

## 16T1 over Packet / TDM over IP

### Product Overview

Valiant's 'VCL-T1oP' T1 over Packet (16 T1 Port GE Version) TDM over IP equipment supports transmission of up to 16 x T1 links over IP / Ethernet, MEF or MPLS Pseudo-wire networks.

The 'VCL-T1oP' T1 over Packet (16 T1 Port GE Version) TDM over IP equipment, equipped with a highly reliable clock recovery mechanism for low jitter and wander control, even under variable network conditions.

16 x T1 Port T1oP (T1 over Packet) equipment provides 4x Gigabit electrical Ethernet ports along with 4 x Gigabit optical Ethernet ports out of which the user may select and use any 4, to implement 1+1 add-drop (Drop-Insert), Ethernet link redundancy (Rapid Spanning Tree Protocol and Ethernet Port Trunking) and QoS by implementing 802.1Q based VLAN, Differentiated Services (Diffserv / DSCP), Port based Priority and 802.1p packet priority classification protocols for network optimization.

The 'VCL-T1oP' T1 over Packet (16 T1 Port GE Version) TDM over IP equipment also optimizes on the network usage, such that the bandwidth used by the T1oP equipment on the packet network is limited to the corresponding to the number of T1 ports and the time-slots that are being transported over the Ethernet / packet network.



### Purpose of TDM over Packet technology

Telecom companies and enterprise users can save network and equipment cost and generate additional revenue by offering different types of services over a single packet-switched infrastructure by the use of T1 over Packet/IP equipment. The T1 over IP equipment is also suitable for connecting to Ethernet / packet wireless equipment to achieve fast deployment of T1 services over wireless Ethernet networks. One particular application is to build T1 links with low cost Wireless LAN bridges, replacing expensive TDM / T1 microwave radios.

The 16 x T1 over Ethernet/ Packet (VCL-T1oP) multiplexer may be used to provide legacy TDM services over Gigabit Ethernet optical fiber, or wireless Ethernet/IP networks.

### How the TDM over Packet (16 T1 Port GE Version) equipment works

The T1 data streams received on the T1 interfaces are converted by the T1oP engine of the T1oP equipment to Ethernet data packets (of a fixed size) and transported over the Ethernet network with UDP / IP, MEF or MPLS headers. At the receiving end the T1oP reconstructs the original data streams by removing the IP, MEF or MPLS headers and converts the Ethernet data packets back to T1 frames using highly reliable and accurate clock recovery mechanism. The 'VCL-T1oP' (16 T1 port GE Version) offers the user a choice of standard, T1 to packet and packet to T1 conversion mechanisms that include SAToP and CESoPSN technologies.

### Hardware Highlights

- 19-Inch rack mountable
- 1U form factor (44mm high)
- 1+1 Redundant Power Supplies, AC and DC, or AC plus DC
- Redundant power supply inputs
- Extended Temperature Range: (-20° C to +60° C)
- EMI / EMC Compliant
- Real time battery backed clock with life in excess of 10 years

### T1 Clock recovery and synchronization techniques

- Adaptive Clock Recovery (ACLK)
- Recovered Clock (RCLK) / Loop-Timed Clock
- Asymmetrical (One-Clock and Two-Clock) Clock
- Synchronization to an External Clock (ECLK)
- Synchronization to an Internal Clock
- Automatic clock priority selection with fall back
- Plesiochronous Clocking.

### Key Features - T1 and T1oP Interface

- Supports 16 independent T1 interfaces.
- Internal, External, Adaptive, Recovered clock and Asymmetrical (One-Clock and Two-Clock) options for the T1 TDM port synchronization. Automatic clock priority selection with fall back.
- Supports CESoPSN payload mechanism to support the fractional T1 with data rate of 64Kbps to 1.544Mbps (DS0 timeslot level). User configurable data rate from 64kbps to 1544kbps, in steps of 64kbps.
- CESoPSN payload mechanism feature allows the user to optimize the packet switched network by limiting its usage to the corresponding number of time slots carried by a T1 channel.
- Supports SAToP payload mechanism to transport full T1 (transparent to the structure of the TDM frame useful for transporting framed / unframed T1 channels).
- Supports IETF-PWE3 (pseudo-wire), SAToP and CESoPSN transport mechanisms.
- Supports IP, MPLS and MEF8 (Metro Ethernet) tagging.
- Supports three T1 framing modes - SF, ESF and Unframed.
- Supports two T1 linecodes - B8ZS and AMI
- Supports point-to-point, point-to-multipoint and drop and insert applications.
- Supports network latency / packet delay variation / jitter buffer of up to 512ms.
- Absolute and Differential time stamps.
- Jitter and Wander conforms to G.823 / G.824 and G.8261 and TDM specifications.
- RJ45 - 100 ohms T1 interfaces.
- T1 Local and Remote Loopback (RLOOP) facility for testing and diagnostics.

### Key Features - Ethernet / IP Network Interface

- Switching Capacity upto 6 Gbps, non-blocking
- 4 GigE Ports.
- Optical SFP based (1000Base-FX) and Electrical (10/100/1000Base-T) Ethernet port options.
  - 4 x 10/100/1000BaseT Copper Ports.
  - 4 x 1000BaseFX Optical Fiber Ports.
  - (may use a combination / mix of only 4 Copper or Fiber Ports)
- Point-to-point and point-to-multipoint applications based on IP addressing.
- Supports drop and insert applications.
- Port Control Ingress Rate Limiting.
- 1+1 Ethernet link redundancy
  - Rapid Spanning Tree Protocol.
  - Ethernet Port Trunking
- User configurable MTU (T1oP payload) packet size up to 1800 Bytes.
- Configurable payload size for each bundle
- Switch supports jumbo frame sizes of up to 9000 Bytes.
- Supports 802.1Q based QoS, 802.1p based packet priority.
- Port Based Priority (Classifying Services)
- DSCP and 802.1Q / 802.1p based packet tagging and prioritization
- Flow Control in an Ethernet Packet Networks: (Regulating Traffic)
- Port / Customer based bandwidth allocation (Port Rate Limiting)
- MPLS, MEF and UDP tagging for Ethernet traffic.
- Separate IP Address for TDM traffic and equipment management

- VLAN tagging for TDM traffic and equipment access / management
- Single / Double 802.1 VLAN tagging (Q in Q VLAN Tagging) - User configurable.
- UDP-specific "Special" Ethernet type.
- In band VCCV ARP.
- Broadcast DA.

### Key Features explained

- Port Based Priority (Classifying Services) - Port based Priority feature allows the user to assign priority to the individual Ethernet ports, so that traffic can be regulated according to the port on which that service is connected. The user may also assign highest priority to TDM (T1/T3/DS3) traffic and Ethernet services on a lower priority.
- VLAN Based Priority (Classifying Services) - VLAN based Priority feature allows the user to assign priorities to different VLANs carrying various types of services / traffic according based on user categories and preferences. The user may assign highest priority to TDM (T1/T3/DS3) traffic and Ethernet services on a lower priority. User may also configure which TDM link should be given preference over the other TDM links when the uplink bandwidth falls below a particular threshold.
- Flow Control in an Ethernet Packet Networks: (Regulating Traffic) - Flow Control feature allows the user to regulate Ethernet traffic flow to minimize packet loss due to data bursts.
- Port / Customer based bandwidth allocation (Port Rate Limiting) - Port based Ingress Ethernet Rate Limiting allows the user to assign the bandwidth as per port / service requirements, in addition to provisioning traffic by using 802.1Q and 802.1p VLANs and packet priority.

### System Management, Monitoring and Alarm Interfaces

- NMS (Network Management System) to monitor multiple units from single Central Location.
- External Alarm - Dry contact relay alarms are also available at rear of the system to connect the system to an external alarm.
- Supports system temperature monitoring with High Temperature threshold and Low Temperature threshold alarms and SNMP Traps.
- Supports SNMP V2 Monitoring and Traps.
- Self-test for checking system errors upon system bootup.
- Event Logging.
- Clock Performance Alarms.
- Network Performance Alarms.
- Network Performance Monitoring and Diagnostics.
- Online / remote upgrade of firmware.

### System Access, Control and Management Options

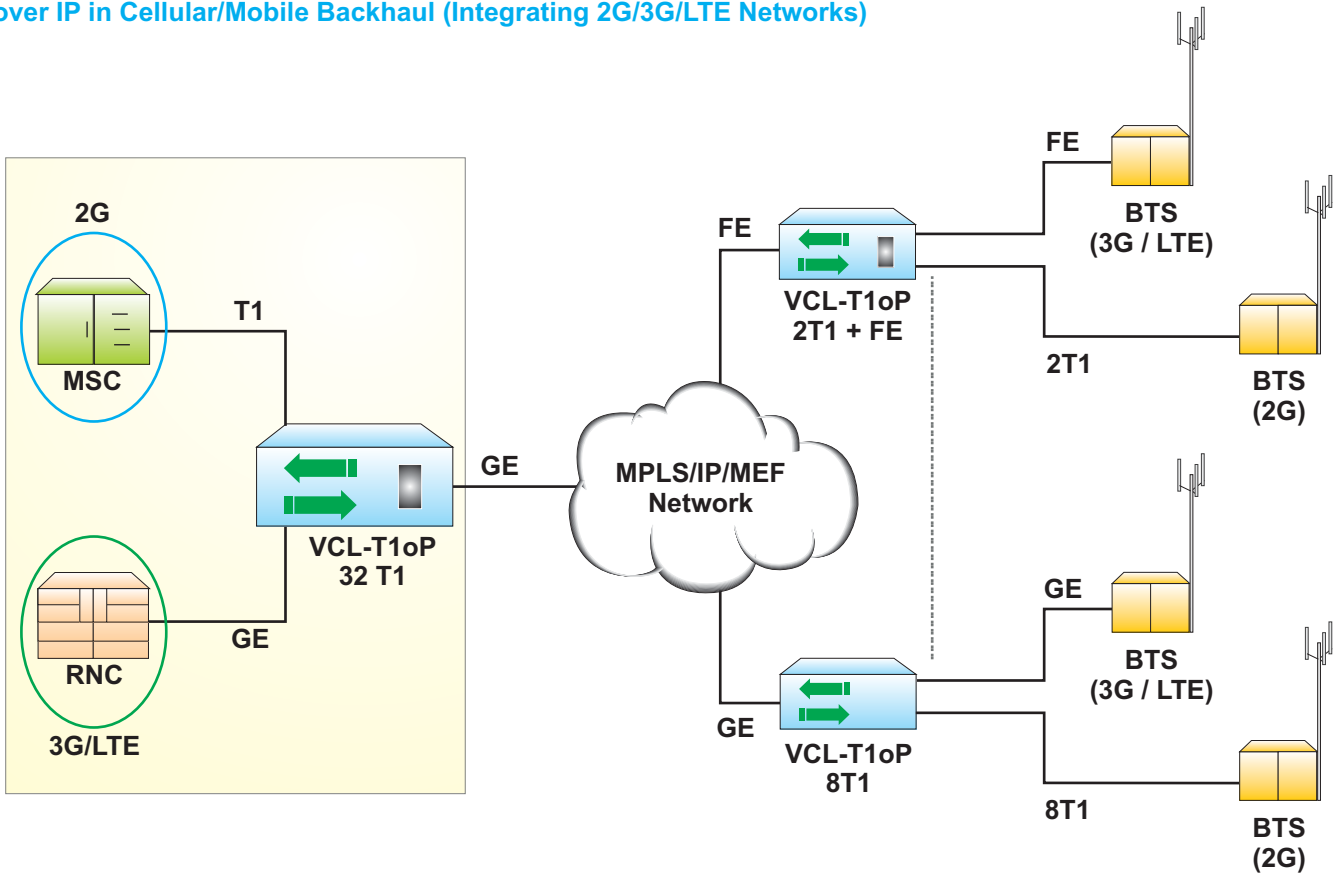
- Telnet.
- CLI Control Interface (HyperTerminal or VT100).
- SNMP V2 Traps (MIB File provided).
- Windows based GUI (Graphical User Interface) for easy configuration, management and access. Ability to monitor multiple units from a single NMS.
- Password Protection.

### OAM: Operation and Management Ports

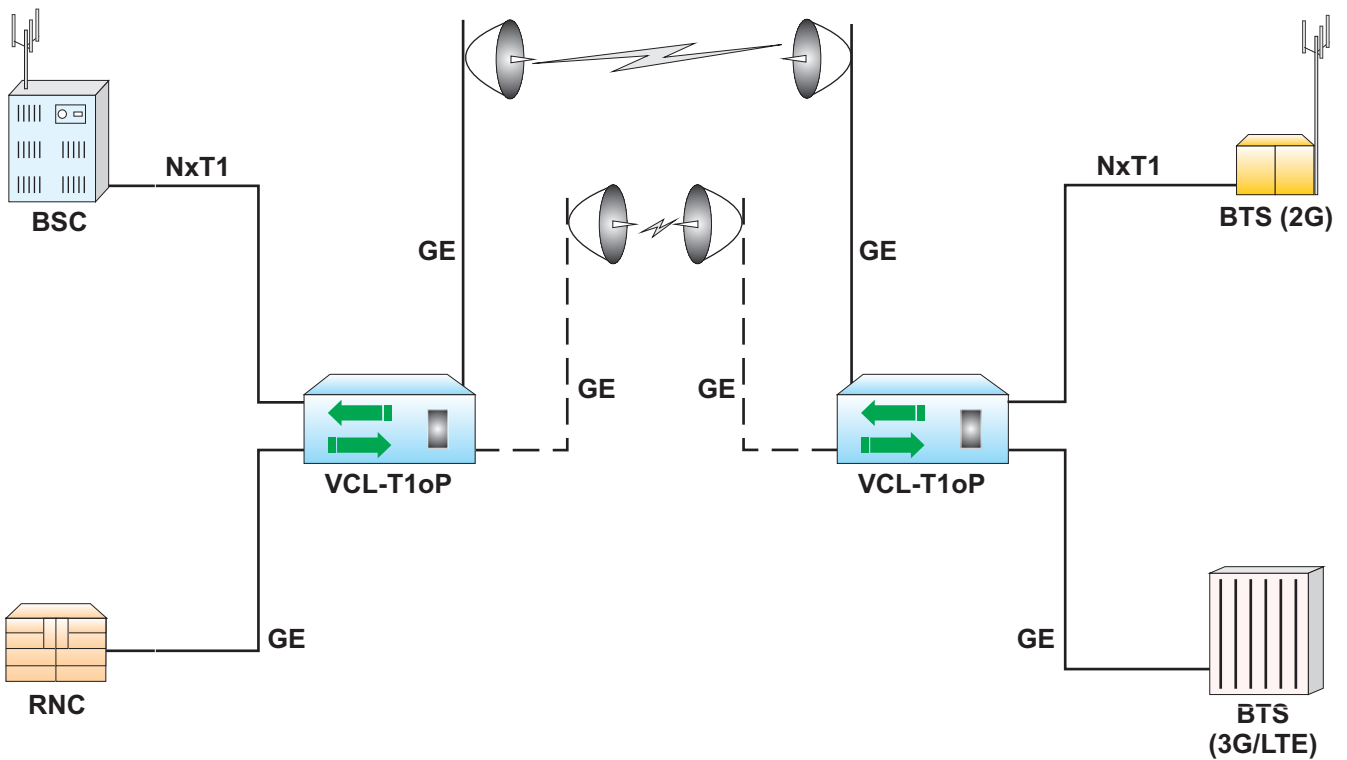
- RS232 Serial Port.
- USB COM Port.
- 10/100/1000BaseT Ethernet Management for In-band remote access.

Application Diagram

TDM over IP in Cellular/Mobile Backhaul (Integrating 2G/3G/LTE Networks)

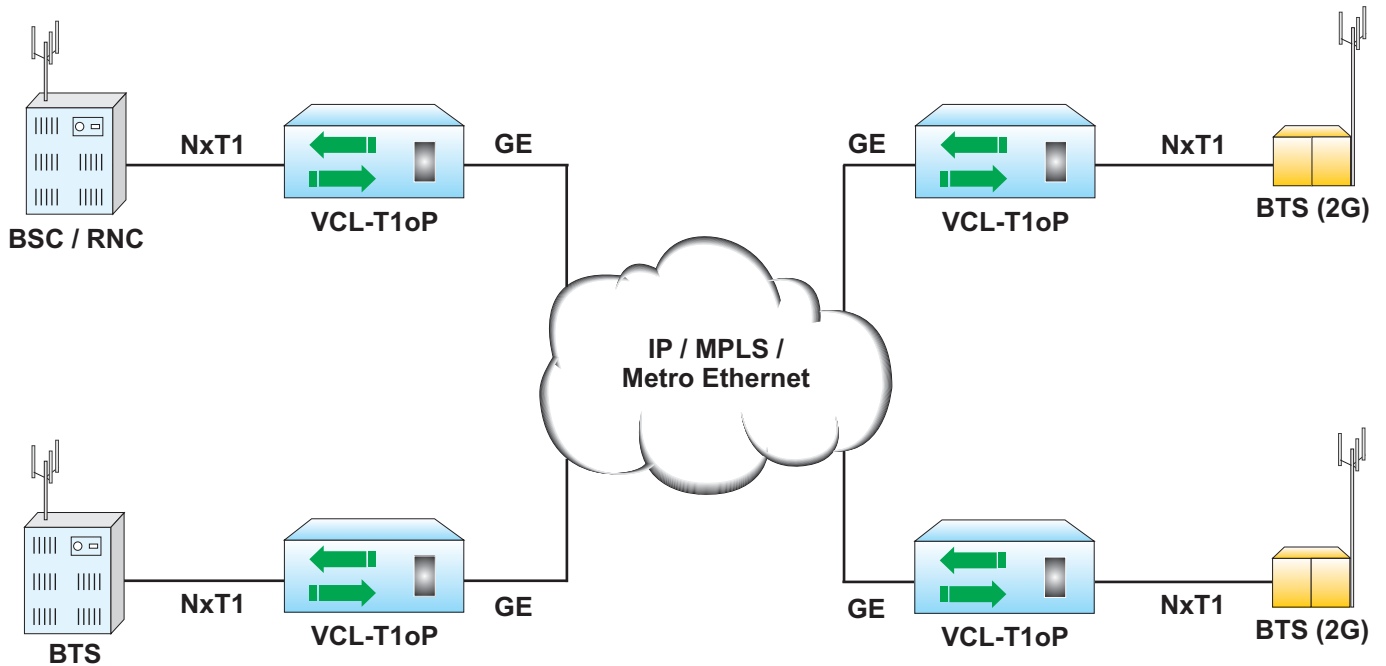


TDM over IP for 2G/3G/LTE - Typical Application in a redundant Wireless Network (1+1 Link Redundancy)



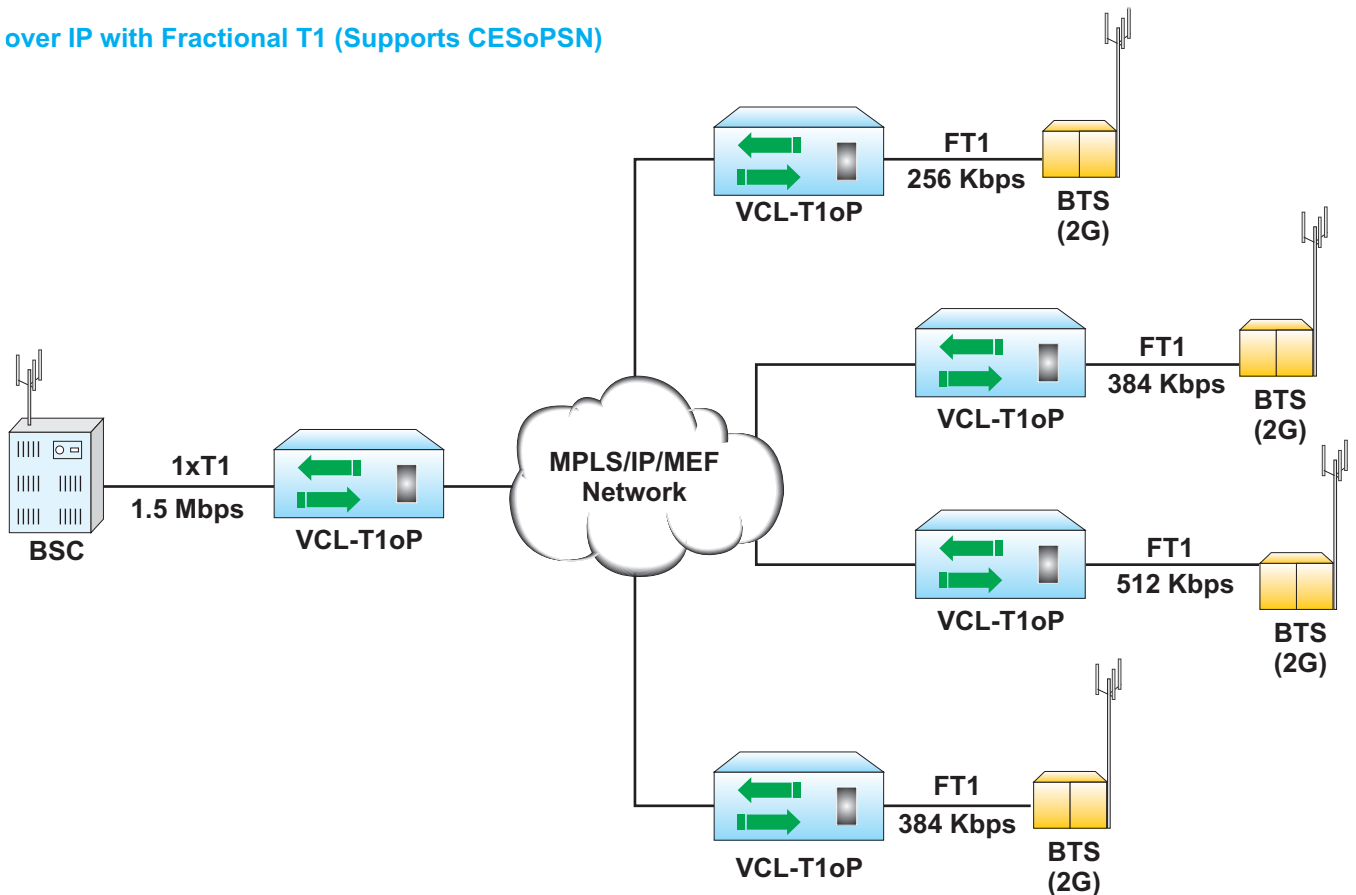
Application Diagram

TDM over IP / Ethernet - Providing 2G/3G/LTE integration over an IP Cloud



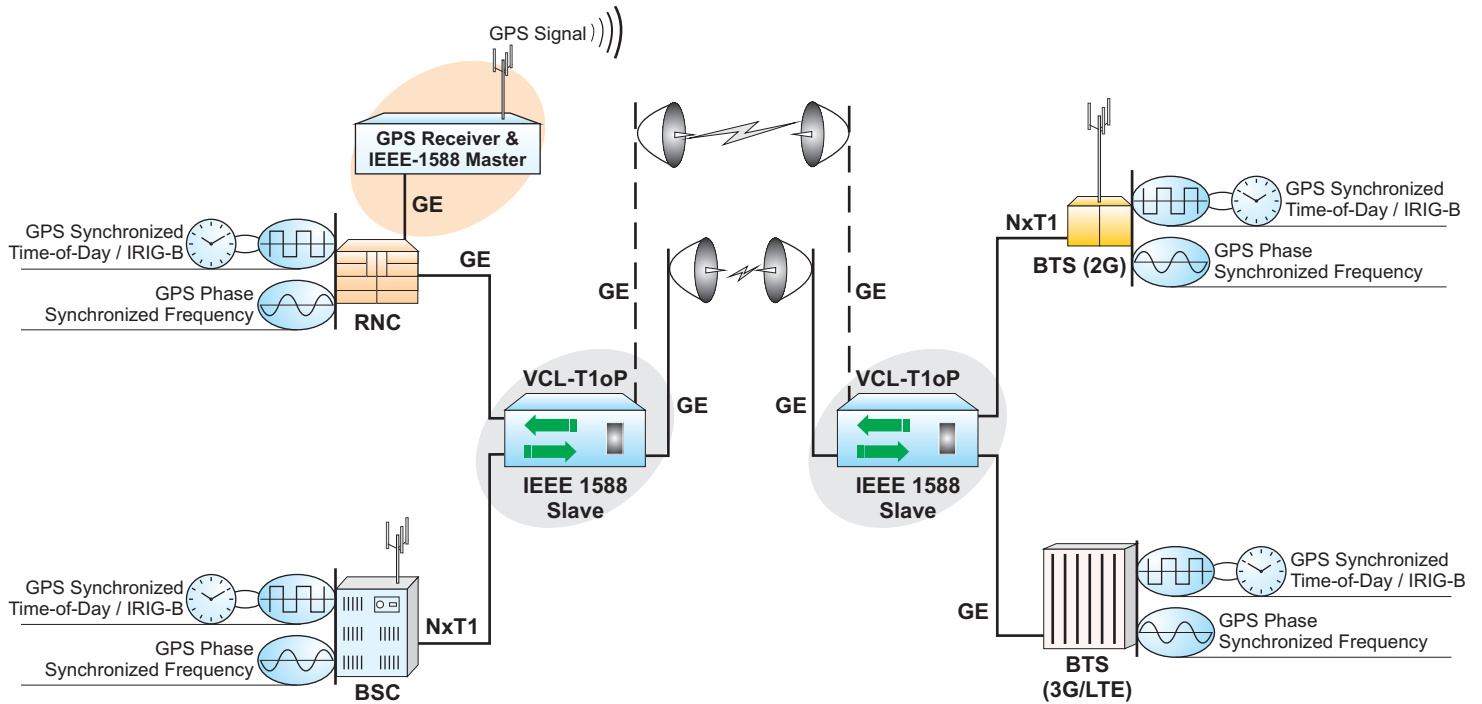
**Note:** Application illustrates link protection using Spanning Tree Protocol between all nodes.

TDM over IP with Fractional T1 (Supports CESoPSN)

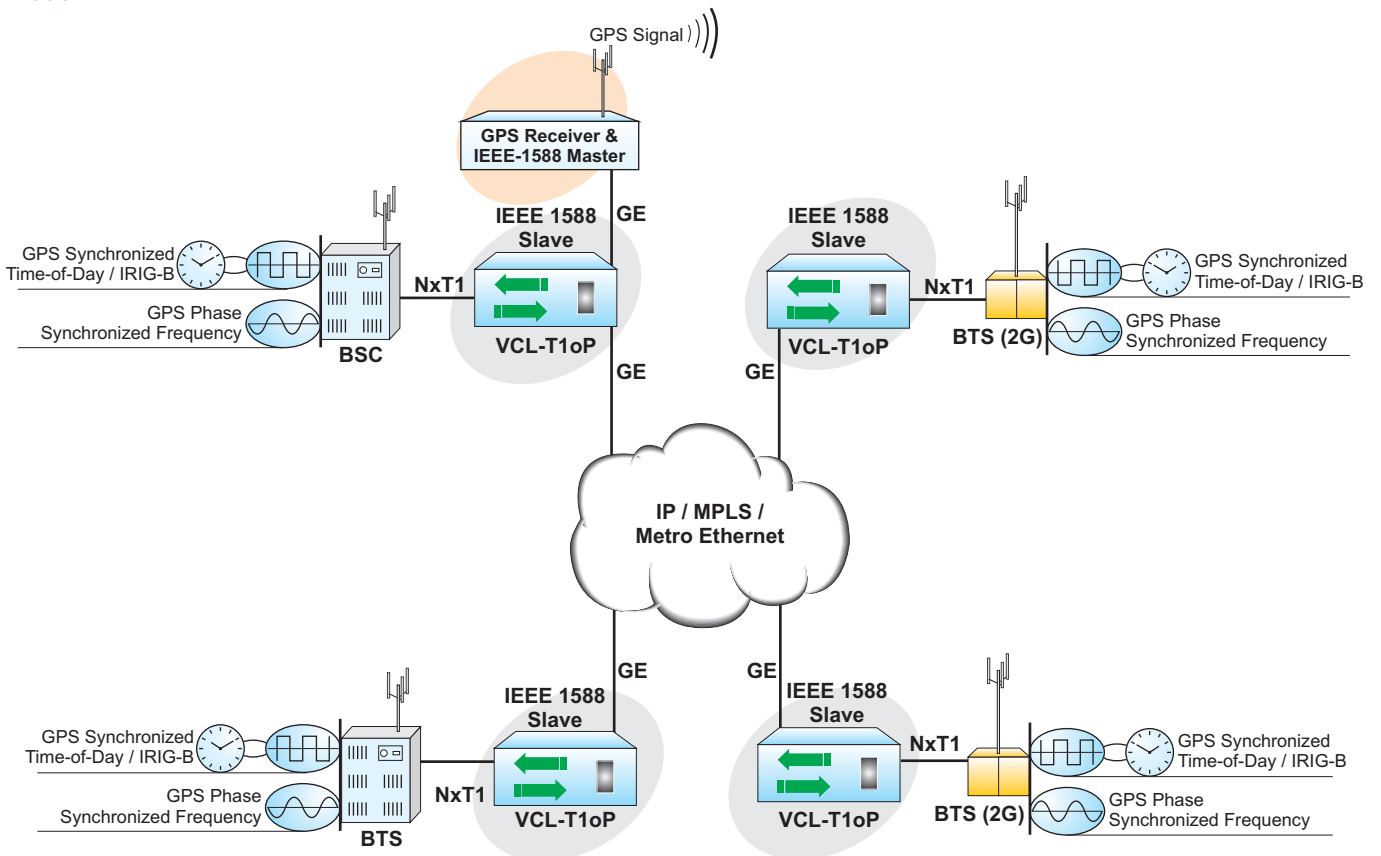


Application Diagram

TDM over IP for 2G/3G/LTE in a redundant Wireless Network (1+1 Link Redundancy) with IEEE 1588 v2\* Synchronous Ethernet



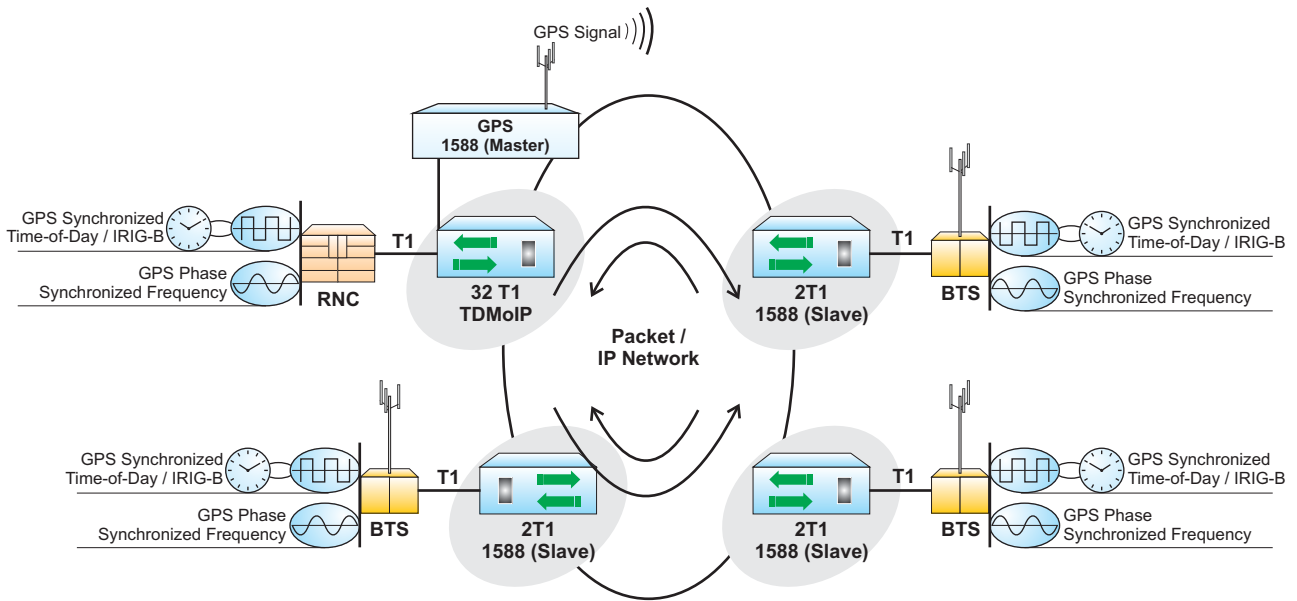
TDM over IP/Ethernet - Distributing T1s, ToD (Time-Of-Day) and Frequency Synchronization over an IP Cloud using IEEE 1588v2\*



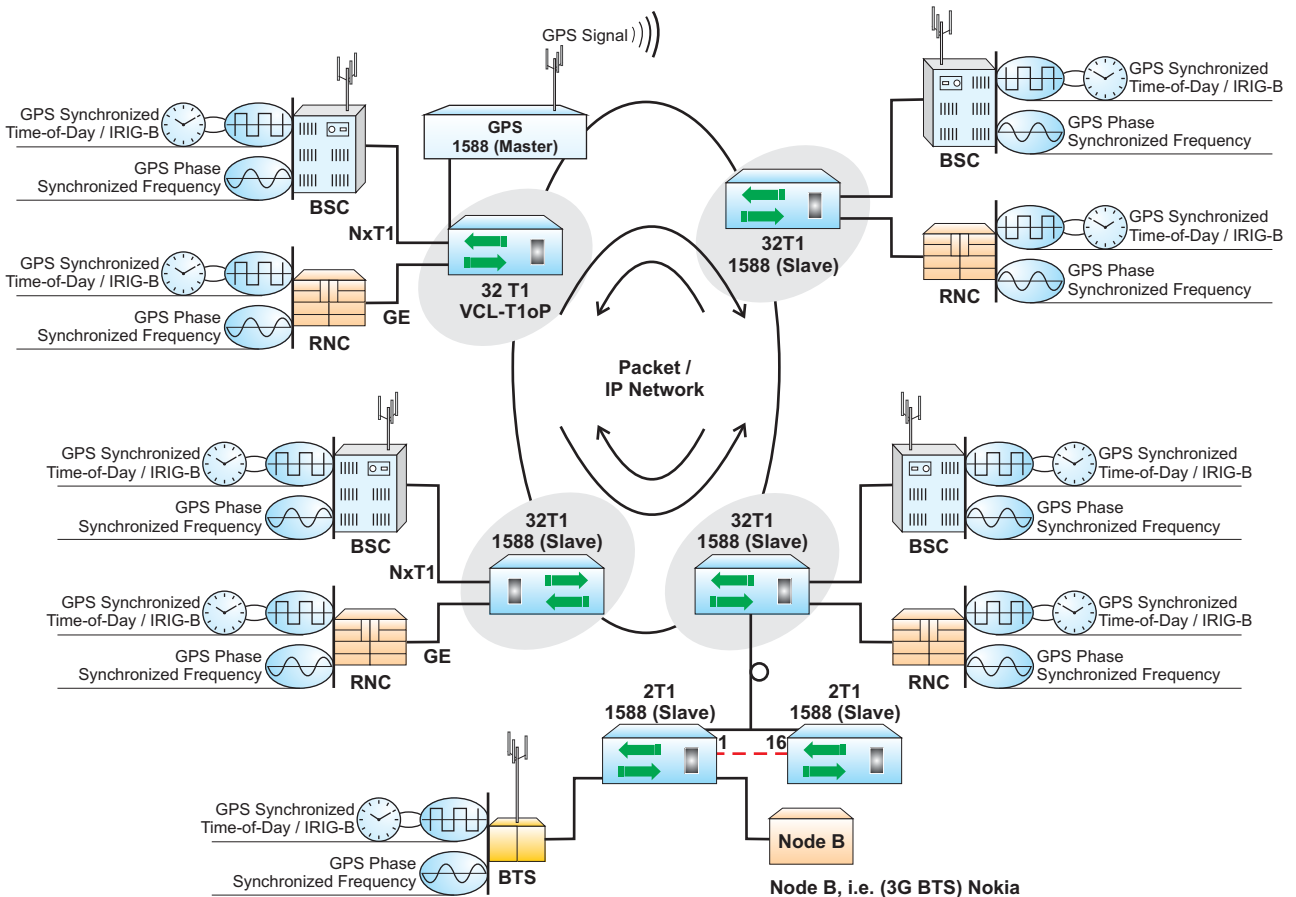
\* This option is available with T1oP with 1588v2 Version hardware equipment (Part # VCL-T1oP-2T1 GE-40E-1588-2U-2124).

Application Diagram

TDM over IP/Ethernet: Using IEEE 1588v2\* to distribute T1s along with ToD (Time-Of-Day) and Frequency Synchronization over Optical Fiber Ring



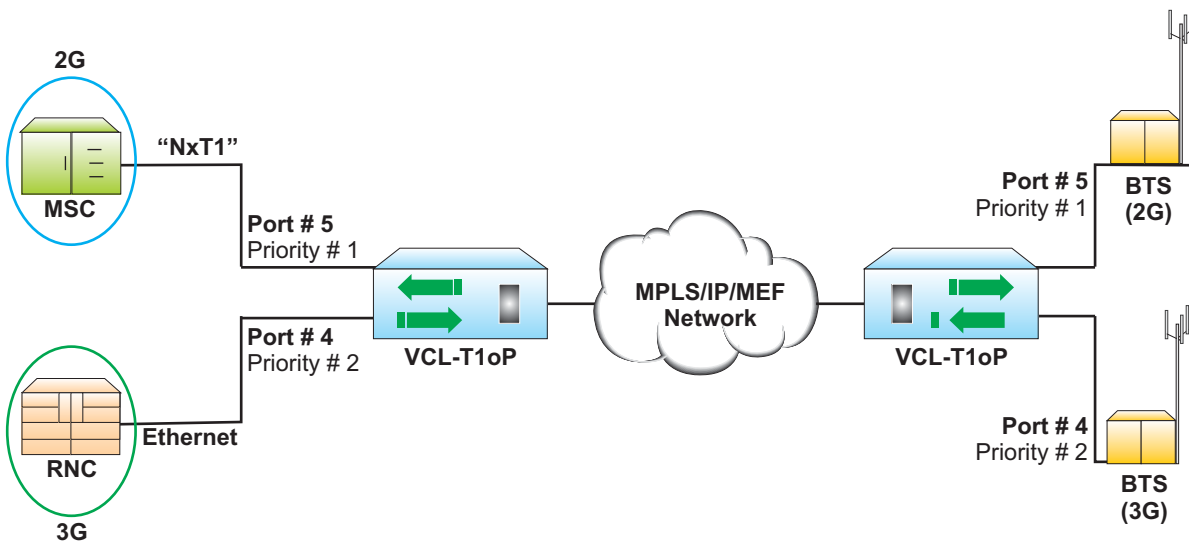
TDM over IP/Ethernet: Using IEEE 1588v2\* to distribute T1s, ToD (Time-Of-Day) and Frequency Synchronization over a Complex Ring and Spoke Optical Fiber Networks



\* This option is available with T1oP with 1588v2 Version hardware equipment (Part # VCL-T1oP-2T1 GE-40E-1588-2U-2124).

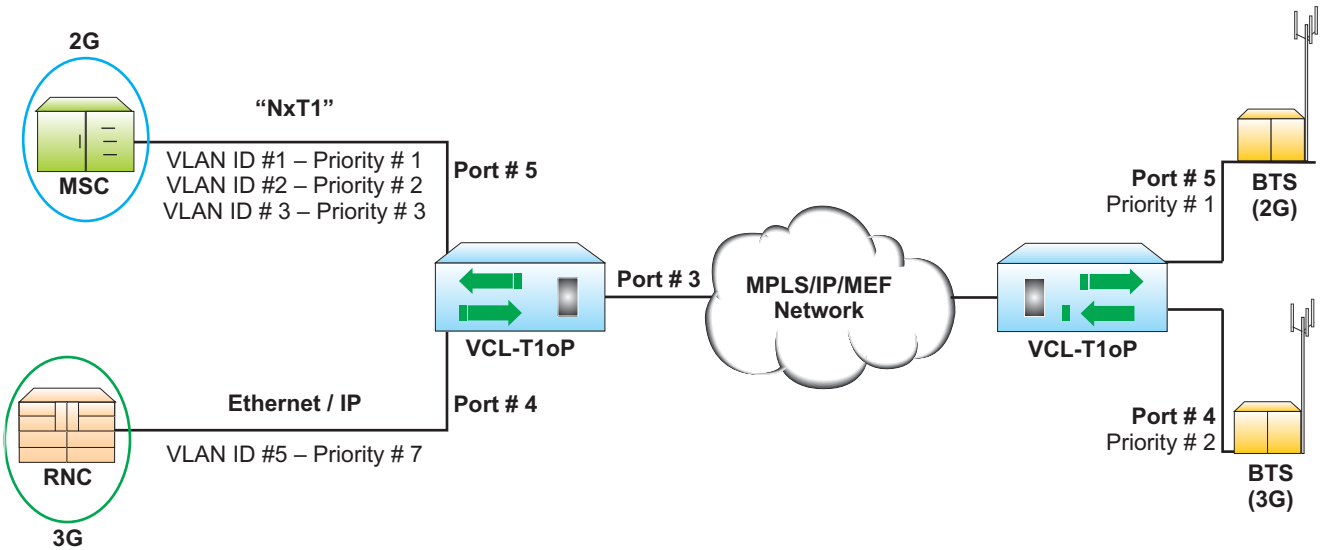
Application Diagram

TDM over IP/Ethernet - Port Based Priority (Classifying Services)



**Notes:** Port based Priority feature allows the user to assign priority to the 2G and 3G traffic ports, so that traffic can be regulated according to the port on which that service is connected.

TDM over IP/Ethernet - VLAN Based Priority (Classifying Services)



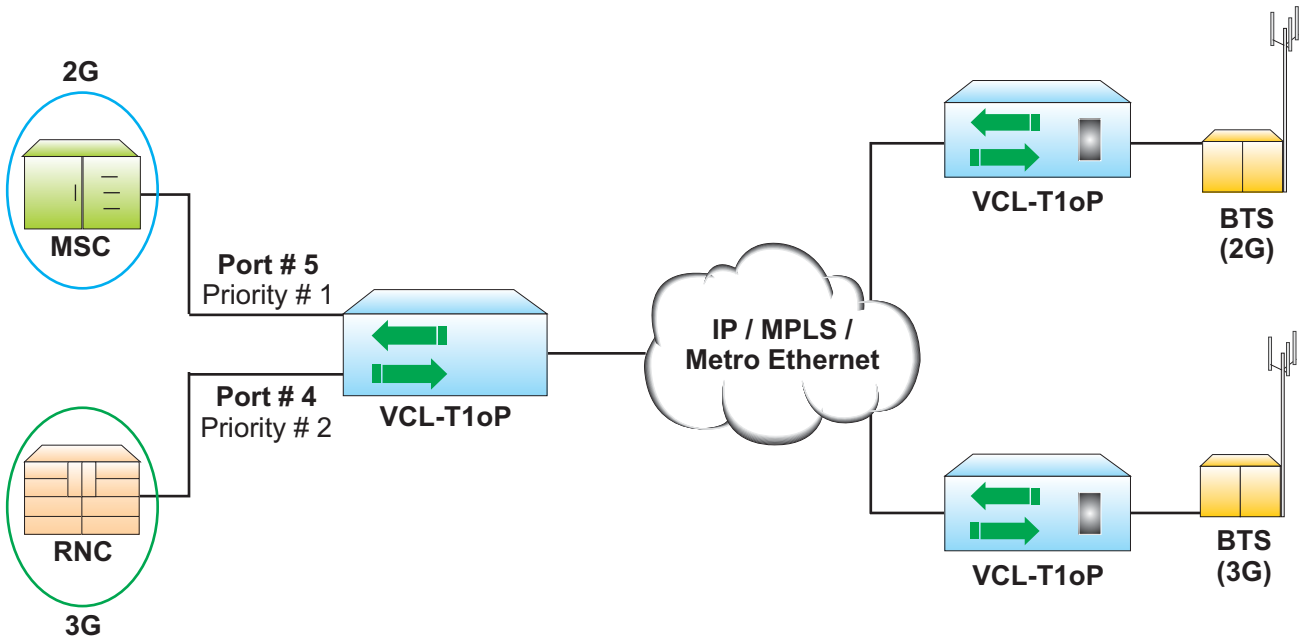
**Notes:**

VLAN based Priority feature allows the user to assign priorities to VLANs carrying different types of services / traffic according based on user preferences.

The user may configure the TDM traffic on highest priority and Ethernet service (3G data network) on a lower priority. User may also configure which TDM link should be given preference over the other TDM links when the uplink bandwidth decreases below a particular threshold.

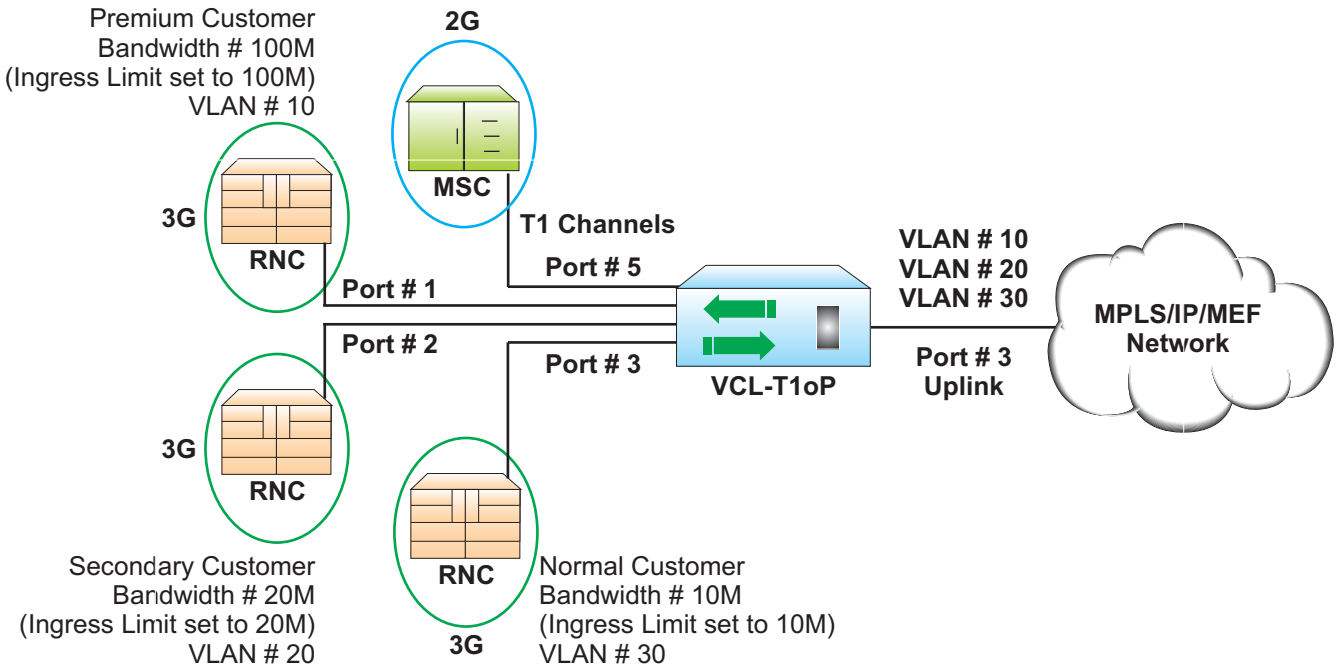
Application Diagram

TDM over IP/Ethernet - Flow Control in an Ethernet Packet Network (Regulating Traffic)



**Notes:** Flow Control feature allows the user to regulate the Ethernet traffic flow to minimize link to minimize packet loss due to data bursts.

TDM over IP/Ethernet Port / Customer based bandwidth allocation (Port Rate Limiting)



**Notes:** Port based Ingress Ethernet Rate Limiting allows the service provider to assigned the bandwidth as per customer requirements and separating their traffic by assigning 802.1Q based VLANs.



## Technical Specifications

### T1oP Specifications

Max number of T1 Ports	Number of Ports 16
Max number of logical links	Up to 128
Synchronization clock Recovery	<ul style="list-style-type: none"> <li>- Adaptive Clock Recovery (ACLK) Options</li> <li>- Recovered Clock (RCLK) / Loop-Timed Clock</li> <li>- Asymmetrical (One-Clock and Two-Clock) Clock</li> <li>- Synchronization to an External Clock (ECLK) and an Internal Clock</li> <li>- Automatic fall back</li> </ul>
Max number of Ethernet	<ul style="list-style-type: none"> <li>- 4 x Gigabit Optical Ethernet Ports (SFP)</li> <li>- 4 x 10/100/1000Base-T Electrical Ethernet</li> </ul> <p><i>Note: may use a combination of any 4 ports only.</i></p>
Supported Transport	ETF-PWE3, SAToP and CESoPSN Mechanisms
Supported PSN (Packet Switched Networks) type	UDP, IP, MPLS and MEF
QoS	802.1q, 802.1p packet Priority

### T1 Interface

Number of Ports	Number of Ports 16 (supporting 64Kbps upto 1.544Mbps on each port)
Framing Formats	Unframed, SF and ESF
Line Coding	B8ZS, AMI
Compliance	ITU-T G.703, G.704, G.706 and G.732
Jitter and Wander	Complies to ITU-T G.823, G.824
Line Impedance	100 Ohms balanced
Protection	<ul style="list-style-type: none"> <li>- Optional Metallic and Longitudinal Protection</li> <li>- ESD protection</li> </ul>

### Ethernet Interface

Number of Ports	<ul style="list-style-type: none"> <li>- 4 Gigabit optical ports and</li> <li>- 4 GigE (electrical) ports, complies with IEEE802.3, 802.1Q and 802.1P</li> </ul> <p><i>Note: may use a combination of any 4 ports only.</i></p>
Electrical	10/100/1000 Auto-negotiation / MDI-X (Auto-sensing), Full-Half Duplex, Rj45 Electrical Connector
Optical	1000Base-FX (Gigabit Ethernet), SFP
Protection	ESD protection
Maximum Frame Size	9000 Bytes (Jumbo Frames)
Switching Capacity	Upto 6 Gbps, Non-blocking

### Gigabit Optical Ethernet Specifications

Type	SFP
Compliance	<ul style="list-style-type: none"> <li>- Compliant with IEEE 802.3z Fast Ethernet 1000BASE-LX</li> <li>- MSA Compliant</li> <li>- RoHS</li> <li>- EMI</li> <li>- ESD</li> <li>- DDM</li> </ul>
Safety	Class 1 Laser Safety / IEC-60825 Compliant
Bit Rate	1.25 Gbps
Wavelength	1310 / 1550 nm
Distance	550m to 80Kms, as per order
Optical Connector	LC

### Power Consumption

Power Consumption	<20 Watts
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### Power Supply Options

Dual Redundant  
 1+1 AC power (100 to 240V AC, 50/60 Hz)  
 1+1 DC (-48V) power (40 to 72V DC)  
 1+1 DC (-24V) power (18 to 40V DC)  
 AC plus DC (AC + DC), AC or DC  
 EMI/EMC compliant.

### Command Language

Windows based GUI (Graphical User Interface)  
 Command Line Interface (English text commands)

## Management and Control Interfaces

- COM Port (RS232 Serial Port)
- 10/100/1000BaseT Ethernet Port (each multiplexer may be assigned an IP address and connected to a LAN / IP network for remote access and management through the 10/100/1000BaseT Ethernet Port for in-band configuration, management and access).
- Telnet
- SNMP, V2
- Additionally, a Windows based GUI (Graphical User Interface) for easy configuration, management and access.

## AC Power Supply Specifications

Input AC Voltage	110 / 220 Volts AC
Range of input AC voltage	100 V to 240 V AC, 50Hz/60Hz.
AC Input Connector	IEC Connector

## 24V DC Power Supply Specifications

Power Supply	24V DC
Range of input	18V to 40V DC
Input voltage reversal protection	Provided
Under voltage protection	< 4.85V
Over voltage protection	> 5.15V
Efficiency at full load	> 90% @ 5V/4A (when input voltage 24V)
Ripple at full load	< 5mVrms
Spike at full load	< 50mV

## 48V DC Power Supply Specifications

Power supply	-48V DC
Range of input	-40V DC to -72V DC
Under voltage protection	< 4.85V
Over voltage protection	> 5.15V
Efficiency at full load	> 91% @ 5V/2A (when input voltage -48V)
Ripple at full load	< 5mVrms
Spike at full load	< 50mV

## Environment

Temperature	-20°C ~ +60°C for Operation
Humidity	5% to 95% (at 35°C) Non-condensing

## Regulatory Compliance

- Safety - IEC 60950 Safety - IEC 60950
- CE
- RoHS
- Complies to ANS/IEC standards
- Complies with Telecom Part 68, FCC Part 15 and CISPR 22 Class A
- EMC EN55022: 1998 + A1 and A2
- EMC EN55024,
- Operation ETS 300 019 Class 3.2
- Storage ETS 300 019 Class 1.2
- Transportation ETS 300 019 Class 2.3

## NMS (with Telnet) OAM port Specifications

Network Interface	RJ-45 10/100/1000BaseT (Auto sensing)
Compatibility	Ethernet Version 2.0 IEEE802.3
Protocols supported	ARP, UDP/IP, TCP/IP, Telnet, ICMP, SNMP
Management	SNMP, Serial login, Telnet login,
EMI Compliance	- Radiated and conducted emissions complies with Class B limits of EN55022:1998 - Direct and Indirect ESD complies with EN55024: 1999 - RF Electromagnetic Field Immunity complies with EN55024:1998 - Electrical Fast Transient/Burst Immunity complies with EN55024:1998 - Power Frequency Magnetic Field Immunity complies with EN55024:1998 - RF Common Mode Conducted Susceptibility complies with EN55024:1998

## External Alarms

- Dry Contact Relay - 2 Form C
- Rated upto 72V DC, 1 Amp.

## Chassis

- 1U High (44mm)
- 19-inch rack-mounting shelf
- Also available in Desktop / Table Top Version.

## Mechanical Specification

Height	44 mm (1U)
Depth	260 mm
Width	480 mm (19 inch rack mountable)
Weight	4 Kgs.

## Ordering Information

S. No.	Part #	Product Descriptions	Remarks
1	VCL-T1oP-16T1 GE-4OE-2120	VCL-16T1 over Ethernet [GE] Multiplexer (TDM over IP) 19-inch 1U High Rack Mount version Supports: - Upto 16 x T1 [RJ45 (F)] - 4 x Ethernet Ports (1000Mbps, Gigabit) (4 x Electrical or Optical Ethernet port in any combination – User Configurable) - 4 x Electrical Ethernet Ports [RJ45 (F)] - 4 x Optical Ethernet Ports [SFP based / without SFPs] - High Stability Timing, Ultra Low Noise OXCXO - 1 x System Core Cables, Installation Accessories, Documentation, System User Manual / Disk (Set) - OAM [SNMP, Telnet (RJ45 Port) and Serial Port (USB and DB-9 COM Port)] * Add Power Supply Option from below	CORE UNIT without PSUs.

## Power Supply Options

1	AC220	1 x 100-240V AC Power Supply Input	Any One Option.
2	DC048	1 x (-) 48V DC Power Supply Input	
3	ACDC	1 x 100-240V AC Power Supply Input 1 x (-) 48V DC Power Supply Input	
4	AC220R	2 x 100-240V AC Power Supply Input [Redundant]	
5	DC048R	2 x (-) 48V DC Power Supply Input [Redundant]	

## Gigabit Ethernet SFP Options

1	VCL-EMOD 0206	1.25Gbps SFP Transceiver Duplex LC, 850nm, 550m, MMF	Maximum 2 SFPs per CORE UNIT.
2	VCL-EMOD 0205	1.25Gbps SFP Transceiver Duplex LC, 1310nm, 10Km, SMF	
3	VCL-EMOD 0231	1.25Gbps SFP Transceiver Duplex LC, 1310nm, 20Km, SMF	
4	VCL-EMOD 0255	1.25Gbps SFP Transceiver Duplex LC, 1310nm, 40Km, SMF	
5	VCL-EMOD 0155	1.25Gbps SFP Transceiver Duplex LC, 1550nm, 40Km, SMF	
6	VCL-EMOD 0256	1.25Gbps SFP Transceiver Duplex LC, 1550nm, 80Km, SMF	

## Cables and Accessories Options

1	VCL-HRNS 1229	Optical Patch Cord Connectorized Cable [2LC-2LC, 3m, SM]	As per Site Requirement.
2	VCL-HRNS 1238	Optical Patch Cord Connectorized Cable [2LC-2LC, 10m, SM]	
3	VCL-HRNS 1242	Optical Patch Cord Connectorized Cable [LC-FC, 10m, SM]	
4	VCL-HRNS 1243	Optical Patch Cord Connectorized Cable [2LC-2FC, 10m, SM]	
5	VCL-HRNS 1239	Optical Patch Cord Connectorized Cable [LC-SC, 10m, SM]	
6	VCL-HRNS 1258	Optical Patch Cord Connectorized Cable [2LC-2SC, 10m, SM]	
7	VCL-ECON 1172	Connector (Attenuator LC-LC (10 db.))	
8	VCL-ECON 1173	Connector (Attenuator LC-LC (20 db.))	
9	VCL-ECON 1186	Connector (Attenuator FC-FC (10 db.))	
10	VCL-ECON 1187	Connector (Attenuator FC-FC (20 db.))	
11	VCL-ECON 1197	Connector (Attenuator SC-SC (10 db.))	
12	VCL-ECON 1198	Connector (Attenuator SC-SC (20 db.))	

**Note:** 1. SFPs to be added if 1000BaseSX/LX (Optical) Ethernet Ports are required.  
2. Redundant power supply to be added, if required.

**Notes:**

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