



T1 Circuit Extension Over IP



- **Exploits Efficiency of Ethernet**
- **ROI Measured in Weeks**

T1 Voice and Data Over IP

The **IP•Tube G4 T1** encapsulates a full or fractional T1 circuits into IP packets. T1 Over IP connections provide for the interconnection of PBXs, Cellular equipment and Telecom Switches via LANs, WANs, MANs, IP Satellite, xDSL, Cable and Wireless Ethernet.

Transparent Interconnect

The **IP•Tube G4 T1's** transparent operation maintains the proprietary signaling required to support PBX features such as call conferences, call forwarding, caller ID and SS7. Legacy phone equipment investment is preserved.

T1 Over IP Ethernet Benefits

- Transparent leased and private line services over less expensive IP and Ethernet networks
- Protects investment in traditional telephony and TDM equipment.
- Disaster recovery for T1 circuits with 1+1 and 1:1 redundancy.
- Operating expenses are minimized by leveraging the efficiencies and ubiquity of IP, Ethernet and MPLS
- Ethernet, IP and MPLS infrastructures are inexpensive, fast to provision and scalable.
- Easy installation with IP-based management and carrier grade diagnostics.



The **IP•Tube G4 T1** provides organizations with the ability to interconnect their existing phone systems over flexible bandwidth lines that are used to carry data, voice, and video. The Voice Only Leased Line Toll charges assessed by long distance and local carriers are eliminated or dramatically reduced by transporting voice traffic across packet-switched infrastructure. The following organizations incur significant recurring monthly costs for rigid-bandwidth leased lines used only for the interconnection of PBXs and Telecom switches.

- Multi-Site Enterprises
- Education Districts
- National, State and Local Government
- Health Care Service Providers
- Cellular Service Providers
- Universities
- Defense & Defence Contractors
- 911 Emergency Networks

T1 PRIVATE LINE SERVICES OVER IP

LANs

The most compelling option for the interconnection of T1 based systems is when it can be accomplished over a Local Area Network. The deployment of Fiber based LANS such as Gigabit Ethernet, provides organizations with high performance and high quality bandwidth that is especially well suited for the interconnection of PBXs and Switches.

WANs

Wide Area Networks that have sufficient bandwidth and Quality of Service provisioning result in very significant cost savings especially for Multi-Site Corporations. The **IP•Tube G4 T1-C** with lossless data compression, detects idle and redundant data within each voice circuit resulting in as much as 56 to 1 bandwidth savings.

T1 CIRCUIT EXTENSION OVER WIRELESS ETHERNET

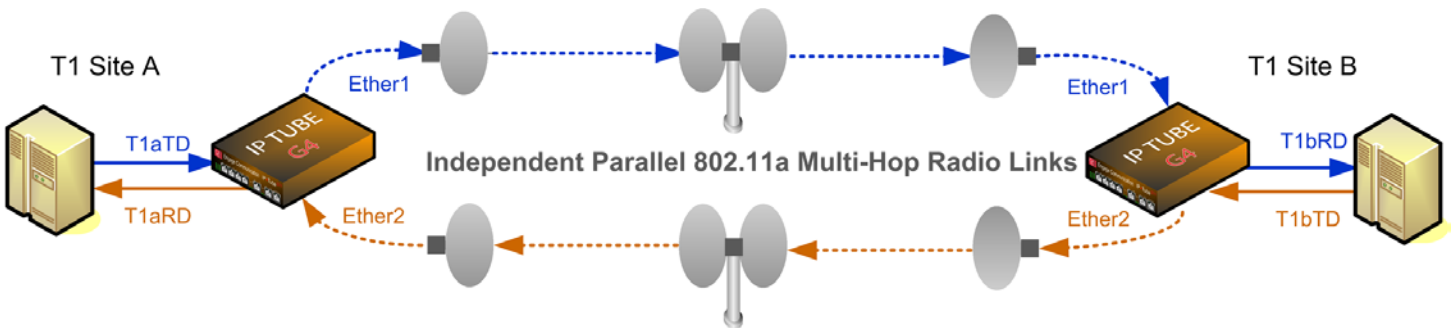
Wireless Ethernet

The IPTube has proven itself around the world as an effective method for using Commercial Off the Shelf Wireless Ethernet Bridges to interconnect T1 circuits.

The IPTube's Assured Delivery Protocol has the sophistication required for solid performance across a wide range of wireless connections.

Interconnection of T1 based data communication systems over wireless as a primary or back up connection is a major application.

The use of parallel Wireless Ethernet links minimizes the latency and Radio's packet processing requirement. Note: Parallel Application requires Ethernet Switch Option.



CELLULAR BASE STATION BACKHAUL

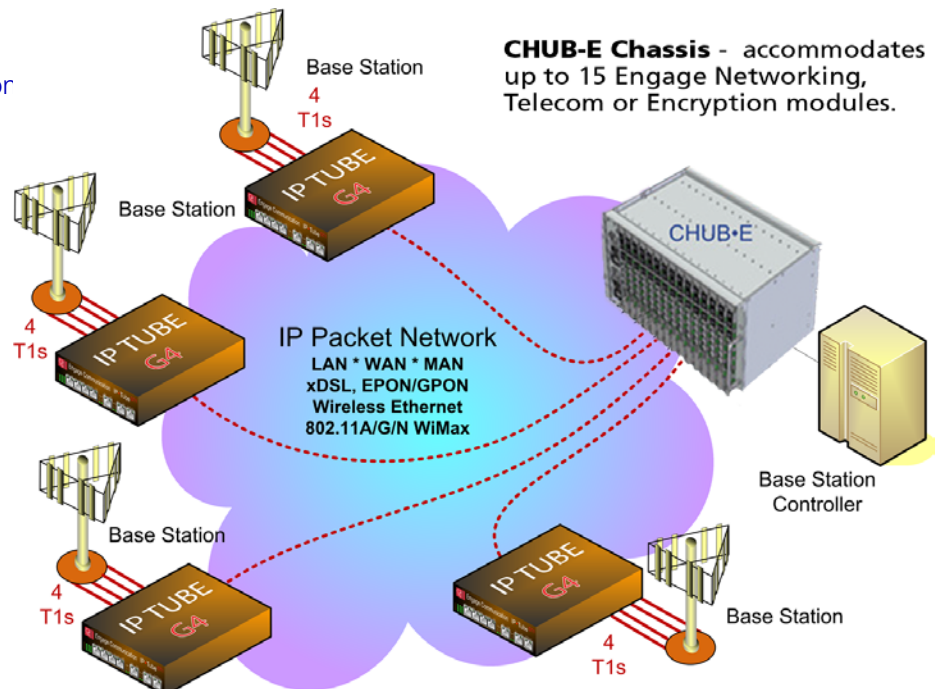
IP Cellular Backhaul

IP•Tube G4 T1s provide transparent interconnection of Base Stations, Base Station Controllers and Mobile Switching Centers over IP Ethernet packet-switched networks.

Cellular service providers save substantially by converting to a packet switch network. The Lossless Data compression option, which is especially well suited to Cellular communication links, minimizes the bandwidth required to interconnect.

Note: The Ethernet Switch Option has the sophistication to support Ethernet Native Base Station applications with QoS and rate limiting.

CHUB-E Chassis - accommodates up to 15 Engage Networking, Telecom or Encryption modules.



IP•Tube G4 T1 Standard Features

Assured Delivery Protocol

In order to assure high quality communications over links with intermittent or noisy performance, such as Wireless or Broadband over Power Line, the **IP•Tube G4 T1** employs Engage's robust Assured Delivery Protocol with the following benefits:

- Packet out of sequence detection and re-sequencing
- Duplicate skipping
- Lost packet retransmission with configured delay.

Dynamic Host Configuration Protocol - DHCP

The **IP•Tube G4 T1** can be configured to obtain its Internet Protocol network parameters: IP Address, Subnet Mask, Default Gateway, DNS; from a local DHCP server.

Domain Name Addressing

IP•Tube G4 T1 can be configured to use a Domain Name for the remote IP•Tube in place of a fixed IP address. Supports mobile multi service provider installations with ease.

Dynamic DNS

IP•Tubes can be configured to register their IP address with Dynamic Domain Name Servers for discovery by the IPTube at the other end of the T1 circuit. DDNS support combined with DHCP make installations Name-based which is very easy to setup and maintain when compared to Static IP addressing.

Secure Socket Shell - SSH

Engage's Secure Socket Shell, which is based upon industry proven Open SSH and FIPS 140 approved Open SSL version 2.0, provides secure encrypted communications between SSH clients such as OpenSSH, SecureCRT, and PuTTY and the IPTube's Command Line Interface.

SNMP

The **IP•Tube G4 T1** is able to be fully managed with SNMP via standard and private MIBs. Large scale deployments of IPTubes with centralized management have made SNMP support a priority. SNMP Traps for error events enable proactive service fault isolation.

IP•Tube G4 T1 Optional Features

Ethernet Switch OPTION - SWITCH

The **IP•Tube G4 T1** is available with a four port 10/100 Ethernet QoS switch integrating a high-performance switching fabric with four priority queues. Advanced features include 802.1p/IPv4/IPv6 traffic classification, full IEEE 802.1Q VLAN, RMON, SNMP, Port Monitoring and Layer 2 firewall.

QoS determined by destination MAC address, port ID, IEEE 802.1p and multimedia traffic tags, IPv4 Type of Service (TOS), and Differentiated Services (DiffServ).

Rate Limiter

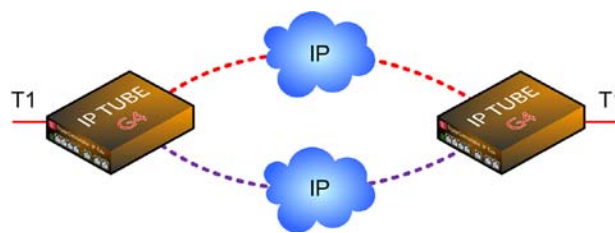
The Ethernet switch Ingress and/or Egress Rate Limiter option enables the reservation of the bandwidth for time-sensitive T1 Over IP real time connections.

Required for applications where the LAN traffic can exceed the WAN bandwidth required by the T1 over IP/Ethernet application. The data rate limit range is 128 kilobits to 64 Megabits in binary increments.

Protector OPTION -PRO

The protector option utilizes the Ethernet Switch port ETH1 as a redundant path for the interconnection of the IP encapsulated T1 data.

The PRO Option is configured to Always-On, or with Switch-Over criteria.



Alternator OPTION -ALT

The Alternator option alternatively sends the IP packetized T1 frames on two Ethernet interfaces, balancing the load.

The Alternator option enables fractional and full T1 circuits to be split over two IP WAN connections such as ADSL.

SuperTube OPTION - SUPER

The SuperTube option multiplexes four T1 circuits onto one IP packet stream. The SuperTube Sized IPTube reduces the encapsulation overhead bandwidth and the packet frequency by 75%. The substantial reduction of packet frequency enables network packet processors, such as wireless Ethernet radios and WAN routers/bridges, that can be overstressed with the low latency packet processing to reliably support the extension of real time circuits over their packet networks.

Four Multiplexed T1 Circuits Extended over Ethernet/IP



Technical Specifications

LAN Network Interface:

- One 10/100BaseT Full/Half Ethernet (2nd LAN requires Switch)
- Auto negotiation or Configured Speed and Duplex

LAN Network Protocols Supported:

- IP, TCP, UDP, ICMP
- Assured Delivery Protocol
- DHCP • DNS Address Discovery • Dynamic DNS

1 to 4 Duplicate Packet Transmission:

- Resilient performance through a lossy interconnect.

T1/Fractional T1 Specifications:

- One to Four Port Model • Connects directly to T1 or DS1
- Framing - ESF or D4 • Coding - B8ZS or AMI
- Supports DS0 assignments from 1 to 24
- Not Contiguous Configuration x,y,z Supported
- Comprehensive Clocking:
 - Internal** – the master clock source for the TDM circuit is provided by an internal clock oscillator
 - Network/Loopback** – the transmit clock is derived from the T1 port receive clock
 - Adaptive** – the clock is recovered from the Ethernet network interface
 - GPSDO** - the transmit clock is sourced by a Stratum1 timing signal from an optional GPS Disciplined Oscillator module

T1 Over IP Protocol:

- Assured Delivery Protocol
- TDM Over IP
- Circuit Extension Services Over IP - CESOIP
- HDLC Over IP - HDLCOIP
- Frames Per Packet Configured 8 to 56
- Low Latency Mode: 500 microseconds 4 T1 frames
- Max Payload Mode: 7 millisecond 56 T1 frames
- Jitter buffer: 1 to 595 milliseconds

TFTP Online Upgrade Capable (FLASH ROMs)

- IPTube is fully operational during upgrade

Lossless Data Compression OPTION:

- Detects idle and redundant data within each DS0
- Configured Silence Detection Range
- Interconnect bandwidth is not consumed by silent or redundant data
- Low Latency 8 to 1 Compression settings from 8 to 1 to 56 to 1

Quality of Service Support:

- IANA Registered UDP Port 3175 • IP Type of Service (TOS) CLI configured
- Diffserv configuration of TDMOverIP header
- VLAN tagging and priority labeling according to 802.1p&Q
- T1 Over IP frames are tagged with a dedicated VLAN ID.

Regulatory:

- CE • Safety -IEC60950 • EMC - CFR 47 Part 15 Sub Part B:2002, EN55022:1994+A1&A2, ICES-003 1997, CISPR 22 Level A
- Telecom Part 68

Management:

- Remote config., monitoring, & reset • Secure Socket Shell - SSH Diffie-Hellman Group1/14 key exchange and strong integrity checking via MAC SHA1/SHA1-96 with Cipher AES-128 and 3DES and DSS and OpenSSH public key format
- Telnet support with Edit and Paste Template Files
- Console Port for Out of Band Management
- SNMP support (MIB I, MIB II, Engage proprietary) with configured traps

Environmental:

- Temperature: 0–50°C (32–122°F) • Optional Extended Temp ranges avail.
- Humidity: Up to 90% non-condensing

Rear Panel/Power:

- 10-30 VDC, 1.0A. • Screw Locking Connector • Power 7 Watts
- Universal Adapter 100/240 VAC 50/60 Hz
- Optional -48V 0.25 Amp • Hot Standby

Physical:

- Dimensions: Length 7" (17.78 cm); Width 5.5" (14 cm); Height 1.50" (3.81 cm) • Weight 2 Pounds (1 kilogram)

Ethernet Switch OPTION:

- Out of band management interface with independent IP configuration
- 802.1Q VLAN support with Filtering for up to 64 VLANs
- Support both port-based membership or 802.1Q VLAN-based VLANs
- 2,048 MAC address entries with automatic learning and aging

Diagnostics:

- Telco Diagnostics: Local Loop, Remote Loop, Loop Up/Down NIU and CSU Codes. Enables isolation of connectivity faults to local, network or remote equipment
- Physical layer alarms for LOS, AIS, LOF
- Comprehensive statistics: LAN and IP layer network statistics: such as packet loss and packets arriving late, out of sequence, underruns, overruns CRC, and delay variation (jitter).

How to Order – IP•Tube G4 T1

Part No.	Description	Notes
400-1544-0x	IP•Tube G4 T1, (x=1 - 4 Ports)	Base Model Specify # of T1 Ports Enabled
400-1544-Cx	IP•Tube G4 T1 with T1 Compression	w/Lossless Data Compression Option (up to 4)
Base Options		Specify as suffix
-ROHS	ROHS compliant materials and processes	Restriction of Hazardous Substances no PB
-GPSDO	GPS Disciplined Oscillator Module	Stratum 1 Clock Source
-SUPER	Extends 4 T1s within a single IP Packet Stream	Reduces Bandwidth/Packet frequency by 75%
-SWITCH	4 Port QOS/VLAN/Rate Limiter 10/100 Ethernet Switch	QOS and VLAN tagging Reserve T1 Over IP Bandwidth w Rate Limiter
-PRO	Protector Option	Fault Tolerant Network Interconnect Requires Ethernet Switch Option
-ALT	Alternator Load Balancing Option	Load Balancing Inverse Mux
Power Options		Specify as suffix
-DCMOD	Power Module 10/30 VDC ADAPTER	Ships with Universal Adapter 100/240 50/60
-N48VDC	Power Supply Module Negative 48 Volt DC	Isolated Negative 48 Volt Power