE Available)
RD (Receive Data Reserved)	4, 29	→	11, 36	SD (Send Data)
LC (Loopback circuit C)	5, 30	→	10, 35	LA (Loopback A)
ST (Send Timing)	6, 31	→	6, 31	ST (Send Timing)
TA (DTE Available)	8, 33	→	3, 28	CA (DCE Available)
TT (Terminal Timing)	9, 34	→	2, 27	RT (Receive Timing)
LA (Loopback Circuit A)	10, 35	→	5, 30	LC (Loopback C)
SD (Send Data)	11, 36	→	4, 29	RD (Receive Data)
GND (Ground)	1, 26, 7, 32, 13, 38, 19, 44, 25, 50	-	1, 26, 7, 32, 13, 38, 19, 44, 25, 50	GND (Ground)
Loopback (not connected)	12, 37	-	-	-
-	-	-	12, 37	Loopback (not connected)
Not used	14-18, 20-24, 39-43, 45-49	-	14-18, 20-24, 39-43, 45-49	Not used

1) Router is + side (DTE). DSU is - side (DCE).

FXS-24 Module Cable

Cable Shape

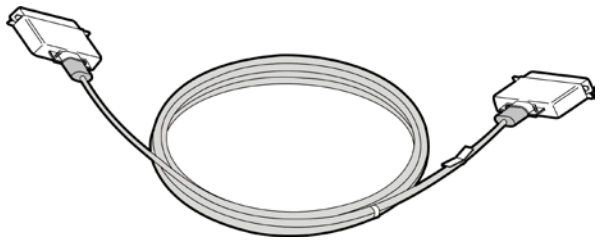

Figure A.9 FXS-24 Module Cable

Cable Signaling and Pinout

RJ-21 (Left)	RJ-21 (Right)	Signal name	RJ-21 (Left)	RJ-21 (Right)	Signal name
1 26	1 26	TIP 1 RING 1	14 39	14 39	TIP 14 RING 14
2 27	2 27	TIP 2 RING 2	15 40	15 40	TIP 15 RING 15
3 28	3 28	TIP 3 RING 3	16 41	16 41	TIP 16 RING 16
4 29	4 29	TIP 4 RING 4	17 42	17 42	TIP 17 RING 17
5 30	5 30	TIP 5 RING 5	18 43	18 43	TIP 18 RING 18
6 31	6 31	TIP 6 RING 6	19 44	19 44	TIP 19 RING 19
7 32	7 32	TIP 7 RING 7	20 45	20 45	TIP 20 RING 20
8 33	8 33	TIP 8 RING 8	21 46	21 46	TIP 21 RING 21
9 34	9 34	TIP 9 RING 9	22 47	22 47	TIP 22 RING 22
10 35	10 35	TIP 10 RING 10	23 48	23 48	TIP 23 RING 23
11 36	11 36	TIP 11 RING 11	24 49	24 49	TIP 24 RING 24
12 37	12 37	TIP 12 RING 12	25 50	25 50	TIP 25 RING 25
13 38	13 38	TIP 13 RING 13	-	-	-

E & M-1M, E & M-2M Module Cable

Cable Shape

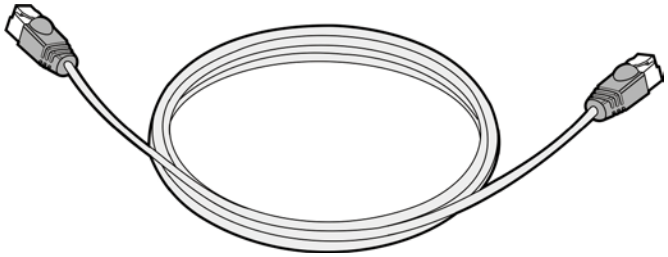

Figure A.10 E & M-1M, E & M-2M Module Cable

Cable Signaling and Pinout

Pin	Signal	Description	Two-Wire Operation, Type				Four-Wire Operation, Type			
			1	2	3	5	1	2	3	5
1	SB	-48 V signaling battery	-	SB	SB	-	-	SB	SB	-
2	M-lead	Signaling input	M	M	M	M	M	M	M	M
3	R	Ring, audio input	-	-	-	-	R	R	R	R
4	R or R1	Ring, audio input /output or output	R	R	R	R	R1	R1	R1	R1
5	T or T1	Tip, audio input/ output or output	T	T	T	T	T1	T1	T1	T1
6	T	Tip, audio input	-	-	-	-	T	T	T	T
7	E-lead	Signaling output	E	E	E	E	E	E	E	E
8	SG	Signaling ground return	-	SG	SG	-	-	SG	SG	-

FXO-2M, FXO-4M, FXS-2M, FXS-4M Module Cable

Cable Shape

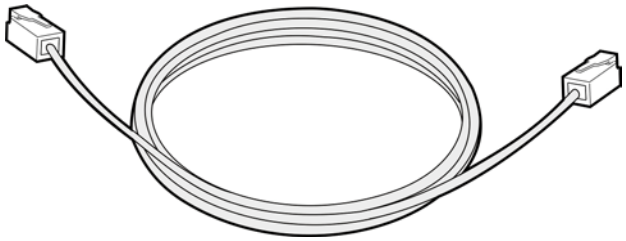

Figure A.11 FXO-2M, FXO-4M, FXS-2M, FXS-4M Module Cable

Cable Signaling and Pinout

RJ-11 connector		RJ-11 connector	
Pin	**Signal**	**Signal**	**Pin**
1	-	-	1
2	-	-	2
3	Ring	Ring	3
4	Tip	Tip	4
5	-	-	5
6	-	-	6

ATOP-1, ATOI-1 Module Cable

Cable Shape

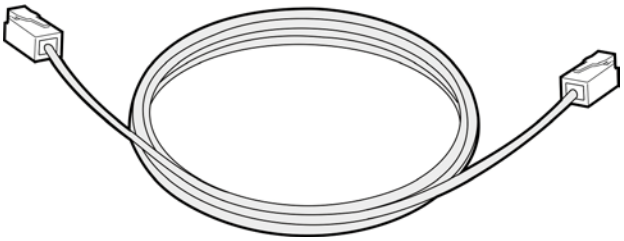

Figure A.12 ATOP-1, ATOI-1 Module Cable

Cable Signaling and Pinout

RJ-11 connector		RJ-11 connector	
Pin	**Signal**	**Signal**	**Pin**
1	-	-	1
2	-	-	2
3	Ring	Ring	3
4	Tip	Tip	4
5	-	-	5
6	-	-	6

WTE-1SM/2SM/4S Module Cable (X.21 DCE)

Cable Shape

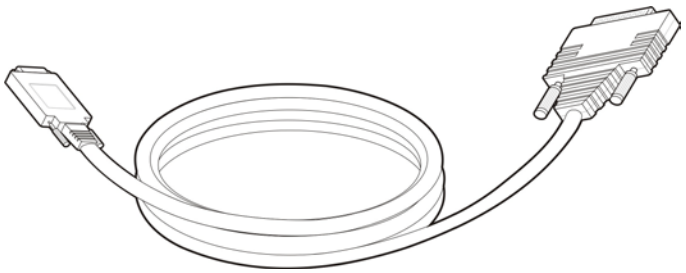

Figure A.13 WTE-1SM/2SM/4S Module Cable (X.21 DCE)

Cable Signaling and Pinout

SMART Serial		DB15 Female	
PIN	**Signal**	**Signal**	**PIN**
21	-	-	-
SHELL	-	Shield GND	1
26	GND	Circuit GND	8
-	Not Used	Not Used	
8	O_RTS/CTS	INDICATION+	5
9	O_DTR/DSR+	INDICATION-	12
11	I_CTS/RTS+	CONTROL+	3
10	I_DSR/DTR+	CONTROL-	10
5	I_RXD/TXD+	TRANSMIT+	2
18	I_RXD/TXD-	TRANSMIT-	9
2	O_TXCE/RXC+	TIMING+	6
15	O_TXCE/RXC-	TIMING-	13
1	O_TXD/RXD+	RECEIVE+	4
14	O_TXD/RXD-	RECEIVE-	11
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (X.21 DTE)

Cable Shape

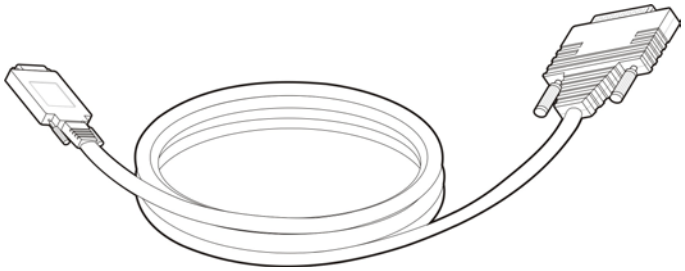

Figure A.14 WTE-1SM/2SM/4S Module Cable (X.21 DCE)

Cable Signaling and Pinout

SMART Serial		DB15 Male	
PIN	Signal	Signal	PIN
21	-	-	-
24	-	-	-
SHELL	-	Shield GND	1
26	GND+	CCT GND	8
-	Not Used	Not Used	-
11	I_CTS/RTS+	INDICATION+	5
10	I_DSR/DTR+	INDICATION-	12
8	O_RTS/CTS+	CONTROL+	3
9	O_DTR/DSR+	CONTROL-	10
1	O_TXD/RXD+	TRANSMIT+	2
14	O_TXD/RXD-	TRANSMIT-	9
4	I_RXC/TXCE+	TIMING+	6
17	I_RXC/TXCE-	TIMING-	13
5	I_RXD/TXD+	RECEIVE+	4
18	I_RXD/TXD-	RECEIVE-	11
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (RS232 DCE)

Cable Shape

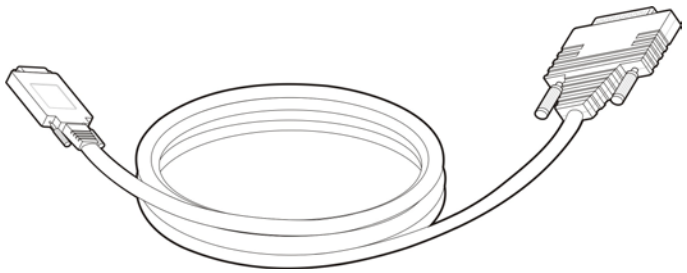

Figure A.15 WTE-1SM/2SM/4S Module Cable (RS232 DCE)

Cable Signaling and Pinout

SMART Serial		DB25 Female	
PIN	**Signal**	**Signal**	**PIN**
23	-	-	-
SHELL	-	Shield GND	1
6	B_DCD/DCD+	DCD	8
19	GND+	GND	7
11	I_CTS/RTS+	RTS	4
12	I_DSR/DTR+	DTR	20
13	B_LL/LL+	LTST	18
26	GND+	GND	-
8	O_RTS/CTS	CTS	5
7	O_DTR/DSR+	DSR	6
5	I_RXD/TXD+	TXD	2
18	GND+	GND	-
4	I_RXC/TXCE+	TXCE	24
17	GND+	GND	-
3	B_TXC/TXC+	TXC	15
16	GND+	GND	-
2	O_TXCE/RXC+	RXC	17

(Continued)

SMART Serial		DB25 Female	
PIN	**Signal**	**Signal**	**PIN**
15	GND+	GND	-
1	O_TXD/RXD+	RXD	3
14	GND+	GND	-
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (RS232 DTE)

Cable Shape

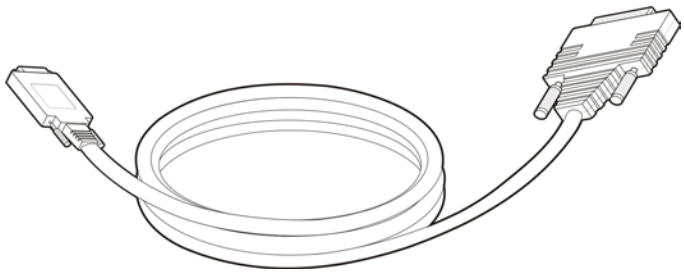

Figure A.16 WTE-1SM/2SM/4S Module Cable (RS232 DTE)

Cable Signaling and Pinout

SMART Serial		DB25 Male	
PIN	Signal	Signal	PIN
23	-	-	-
24	-	-	-
SHELL	-	Shield GND	1
6	B_DCD/DCD+	DCD	8
19	GND+	GND	7
11	I_CTS/RTS+	CTS	5
12	I_DSR/DTR+	DSR	6
13	B_LL/LL+	LTST	18
26	GND+	GND	-
8	O_RTS/CTS	RTS	4
7	O_DTR/DSR+	DTR	20
1	O_TxD/RxD+	TXD	2
14	GND+	GND	-
2	O_TXCE/RXC+	TXCE	24
15	GND+	GND	-
3	B_TXC/TXC+	TXC	15
16	GND+	GND	-
4	I_RXC/TXCE+	RXC	17

(Continued)

SMART Serial		DB25 Male	
PIN	**Signal**	**Signal**	**PIN**
17	GND+	GND	-
5	I_RxD/TxD+	RXD	3
18	GND+	GND	-
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (RS449 DCE)

Cable Shape

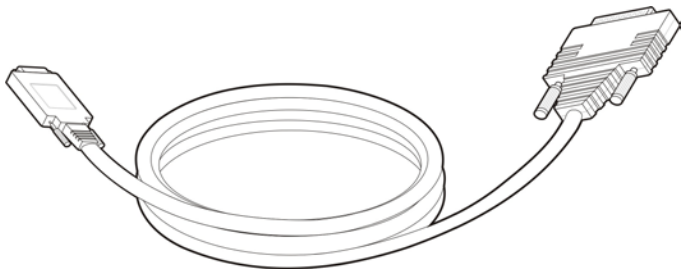

Figure A.17 WTE-1SM/2SM/4S Module Cable (RS449 DCE)

Cable Signaling and Pinout

SMART Serial		DB37 Female	
PIN	**Signal**	**Signal**	**PIN**
SHELL	-	Shield GND	1
11	I_CTS/RTS+	RS+	7
10	I_CTS/RTS-	RS-	25
22	-	SG	19
-	-	RC	20
12	I_DTR/DSR+	TR+	12
25	I_DTR/DSR-	TR-	30
8	O_RTS/CTS+	CS+	9
9	O_RTS/CTS-	CS-	27
5	I_RXD/TXD+	SD+	4
18	I_RXD/TXD-	SD-	22
4	I_RXC/TXCE+	TT+	17
17	I_RXC/TXCE-	TT-	35
3	B_TXC/TXC+	ST+	5
16	B_TXC/TXC-	ST-	23
2	O_TXCE/RXC+	RT+	8
15	O_TXCE/RXC-	RT-	26

(Continued)

SMART Serial		DB37 Female	
PIN	**Signal**	**Signal**	**PIN**
1	O_TXD/RXD+	RD+	6
14	O_TXD/RXD-	RD-	24
7	O_DTR/DSR+	DM+	11
20	O_DTR/DSR-	DM-	29
6	B_DCD/DCD+	RR+	13
19	B_DCD/DCD-	RR-	31
13	B_LL/LL+	LL	10
26	GND+	SC	37
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (RS449 DTE)

Cable Shape

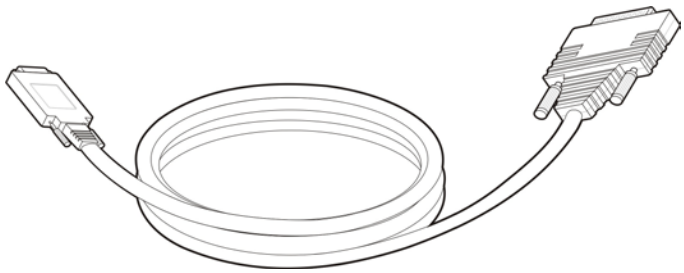

Figure A.18 WTE-1SM/2SM/4S Module Cable (RS449 DTE)

Cable Signaling and Pinout

SMART Serial		DB37 Male	
PIN	**Signal**	**Signal**	**PIN**
SHELL	-	Shield GND	1
8	O_RTS/CTS	RS+	7
9	O_RTS/CTS-	RS-	25
22	-	SG	19
24	-	RC	20
7	O_DTR/DSR+	TR+	12
20	O_DTR/DSR-	TR-	30
11	I_CTS/RTS+	CS+	9
10	I_CTS/RTS-	CS-	27
1	O_TXD/RXD+	SD+	4
14	O_TXD/RXD-	SD-	22
2	O_TXCE/RXC+	TT+	17
15	O_TXCE/RXC-	TT-	35
3	B_TXC/TXC+	ST+	5
16	B_TXC/TXC-	ST-	23
4	I_RXC/TXCE+	RT+	8
17	I_RXC/TXCE-	RT-	26

(Continued)

SMART Serial		DB37 Male	
PIN	**Signal**	**Signal**	**PIN**
5	I_RXD/TXD+	RD+	6
18	I_RXD/TXD-	RD-	24
12	I_DTR/DSR+	TR+	11
25	I_DTR/DSR-	TR-	29
6	B_DCD/DCD+	RR+	13
19	B_DCD/DCD-	RR-	31
13	B_LL/LL+	LL	10
26	GND+	SC	37
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (V.35 DCE)

Cable Shape

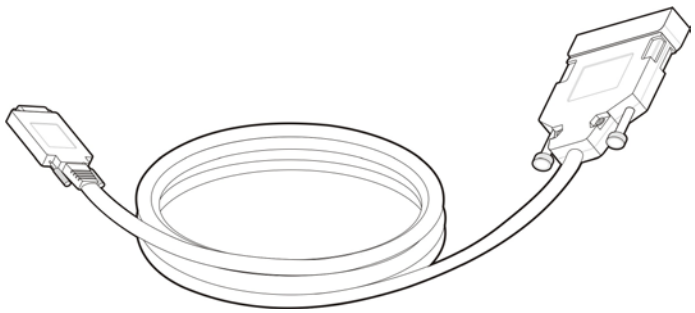

Figure A.19 WTE-1SM/2SM/4S Module Cable (V.35 DCE)

Cable Signaling and Pinout

SMART Serial		V.35 RECEPT.	
PIN	Signal	Signal	PIN
22	-	-	-
23	-	-	-
SHELL	-	Shield GND	A
11	I_CTS/RTS+	RTS	C
12	I_DSR/DTR+	DSR	H
8	O_RTS/CTS	CTS	D
7	O_DTR/DSR+	DSR	E
6	B_DCD/DCD+	RLSD	F
19	GND+	-	-
13	B_LL/LL+	LT	K
26	-	GND	B
5	I_RXD/TXD+	SD+	P
18	I_RXD/TXD-	SD-	S
1	O_TXD/RXD+	RD+	R
14	O_TXD/RXD-	RD-	T
4	I_RXC/TXCE+	SCTE+	U
17	I_RXC/TXCE-	SCTE-	W

(Continued)

SMART Serial		V.35 RECEPT.	
PIN	**Signal**	**Signal**	**PIN**
2	O_TXCE/RXC+	SCR+	V
15	O_TXCE/RXC-	SCR-	X
3	B_TXC/TXC+	SCT+	Y
16	B_TXC/TXC-	SCT-	AA
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (V.35 DTE)

Cable Shape

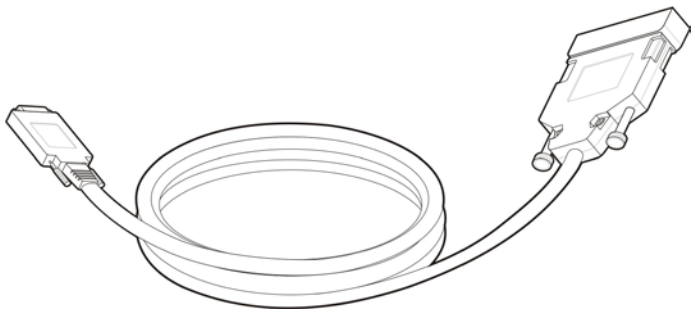

Figure A.20 WTE-1SM/2SM/4S Module Cable (V.35 DTE)

Cable Signaling and Pinout

SMART Serial		V.35 RECEPT.	
PIN	Signal	Signal	PIN
22	-	-	-
23	-	-	-
24	-	-	-
SHELL	-	Shield GND	A
8	O_RTS/CTS	RTS	C
7	O_DTR/DSR+	DTR	H
11	I_CTS/RTS+	CTS	D
12	I_DSR/DTR+	DSR	E
6	B_DCD/DCD+	RLSD	F
19	GND+	-	-
13	B_LL/LL+	LT	K
26	GND	GND	B
1	O_TXD/RXD+	SD+	P
14	O_TXD/RXD-	SD-	S
5	I_RXD/TXD+	RD+	R
18	I_RXD/TXD-	RD-	T

(Continued)

SMART Serial		V.35 RECEPT.	
PIN	**Signal**	**Signal**	**PIN**
2	O_TXCE/RXC+	SCTE+	U
15	O_TXCE/RXC-	SCTE-	W
4	I_RXC/TXCE+	SCR+	V
17	I_RXC/TXCE-	SCR-	X
3	B_TXC/TXC+	SCT+	Y
16	B_TXC/TXC-	SCT-	AA
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (RS530A DTE)

Cable Shape

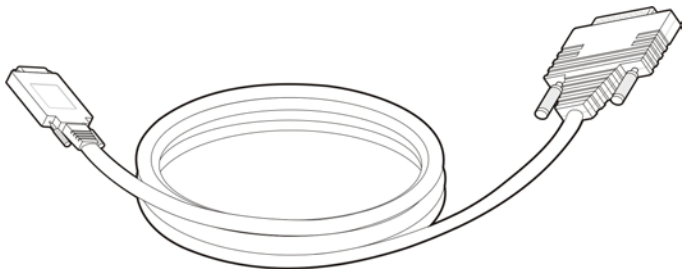

Figure A.21 WTE-1SM/2SM/4S Module Cable (RS530A DTE)

Cable Signaling and Pinout

SMART Serial		DB25 Male	
PIN	Signal	Signal	PIN
21	-	-	-
22	-	-	-
24	-	-	-
SHELL	-	-	1
8	O_RTS/CTS	RTS+	4
9	O_RTS/CTS-	RTS-	19
7	O_DTR/DSR+	DTR+	20
20	GND+	GND	23
11	I_CTS/RTS+	CTS+	5
10	I_DSR/RTS-	CTS-	13
1	O_TXD/RXD+	TXD+	2
14	O_TXD/RXD-	RXD-	14
2	O_TXCE/RXC+	TXCE+	24
15	O_TXCE/RXC-	TXCE-	11
3	B_TXC/TXC+	TXC+	15
16	B_TXC/TXC-	TXC-	12

(Continued)

SMART Serial		DB25 Male	
PIN	**Signal**	**Signal**	**PIN**
4	I_RXC/TXCE+	RXC+	17
17	I_RXC/TXCE-	RXC-	9
5	I_RXD/TXD+	RXD+	3
18	I_RXD/TXD-	RXD-	16
12	I_DSR/DTR+	DSR+	6
25	GND	GND	-
6	B_DCD/DCD+	DCD+	8
19	B_DCD/DCD-	DCD-	10
13	B_LL/LL+	LL	18
26	GND	GND	7
SHELL	-	-	SHELL

WTE-1SM/2SM/4S Module Cable (RS530 DTE)

Cable Shape

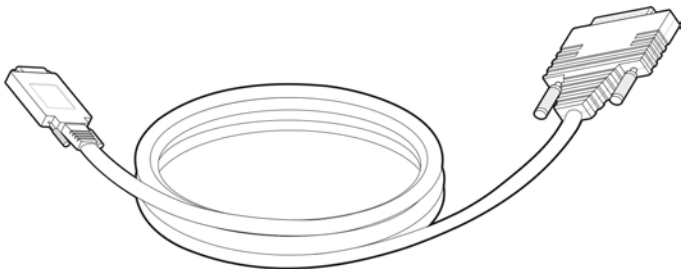

Figure A.22 WTE-1SM/2SM/4S Module Cable (RS530 DTE)

Cable Signaling and Pinout

SMART Serial		DB25 Male	
PIN	Signal	Signal	PIN
21	-	-	-
23	-	-	-
24	-	-	-
SHELL	-	Shield GND	1
8	O_RTS/CTS	RTS+	4
9	O_RTS/CTS-	RTS-	19
7	O_DTR/DSR+	DTR+	20
20	O_DTR/DSR-	DTR-	23
11	I_CTS/RTS+	CTS+	5
10	I_DSR/RTS-	CTS-	13
1	O_TXD/RXD+	TxD+	2
14	O_TXD/RXD-	TxD-	14
2	O_TXCE/RXC+	TxCE+	24
15	O_TXCE/RXC-	TXCE-	11
3	B_TXC/TXC+	TxC+	15
16	B_TXC/TXC-	TXC-	12
4	I_RXC/TXCE+	RXC+	17

(Continued)

SMART Serial		DB25 Male	
PIN	**Signal**	**Signal**	**PIN**
17	I_RXC/TXCE-	RXC-	9
5	I_RXD/TXD+	RXD+	3
18	I_RXD/TXD-	RXD-	16
12	I_DSR/DTR+	DSR+	6
25	I?DSR/DTR-	DSR-	22
6	B_DCD/DCD+	DCD+	8
19	B_DCD/DCD-	DCD-	10
13	B_LL/LL+	LL	18
26	GND	GND	7
SHELL	-	-	SHELL

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Linux Kernel 2.6.13	GPL 2.0		

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RSA Data Security, Inc., MD5 message-digest algorithm

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ABBREVIATION

3

3DES	Triple Data Encryption Standard

A

AES	Advanced Encryption Standard
ATOI	ADSL Transmission Over ISDN
ATOP	ADSL Transmission Over POTS
AS	Autonomous Systems
AUTHD	Authentication Daemon

B

BGP	Border Gateway Protocol
BRI	Basic Rate Interface

C

CAC	Call Admission Control
CAMA	Centralized Automated Message Accounting
CHAP	Challenge Handshake Authentication Protocol
CLI	Command Line Interface
CPE	Customer Premises Equipment
CSPF	Constraint-based Shortest Path First
CSU	Channel Service Unit

D

DDR SDRAM	Double Data Rate Synchronous Dynamic Random Access Memory
DID	Direct Inward Dialing
DMA	Direct Memory Access
DS	Dual Stack
DS3	Digital Signal level-3
DSP	Digital Signal Processor
DSU	Data Service Unit
DV-MRP	Distance Vector-Multicast Routing Protocol

E

E & M	Ear and Mouse
EAP	Extensible Authentication Protocol
EC	Echo Cancellation
ESD	Electrostatic Discharge Damage

F

FR	Frame Relay
FTP	File Transfer Protocol
FXO	Foreign Exchange Office
FXS	Foreign Exchange Subscriber

G

GARP	Generic Attribute Registration Protocol
GMRP	GARP Multicast Registration Protocol
GRE	Generic Routing Encapsulation
GUI	Graphic User Interface
GVRP	GARP VLAN Registration Protocol

H

HDLC	High-level Data Link Control
HSSI	High Speed Serial Interface

I

IDS	Intrusion-Detection Systems
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IP PBX	Internet Protocol Private Branch Exchange
IPS	Intrusion-Prevention Systems
IPSec	Internet Protocol Security
IVM	Integrated Voice Mail

L

L2TP	Layer 2 Tunneling Protocol
LACP	Link Aggregation Control Protocol
LAG	Link Aggregation Group
LAN	Local Area Network
LDP	Label Distribution Protocol
LLQ	Low-Latency Queuing
LSP	Label Switched Path

M

MAC	Media Access Control
MLDv1	Multicast Listener Discovery Protocol
MLPP	Multi Level Precedence and Preemption
MSTP	Multiple Spanning Tree Protocol

N

NCP	Network Control Protocol
NSM	Network Service Module

O

OPX	Off Premises Extension
OSPF	Open Shortest Path First

P

PAP	Password Authentication Protocol
PDU	Packet Data Unit
PDU	Protocol Data Units
PIM	Protocol Independent Multicast
PIM-SM	Protocol Independent Multicast-Sparse Mode
PLAR	Private Line Automatic Ringdown
PoE	Power-over-Ethernet
POTS	Plain Old Telephone Services
PPP	Point to Point Protocol
PSAP	Public Service Answering Point
PSTN	Public Switched Telephone Network

Q

QoS	Quality of Service
QRM	Quality of service Resource Manager

R

RIP	Routing Information Protocol
RIPng	Routing Information Protocol next generation
RMON	Remote Network Monitoring
RP	Rendezvous Point
RSTP	Rapid Spanning Tree Protocol
RTOS	Real-Time Operating System

S

SCM	Samsung iPX
SDP	Session Description Protocol
SF	Smart Forwarder
SFP	Small Form Factor Pluggable
SIP	Session Initiation Protocol
SLA	Service-Level Agreement
SMB	Service Message Block
SNMP	Simple Network Management Protocol
SODIMM	Small Outline Dual In-line Memory Module
STP	Spanning Tree Protocol

T

TCP	Transmission Control Protocol
TDM	Time Division Multiplexer
TFTP	Trivial File Transfer Protocol
TLS	Transparent LAN Service

U

UDP	User Datagram Protocol
USB	Universal Serial Bus
UTP	Unshield Twisted Pair

V

VAD	Voice Activity Detection
VBO	Local Voice Busy Out
VC	Virtual Circuit
VCID	Virtual Circuit Identification
VDC	Volts Direct Circuit
VLAN	Virtual Local Area Network
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network

W

WAN	Wide Area Network

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WEEE SYMBOL INFORMATION

Correct Disposal of This Product (Waste Electrical & Electronic Equipment)

(Applicable in the European Union and other European countries with separate collection systems)

This marking on the product, accessories or literature indicates that the product and its electronic accessories (e.g., charger, headset, USB cable) should not be disposed of with other household waste at the end of their working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources.

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To protect natural resources and to promote material reuse, please separate batteries from other types of waste and recycle them through your local, free battery return system.

Ubigate iBG2016™

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SAMSUNG ELECTRONICS

SAMSUNG DIGITall
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Experience the power of one
Ubigate iBG2016™

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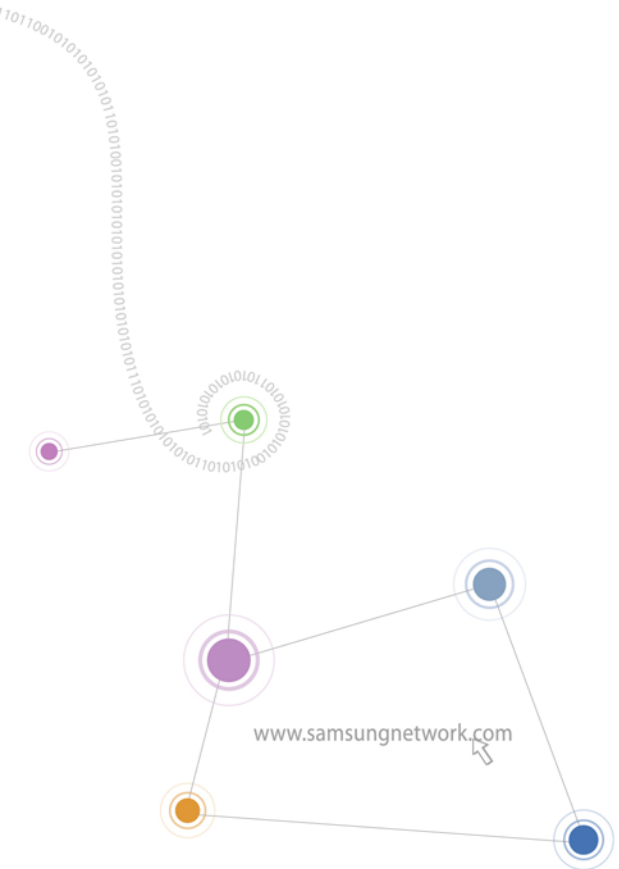

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