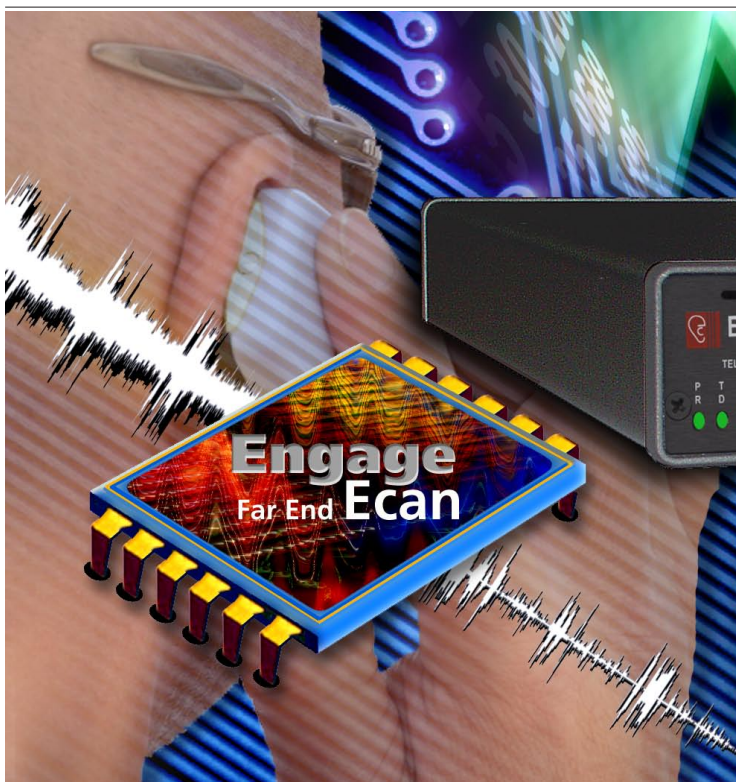


T1 Over IP for Voice with Echo Cancellor



T1 Circuit Extension Over IP

- ROI Measured in Weeks
- On-board Echo Canceller
- Supports Legacy Switches/PBX
- Crystal Clear Voice across Internet
- Exploits Efficiency of IP/Ethernet

T1 Voice Over IP

The **IP•Tube DLT1-Ecan** encapsulates full and fractional T1 circuits into IP packets. T1 Over IP connections provide for the interconnection of PBXs and Telecom Switches via LANs, WANs, MANs, Satellite and Wireless Ethernet.

The **IP•Tube DLT1-Ecan** ships with two T1 interfaces with either 1 or 2 active and two 10/100 BaseT Ethernet Interfaces. The inactive T1 Port can be activated via a software-based license key for a pay as you grow option.

Transparent Interconnect

The **IP•Tube DLT1-Ecan's** transparent operation maintains the proprietary signaling required to support PBX features such as call conferences, call forwarding, caller ID and SS7.

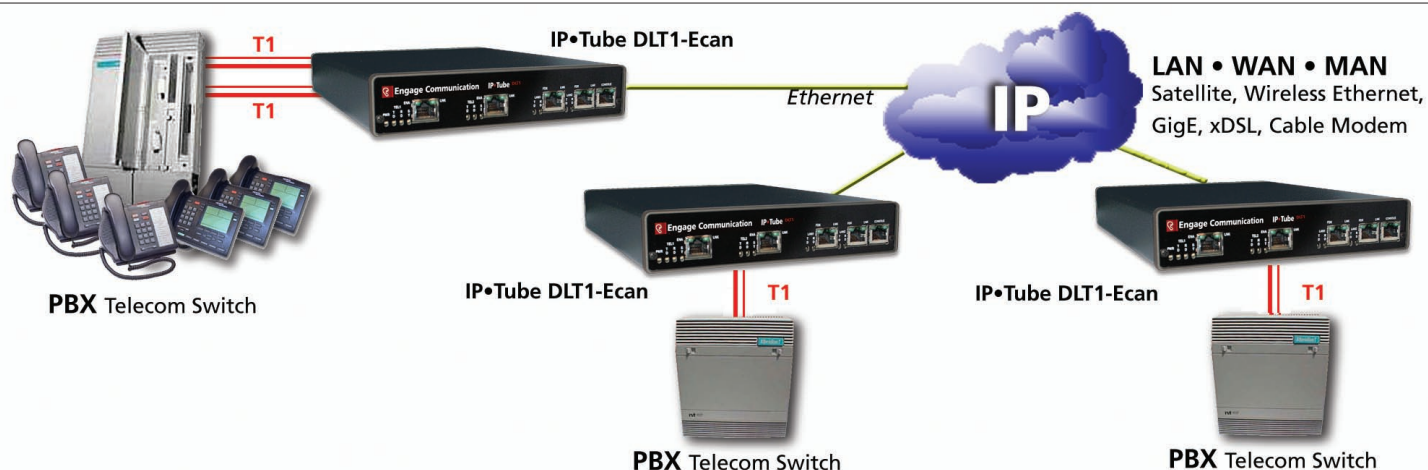
Echo Canceller

The **IP•Tube DLT1-Ecan** has an integrated T1 Echo Canceller that cancels up to 64 milliseconds of Far End echo. The echo canceller meets ITU-T G.164, G.165 and ITU-T G.168 requirements for echo cancellation.

Signaling Support

PRI ISDN, SS7, ESF, D4, SLC-96, Proprietary out of band, and robbed bit signaling is supported. Echo cancellation is automatically disabled during FAX and Modem communications. Transparent support for Modem or Fax. Voice quality is not compromised.

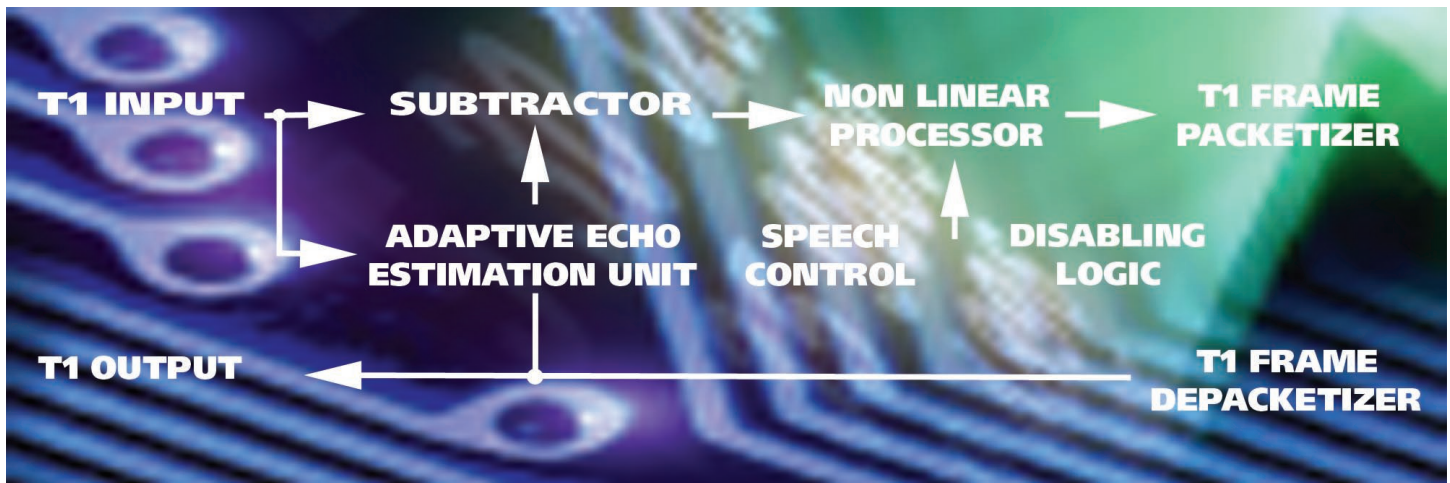
Legacy phone equipment investment is preserved.



Far End Echo Cancelling

IP•Tube DLT1-Ecan utilizes a Digital Signal Processor that detects and cancels echo at the far end so that the packet network delay has no impact on echo. The echo canceller samples the voice signal, estimates and removes the echo, leaving the original speech. The linear digital signal processor (DSP) models the echo and performs the main echo cancellation task. A non-linear DSP processor is then optimally employed to subtract out any residual echo or reflected noise components.

Echo is one of the most important factors that affects voice quality. The presence of echo depends on both echo level and echo delay. The primary source of echo is the impedance mismatch at the hybrid that links a 2-wire analog loop to a 4-wire digital trunk. The hybrid is not completely efficient in carrying the electrical energy and a certain amount of the electrical energy, or voice signal, is reflected back and may be perceived as echo. Occasionally, acoustic feedback of certain phones also causes noticeable echoes. These sources of echo are able to be cancelled by the human brain as long as the time between our speech and the echoed speech is not greater than 24 milliseconds.



Engage's T1 Over IP products have a minimum delay configuration, 1 millisecond packetization and 4 packet buffering, which introduces a delay of 5 milliseconds. The amount of delay introduced by the packet network depends upon its switching times, packet processing, packet jitter, transmission, loading and quality of service configuration.

For example a network connection that utilize Gigabit Ethernet switches, which introduce delays in the microseconds, does not require echo cancellation. Wide Area Networks that traverse an intranet or internet backbone have varying degrees of delay which can easily exceed 24 milliseconds. Total round trip delays in excess of 24 millisecond makes echo perceptible.

The IPTube's Echo Cancellation provides the elasticity to support clear connections across networks with significant delay and packet jitter such as **Wireless** connections in point to point or especially multipoint configurations.

T1 Private Line Services over IP

Multi-Site Enterprises, Education Districts, Universities, National, State and Local Government, and Municipalities, incur significant recurring monthly costs for rigid-bandwidth leased lines used only for the interconnection of Phone Systems.

The **IP•Tube DLT1-Ecan** 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:

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 Telecom Switches.

WANs

Wide Area Networks that have sufficient bandwidth and Quality of Service provisioning result in very significant cost savings especially for Multinational Corporations. The **IP•Tube DLT1-Ecan-C** with loss less data compression, detects idle and redundant data within each voice circuit resulting in a 56 to 1 bandwidth savings. WAN bandwidth is not consumed by silence or redundant samples.

IP•Tube DLT1-Ecan Standard Features

Dual LAN Interfaces

All **IP•Tube DLT1-Ecan** models ship with dual 10/100BaseT Ethernet LAN ports. The dual Ethernet interfaces provide for:

- Management interface on LAN port 2 when LAN port 1 is connected to a VPN tunnel
- Alternator Option for load balanced SDSL interconnects
- Protector Option for Redundant Packet Path connections with Constant or Switch Over Criteria
- Optional LAN1 to LAN2 Bridging with Rate Limiting

Assured Delivery Protocol

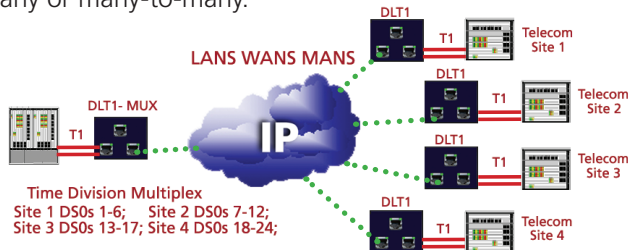
In order to assure high quality communications over links with intermittent or noisy performance, such as Wireless or Broadband over Power Line, the **IP•Tube DLT1-Ecan** employs Engage's robust Assured Delivery Protocol with the following benefits:

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

IP•Tube DLT1-Ecan Optional Features

DSO Timeslot Multiplexor OPTION - MUX

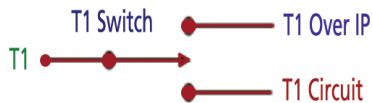
The **IP•Tube DLT1-Ecan-MUX** maps DSOs from a central site to as many as 24 remote locations via an IP/Ethernet connection. Get maximum use of expensive DS1 interfaces on PBX, Channel equipment and datacom gear. Also provides Virtual DACS Over IP capability. Mesh DSOs one-to-many or many-to-many.



T1 Switch OPTION -SWT

The T1 switch option enables the T1 Port 1 interface to be manually switched between a T1 circuit connected to T1 Port 2 or to T1 Over IP packets connected with the remote IPTube.

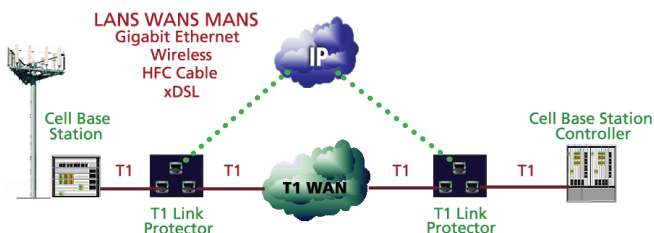
- Remote Control of T1 Connection to Telco or T1 over IP
- Installation performed by a single Technician
- Quick reversion to Telco during debug of T1 over IP



T1 Link Protector OPTION -LPT

The T1 Link Protector provides an automatic backup for T1 circuits with T1 Over IP connecting via Wireless Ethernet, Gigabit Ethernet, IP Satellite Services, xDSL,...

- Automatic Protection Switch for T1 Circuit
- Deliver on Stringent Service Level Agreements
- Back Up for Mission Critical Connectivity
- Disaster Recovery for Public Safety Networks

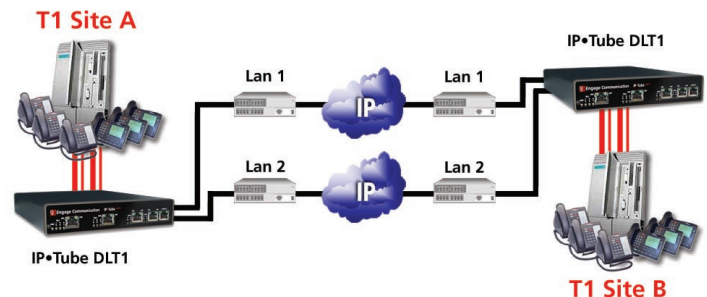


Lossless Data Compression OPTION -C

The **IP•Tube DLT1-Ecan-C** continuously detects idle and redundant data within each T1 Voice circuit resulting in as much as a 56 to 1 bandwidth savings. TDM over IP WAN bandwidth is not consumed by silent or redundant samples.

Protector OPTION -PRO

The protector option utilizes the second LAN interface as a redundant path for the interconnection of the IP encapsulated T1 data. The extension of the T1 circuit has a fault tolerant link that is configured to always on, or with switch over criteria.

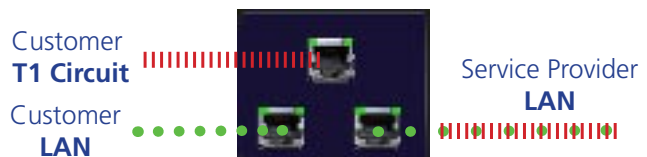


Alternator Load Balancing OPTION -ALT

The **IP•Tube DLT1-Ecan-ALT** Alternator option alternatively sends the IP packetized T1 frames on LAN 1 and LAN 2. The Alternator option enables fractional and full T1 circuits to be split over two IP WAN connections such as SDSL.

Rate Limiter OPTION -RLM

The **IP•Tube DLT1-Ecan-RLM** Rate Limiter option limits the WAN bandwidth utilized by the LAN1 to LAN2 bridge. Rate Limiting the traffic enables the reservation of the WAN bandwidth for time the sensitive T1 Over IP real time connections. Great for Wireless WAN T1 applications.



Rate Governing is only applied in the direction to the WAN to minimize latency. The data rate governor utilizes Time Division Multiplexing based clocking to provide for Nx64, NxT1 and NxFT3 bandwidth regulation that is configured from 64 kilobits up to 45Mbps.

Pay-As-You-Grow Field Upgrades

The **IP•Tube DLT1-Ecans** are designed for Pay-As-You-Grow expansion. Customers can elect to economize initial installation by purchasing a single active T1 port, and then enable the additional T1 port via a software-based license key. Field Upgrade benefits are extended to Loss less Data Compression, Protector, and Alternator. Echo Cancellation is Hardware.

Technical Specifications

LAN Network Interface:

- Two 10/100BaseT Full/Half Ethernet
- Auto negotiation or Configured Speed and Duplex

LAN Network Protocols Supported:

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

Echo Canceller:

- Voiceband Echo Cancelling according to ITU G.165 and G.168
- u- and A-Law coding according to ITU G.711
- 24 channels with end echo path delay of less than 63.75 ms

T1/Fractional T1 Specifications:

- One or two Port Models • 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

T1 Over IP Protocol:

- TDM Over IP
- Circuit Extension Services Over IP - CESOIP
- HDLC Over IP - HDLCOIP
- Frames Per Packet Configured 8 to 56
- Low Latency Mode: 1 millisecond 8 T1 frames
- Max Payload Mode: 7 millisecond 56 T1 frames
- Comprehensive Clocking: Internal, Network, Adaptive

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:

- IP Type of Service (TOS) CLI configured • IANA Registered UDP Port 3175
- 802.1p/q mac level prioritization • Duplicate Packet Transmissions

Regulatory:

- CE • Safety -IEC60950 • EMC - CFR 47 Part 15 Sub Part B:2002, EN55022:1994+A1&A2, EN55024, ICES-003 1997, CISPR 22 Level A
- Telecom Part 68

Management:

- Telnet support with Edit and Paste Template Files
- Console Port for Out of Band Management
- SNMP support (MIB I, MIB II) with configured traps
- Remote config., monitoring, & reset
- Telco Diagnostics: Local Loop, Remote Loop

Rear Panel/Power:

- 10-30 VDC, 1.0A. • Screw Locking Connector
- Universal Adapter 100/240 VAC 50/60 Hz
- Optional -48V 0.25 Amp • Hot Standby
- Dimensions: 9" (L) x 7.3" (W) x 1.50" (H)

How to Order – IP•Tube DLT1-Ecan

Part No.	Description	Notes
221-1544-0x	IP•Tube DLT1-Ecan, xT1 (x=1 - 2 Ports)	Base Model Specify # of T1 Ports Enabled
223-1544-Cx	IP•Tube DLT1-Ecan with xT1 Compression	w/Lossless Data Compression Option
Base Options		Specify as suffix
-ROHS	ROHS compliant materials and processes	Restriction of Hazardous Substances no PB
-MUX	T1 Multiplexor and DACS	Groom 2 to 24 remote locations Over IP
-SWT	T1 Switch Option	Provides for Manual Switching of T1-T1OverIP
-LPT	Link Protector Option	Automatic T1 Circuit Backup with T1OverIP
-PRO	Protector Option	Fault Tolerant Network Interconnect
-ALT	Alternator Load Balancing Option	Load Balancing Inverse Mux
-RLM	Rate Limiter Option	Reserve T1 Over IP Bandwidth
Power Options		Specify as suffix
-DCMOD	Power Module 10/30 VDC ADAPTER	Ships with Universal Adapter 100/240 50/60
-WIRED	Power Supply Module 10/30 VDC Screw Term	
-N48VDC	Power Supply Module Negative 48 Volt DC	Isolated Negative 48 Volt Power
Rack Mount Option		Specify as suffix
-RACKMNT	19/23" Wide Rack Mount Brackets	Enclosure Nut Serts Installed