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XTran Access Node: XTD-2110-A

DIN Rail Mounted, 10 Ethernet Ports (2*1/10G + 8*1G), 2 Serial Ports, Power Over Ethernet
(S30926-D2110-XA)

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Specifications subject to change as design improvements are implemented.

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1. INTRODUCTION

1.1 General

This document is valid as of XTran Release 4.13.

The XTran product line has been designed for industrial MPLS-TP networks. The XTD-2110-A is the most compact member of the XTran product family. It combines MPLS-TP transport on the backbone with Layer 2 and Layer 3 features on the Ethernet access ports in an integrated industrial IP20 housing which can be mounted on a DIN rail.

The XTD-2110-A provides a total of 10 Ethernet ports and 2 serial ports.

The XTran Access nodes have a ruggedized design and are compliant with the EMC standards listed in Ref.[5] in Table 1.

XTD-2110-A nodes can be used to build a stand-alone network, or they can be used as an MPLS access network in combination with modular XTran Core and Aggregation nodes.

NOTE: Port 10 can be converted from an access port to a management port to connect the TXCare (=XTran Management System) for centralized network management, see §2.1.9.

Major Features:

- MPLS-TP network node with 10 Ethernet ports
- LAN/WAN ports (MPLS-TP):
  - 2x 1/10Gbps SFP+ (Port 1&2) (optical)
  - 2x 1Gbps SFP (Port 3&4) (optical/electrical)
- LAN ports (L2/L3):
  - 2x 1Gbps SFP (Port 5&6) (optical/electrical)
  - 4x Gigabit RJ-45 (Port 7-10) ports with PoE+
- Layer2: VLAN handling, QoS, MSTP, LAG+LACP, IGMP Snooping
- Layer3: VRF, VRRP, Static Routing, OSPF, PIM, DHCP Relay (=future), IGMP, VLAN routing (IPv4)
- PoE: IEEE 802.3af & 802.3at compliant with maximum 30 W per port
- Service types: Ethernet, Serial Ethernet, Voice, Serial Port Server
- 2x Serial ports (RS232/422/485)
- 2x Digital I/O
- Fully managed via TXCare
- SD card for easy configuration swap
- DIN rail mountable Aluminum Housing
- Fanless design, passively cooled
- Redundant Power input (24-57VDC)
- Compliance with IEC 61850, IEEE 1613 (Power substation), EN50121-4 (Railway)

An example of an XTran network including all node types (core, aggregation and access nodes) can be found in the figure below. The network is managed by a TXCare PC (=XTran Management System), see also Ref. [2Mgt] in Table 1.

The high capacity core node XT-2215-A is ideal to build up the high bandwidth network that operates as the core network. The other node types can be used to build up the aggregation and access network which might require less bandwidth.

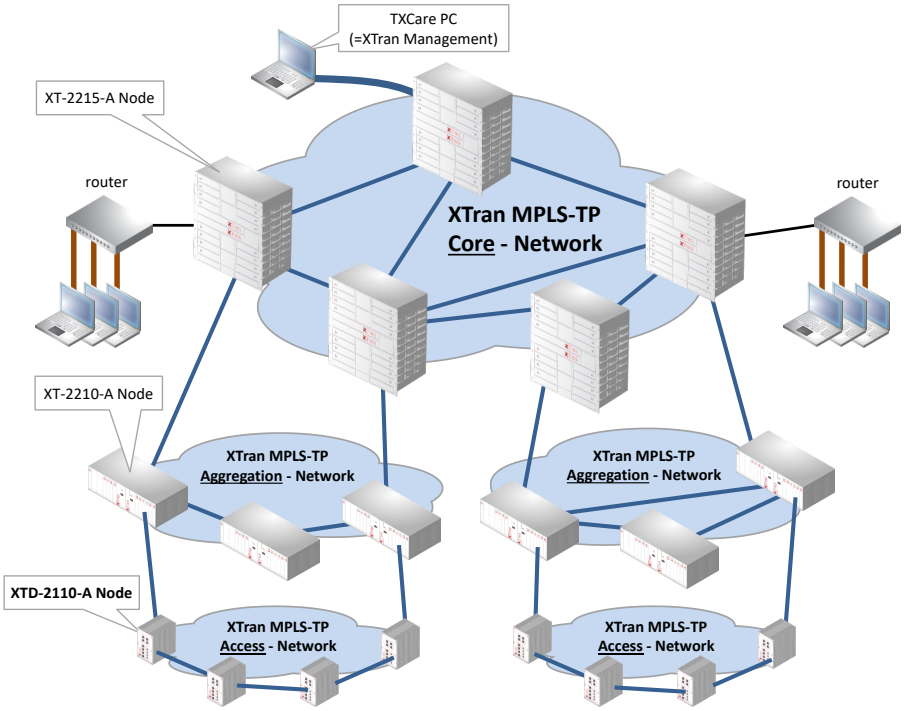

Figure 1 XTran MPLS-TP Network: Core/Aggregation/Access Nodes

1.2 Manual References

Table 1 is an overview of the manuals referred to in this manual. '&' refers to the language code, '*' refers to the manual issue. All these manuals can be found in the TXCare (=XTran Management System) Help function. Table 2 shows the ordering numbers.

Table 1 Manual References

Ref.	Number	Title
[1]	XA-M801-&-*	XTran Installation and Operation
[2Mgt]	XA-M830-&-*	TXCare Management Operation
[2Eth]	XA-M831-&-*	XTran Ethernet Services
[2Leg]	XA-M832-&-*	XTran Legacy Services
[5]	XA-M810-&-*	XTran General Specifications
[10]	XF-M811-&-*	XTran TRMs (Transmit Receive Modules): SFP, SFP+, XFP, QSFP+, QSFP28
[11]	XC-M848-&-*	XTran PSUs for XTR/XTD Access Nodes
[12]	XA-M828-&-*	XTran Bandwidth Overview

Table 2 Product Ordering Numbers

Ordering Number	Description
S30926-D2110-XA	- Node: XTD-2110-A - 2x 2 pole male plugs (12A) for connecting power supplies in a normal environment. - 1x 4 pole male plug (12A) for connecting power supplies in an ATEX environment. - 2x 5 push-in spring digitial I/O PCB connectors.
See Ref.[11] in Table 1	PSUs
V30812-A6073-C3	Micro SD Memory card (16 GB Class 10, UHS-I)
XG-L1003	Layer 3 (L3) Feature License, one per device
XG-L1008	10 Gbps (10G) Feature License, one per device

2. NODE DESCRIPTION

2.1 Front Panel

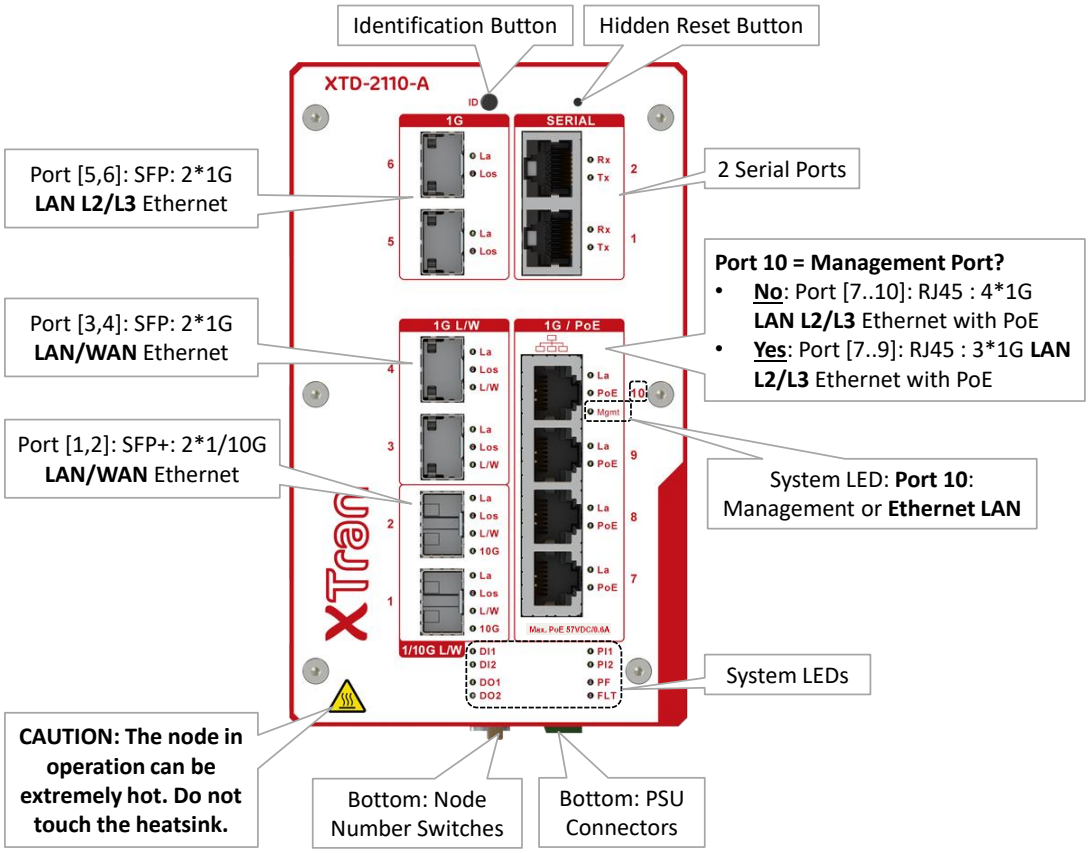

Figure 2 Front Panel

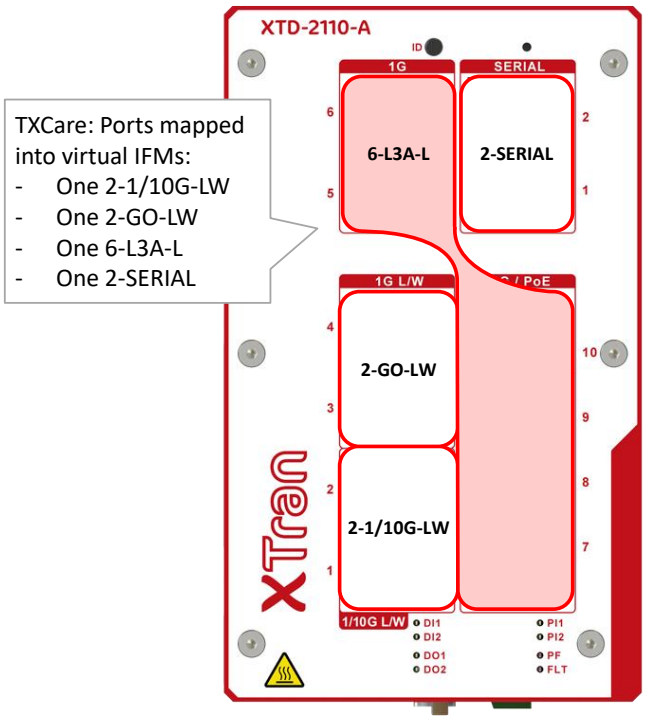

Figure 3 Front Ports Mapped onto Virtual IFMs in TXCare

2.1.1 ID (=Identification) Button

CAUTION: This button is not allowed to be used or pushed during operational maintenance in a hazardous location.

The ID button can be used for two purposes:

- Alter port 10 from LAN to Mgmt port or vice versa, see §2.1.9.
- ID detection, node identification: It is possible to manually identify a node to TXCare or vice versa, see §2.4.

2.1.2 Reset Button - Factory Default/Factory Reset - Reboot Node

CAUTION: This button is not allowed to be used or pushed during operational maintenance in a hazardous location.

This hidden pushbutton is accessible through a small hole on the front panel. When pushing this button, use a fine non-conductive object e.g. a toothpick.

- **Push short (<7 seconds)**: Warm restart: Pushing the reset button less than 7 seconds forces a warm restart of the node without affecting the persistent node configuration;
- **Push long (>7 seconds)**: Warm restart + factory default settings: Pushing the reset button for at least seven seconds forces a warm restart of the node and resets the node with factory default settings and the micro SD memory card (see §2.3.1) will be cleared. As a result, reloading the node configuration from TXCare will be necessary.
- The reset process is signaled by a number of LEDs, §2.1.2/§2.1.3. The node will be reachable again three minutes after the reset was issued. The entire (re)boot will be finished approximately after five minutes. The node is reachable again when it can be discovered and measured by TXCare.

2.1.3 LEDs: Reboot/Factory Reset Operation

A normal reboot and a factory reset are visualised by means of the LEDs. The entire boot cycle time takes approximately 5 minutes. The node is reachable again when it can be discovered and measured by TXCare (=XTran Management System, see also Ref. [2Net] in Table 1);

NOTE: Right-hand side ports = Serial ports, Ethernet ports [7..10];

NOTE: Left-hand side ports = Ethernet ports [1..6];

NOTE: System LEDs = PF, FLT, PI1/2, DI1/2, DO1/2, Mgmt on Port10;

a. Normal Reboot (reset button pushed < 7 seconds)

- System LEDs remain operational;
- On reset button push:
  - Right-hand side port LEDs turn on simultaneously;
  - Left-hand side port LEDs are blanked;

- On reset button release (< 7 seconds):
  - Right-hand side port LEDs are blanked for 1 second and then flashed twice (333 ms on/666 ms off) → normal reboot starts;
  - All port LEDs remain blanked until rebooted;
  - FLT LED blinks until rebooted.

b. Factory Reset (reset button pushed >= 7 seconds)

- System LEDs remain operational;
- On reset button push:
  - Right-hand side port LEDs:
    - turn on simultaneously;
    - per second that the button is pushed, LEDs turn off in sequence starting from top (=SERIAL port2) to bottom (=Ethernet port P7).
    - when all LEDs are off (after 7 seconds) and the FLT LED starts double-blinking fast (=heartbeat) then the clear node is accepted and the factory reset is issued → release the reset button to start the factory reset → the reset button will be blocked and the FLT LED will show heartbeat until the node has booted and the factory reset has been finished. (Note: if the button is released before 7 seconds, a normal reboot is initiated).
  - Left-hand side port LEDs are blanked;
- On reset button release (>= 7 seconds);
  - Factory reset + reboot starts;
  - All port LEDs remain blanked until rebooted;
  - FLT LED blinks until rebooted.

2.1.4 LEDs: Normal Operation

Table 3 LED Indications in Normal Operation

LED	Color	Status
System LEDs		
PI1/2 (=Power Input)	Not lit, dark	Main power input1/2 in the node not OK or not connected (V input < 21V).
	Fast blinking	Main power input1/2 in the node OK for use without PoE (21V < V input < 42V).
	Green	Main power input1/2 in the node OK (42V < V input < 57V).
PF (=Power Failure)	Not lit, dark	Power system in the node itself is OK.
	Red	Power system in the node itself is failing.
FLT (=FauLT)	Not lit, dark	No other fault or error situation, different from PF, is active on the node.
	Red	A fault or error situation, different from PF, is active on the node.
DI1/2 (=Digital Input, §2.2.2)	Not lit, dark	No activity or current has been detected on the corresponding input.
	Green	Current has been detected on the corresponding digital input connector.
DO1 (=Digital Output, §2.2.2)	Not lit, dark	**Minor** alarm is active on the DO1 contact (DO1 contact is deactivated or idle).
	Green	No alarm is active on the DO1 contact (DO1 contact is activated).
DO2 (=Digital Output, §2.2.2)	Not lit, dark	**Major** alarm is active on the DO2 contact (DO2 contact is deactivated or idle).
	Green	No alarm is active on the DO2 contact (DO2 contact is activated).

LED	Color	Status
Management Port LED		
Mgmt (=Management) (Port 10)	Not lit, dark	Port 10 is configured as a normal Ethernet port similar to the ports [7..9].
	Yellow	Port 10 is configured as a management port that can be used to connect the TXCare PC and manage the XTran network. No PoE possible on this port.
Ethernet Port LEDs		
La (=Link Activity) (Ports[1..10])	Not lit, dark	The link on the port is down.
	Yellow lit	The link is up, no activity.
	Yellow blinking	The link is up, with activity.
Los (=Loss of Signal) (ports [1..6])	Not lit, dark	Optical signal OK.
	Red	Loss of optical signal.
L/W (=LAN/WAN) (ports [1..4])	Not lit, dark	The link on the port is a LAN link.
	Green	The link on the port is a WAN link.
10G (ports [1,2])	Not lit, dark	An SFP module is plugged in, the port operates as a 1G port.
	Green	An SFP+ module is plugged in, the port operates as a 10G port.
PoE (=Power over Ethernet) (ports [7…10])	Not lit, dark	PoE is not configured on this port.
	Green lit	PoE is configured on this port and fully operational.
	Green blinking	PoE is configured on this port but not fully operational.
Serial Port LEDs		
Rx (=Receive)	Not lit, dark	- No service programmed. - Service programmed: 'Rx Data' is not active on this port.
	Green	Service programmed: 'Rx Data' is active on this port. - Port = DCE (=default) = output - Port = DTE = input
Tx (=Transmit)	Not lit, dark	- No service programmed. - Service programmed: 'Tx Data' is not active on this port.
	Green	Service programmed: 'Tx Data' is active on this port. - Port = DCE (=default) = input - Port = DTE = output

2.1.5 LEDs: Node Identification

It is possible to manually identify a node to TXCare or vice versa. In this identification process, the LEDs are used as described in §2.4.

2.1.6 Ethernet Interfaces (LAN & WAN)

a. Ports

Different types of Ethernet ports are available for maximum flexibility.

Ports [1, 2] can be used as MPLS-TP ports (WAN) or as access ports (LAN). The ports can be fitted with for Ethernet operation with:

- Optical SFP modules for 1Gbps
- Optical SFP+ modules for 10Gbps

Ports [3, 4] can be used as MPLS-TP ports (WAN) or as access ports (LAN). The ports can be fitted with for Ethernet operation with:

- Optical SFP modules for 1Gbps

- Optical SFP modules for 100Base-FX/100Base-LX
- Electrical SFP modules for 100/1000Base-T

Ports [5, 6] can be used as access ports (LAN) with extended L2 and L3 features (*). The ports can be fitted for Ethernet operation with:

- Optical SFP modules for 1Gbps
- Optical SFP modules for 100Base-FX/100Base-LX
- Electrical SFP modules for 100/1000Base-T

Ports [7..10] can be used as Gigabit Ethernet access ports (LAN) with extended L2 and L3 features (*). The RJ-45 ports can be used for 10/100/1000Base-T Ethernet operation. The PoE (=Power over Ethernet) capability of the node can be enabled on these ports to the connected devices (e.g. IP cameras or WiFi access points).

NOTE: More info on supported SFPs and port speeds can be found in Ref.[10], Ref.[12] in Table 1.

NOTE: More information on PoE can be found in §2.6.5.

NOTE: Port 10 can be converted from an access port to a management port, see §2.1.9.

NOTE: (*) 10 Gbps support and L3 (IP routing) are license based features.

b. Services

The Ethernet ports can be configured in the ‘Ethernet’ service via TXCare.

2.1.7 Serial Interfaces

a. Ports

The XTD-2110-A offers two serial interfaces (S1 & S2) for the connection of legacy applications. The S1 and S2 ports can be configured either as RS232, RS422 or RS485. In RS232 mode TX, RX, CTS & RTS are supported, in RS422/485 mode TX & RX are supported. The serial interface is suitable for asynchronous communication. Inside the XTD-2110-A these serial interfaces are converted to Ethernet frames for transport over the XTran MPLS-TP network.

CAUTION: Both serial ports will always run in the same duplex mode. If both ports are available and you configure one port in RS232 or RS422(=full-duplex), the other port will be automatically configured in full-duplex as well. As a result the other port can not be configured in RS485. If both ports are available and you configure one port in RS485(=half-duplex), the other port will be automatically configured in half-duplex as well.

b. RJ-45 Connector

The serial port is a RJ-45 connector that has 8 pins and 2 green LEDs, see figure below. For the meaning of the LEDs, see §2.1.4. The LEDs shown on connector ‘x’ show information of serial port ‘x’.

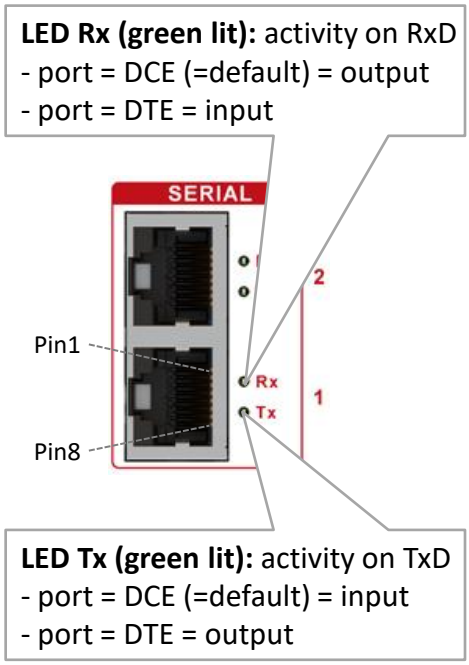

Figure 4 RJ-45 Connector

c. RJ-45 Cable

To connect the XTD serial ports, use a CAT5E shielded RJ-45 cable with one side open end. The color coding of the wires is indicated in the table below.

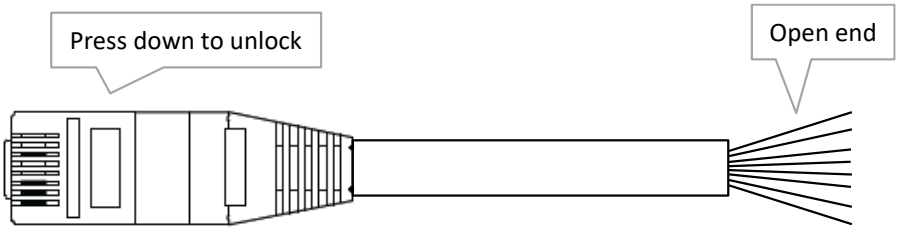

Figure 5 RJ-45 Cable

Table 4 RJ-45 Cable to Serial Ports, Color Coding

RJ-45 Cable Pin n°	Color Scheme (T568A)	Color Scheme (T568B)
1	White/Green	White/Orange
2	Green	Orange
3	White/Orange	White/Green
4	Blue	Blue
5	White/Blue	White/Blue
6	Orange	Green
7	White/Brown	White/Brown
8	Brown	Brown

d. Signals per Serial Port

Table 5 Signals per Serial Port

Pin n°	In/ Out	RS232		RS422		RS485
		Asynchronous		Asynchronous		Asynchronous
		DTE	DCE	DTE	DCE	
1	Open	---	---	---	---	---
2	Open	---	---	---	---	---
3	Open	---	---	---	---	---
4	Out+	TxD	RXD	TxD+	RxD+	TRxD+
5	Out-	RTS	CTS	TxD-	RxD-	TRxD-
6	GND	GND(**)	GND(**)	---	---	---
7	In+	RxD	TxD	RxD+	TxD+	---
8	In-	CTS	RTS	RxD-	TxD-	---
(**) = not isolated ground, connected to chassis ground. '---' = not used.						

e. Services

The serial ports can be configured in the 'Serial Ethernet' and the 'Serial Port Server' service via TXCare. These services are compatible with other products as listed in Ref.[2Leg] in Table 1.

2.1.8 SFP (1 Gbps) / SFP+ (10 Gbps) / Electrical SFP Transceivers

- The XTD-2110-A has 6 Gigabit Ethernet SFP ports that can be equipped with different types of 1000 Base SFP transceivers for Single/Multi Mode fiber operation. Ports 3&4 and 5&6 also support electrical SFPs (100/1000 Base-T) for copper wires whereas ports 1&2 do not.
- Port 1 and Port 2 can optionally be used for 10Gbps SFP+ transceivers to create 10 Gigabit Ethernet MPLS-TP WAN links or LAN connections. These ports are set in 1 Gbps / 10 Gbps mode by plugging in an SFP/SFP+ module. Additionally configuring the 1 Gbps (=default) / 10 Gbps expectation in TXCare via the Network Settings Wizard → XTD/XTR Devices Expectations, see Ref.[2Mgt] in Table 1. A mismatch between the speed of the plugged in SFP/SFP+ and the configured speed expectation in TXCare will only result in an alarm in TXCare. However, the port remains operational with the speed of the plugged in SFP/SPF+.

CAUTION:
- Using 10G links on an XTD-2110-A device requires one 10G license on that device!
- Extra CAUTION in ATEX environment, see §5.3.

NOTE: The supported SFP/SFP+/Electrical SFP modules and speeds can be found in Ref. [10], [12] in Table 1.

2.1.9 Port 10: TXCare Management Port/Channel

a. General

By default, port 10 is a normal Ethernet access port similar to ports[7..9]. However, port 10 can be converted (see next paragraph) from an access port to a management port to connect the TXCare PC (=XTran Management System) for centralized network management.

Port 10 as a management port allows TXCare to access the XTran management or DCN channel, which is built up dynamically between all the connected nodes within the network.

NOTE: DCN = Data Communication Network

NOTE: The management port can be disabled or set administrative down via TXCare for security reasons, see Ref. [2Mgt] in Table 1. If port 10 is converted into a management port, it is by default up.

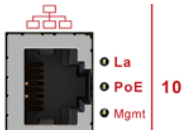

Figure 6 Port 10: TXCare Management Connector

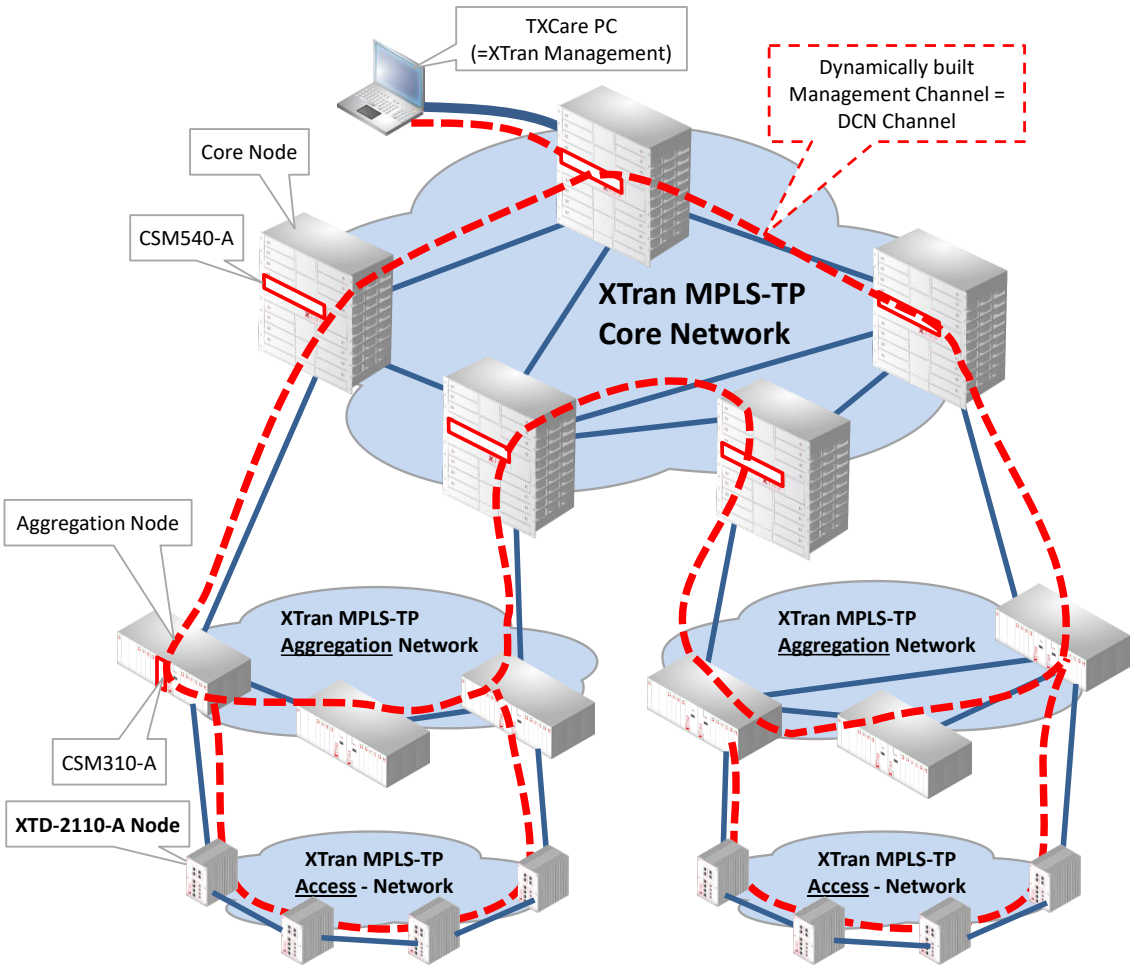

Figure 7 XTran Management, DCN Channel

b. Alter Port 10 from LAN to Mgmt Port

CAUTION: Altering Port 10 from LAN to Mgmt will factory reset the node!

- In TXCare, remove port 10 from configured Ethernet services (if any) first;
- **CAUTION**: next step will factory reset your XTD-2110-A node!
- Reboot the node, and while rebooting the node, push the ID button on the front panel for 20 seconds until the LED sequences below are finished;
  - All LEDs lit for 2 seconds;
  - Port 10 Mgmt LED blinks for 3 seconds;

  - Port 10 Mgmt LED is lit continuously → Port 10 = Management Port!

- In TXCare, set Network Hardware → Network Settings Wizard → XTD/XTR Devices Expectations → Mgmt Port Expectation = Enabled; CAUTION: if there is a mismatch between the hardware/factory setting and the Mgmt Port Expectation, then loading configurations to this XTD-2110-A node via any TXCare connection somewhere in the XTran network, is not possible.
- The management port is by default enabled but it could be 'down' for security reasons. This can be verified via Dashboard → Network Hardware → Devices → XTD Node → CSM-XTD → Properties (Specific) → Management Port.
- Load the existing configuration (if any) from TXCare into this node;

c. Alter Port 10 from Mgmt to LAN Port

CAUTION: Altering Port 10 from Mgmt to LAN will factory reset the node!

- **CAUTION**: next step will factory reset your XTD-2110-A node!
- Reboot the node, and while rebooting the node, push the ID button on the front panel for 20 seconds until the LED sequences below are finished;
  - All LEDs lit for 2 seconds;
  - Port 10 Mgmt LED blinks for 3 seconds;
  - Port 10 Mgmt LED remains dark → Port 10 = LAN Port!
- In TXCare, set Network Hardware → Network Settings Wizard → XTD/XTR Devices Expectations → Mgmt Port Expectation = Disabled; CAUTION: if there is a mismatch between the hardware/factory setting and the Mgmt Port Expectation, then loading configurations to this XTD-2110-A node via any TXCare connection somewhere in the XTran network, is not possible.
- The LAN port is by default disabled. It can be changed in TXCare via Dashboard → Network Hardware → Devices → XTD Node → 6-L3A-L → P10: Properties (Specific) → Admin Status.
- Load the existing configuration (if any) from TXCare into this node;

d. TXCare - CSM Connection Scenarios

There are multiple connection scenarios possible between the TXCare PC and the node Mgmt port 10 (or XTran network).

- Direct connection;
- Connection via switch, router;
- Connection with TXCare Redundancy;
- Connection with Entry Point Redundancy.

Depending on the connection scenario, the configuration differs and IP addresses must be configured in different places.

All these connection scenarios are described in detail in Ref. [2Mgt] in Table 1. In this manual, verify following chapters:

- TXCare: Discover and Approve the XTran Network Topology (DCN);
- TXCare Connectivity Redundancy: Use Cases.

e. IP Address

The IP address of this management port (= CSM Front IP Address) can be changed via TXCare, see Ref. [2Mgt] in Table 1. How to set up the IP address on the TXCare PC, see also Ref. [2Mgt].

CAUTION: When changing IP addresses or IP ranges:
- Make sure that the Device IP Range of your network does not conflict with the CSM Front IP Addresses of your entry points for this network. All these IP addresses and ranges can be verified in the Entry Point(s) in the Discovery Tile in TXCare.
- Make sure that the CSM Front IP address of each node only belongs to its own unique subnet. Therefore each node must be configured in a different subnet.

2.1.10 Hardware Edition

The node Hardware Edition is visible on the node 2D-label or it can be read out in TXCare.

2.2 Bottom Panel

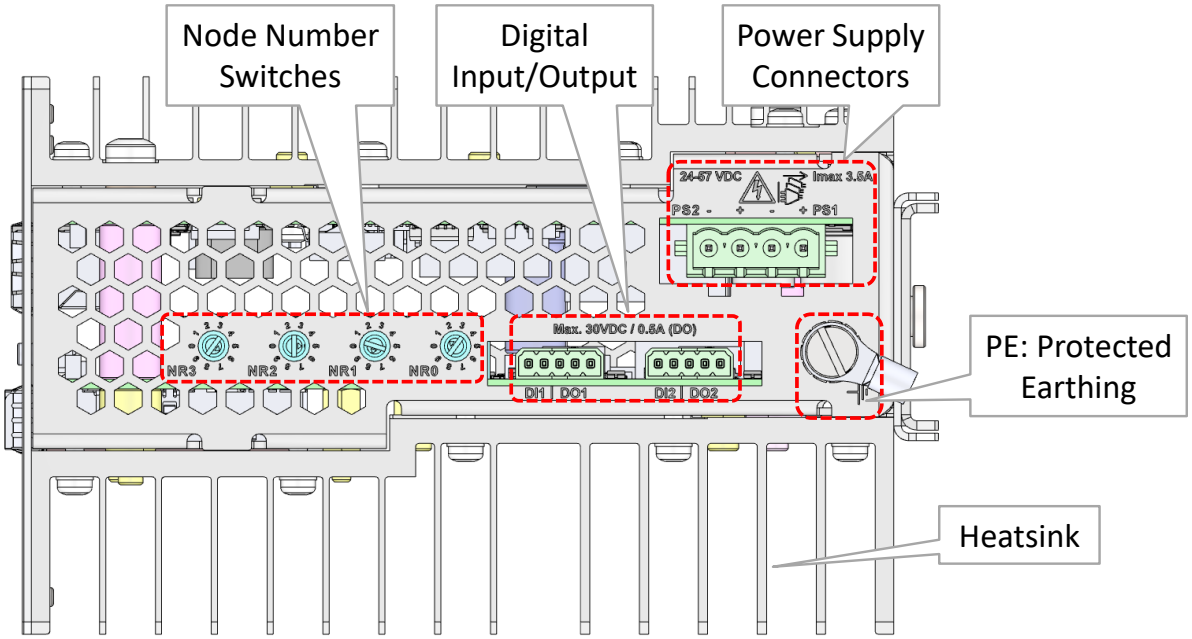

Figure 8 Bottom Panel

2.2.1 Node Number

CAUTION: Node Number switches are not allowed to be used or rotated during operational maintenance in a hazardous location.

Node numbers are set in decimal code using rotary switches NR0 (=least significant) to NR3 (=most significant) on the bottom panel. To select a number, rotate the switch until the arrow points to the desired number. Valid decimal node numbers range from 0001 to 8999. The configured node number (=Device ID) can be verified in TXCare, see Ref.[2Mgt] in Table 1.

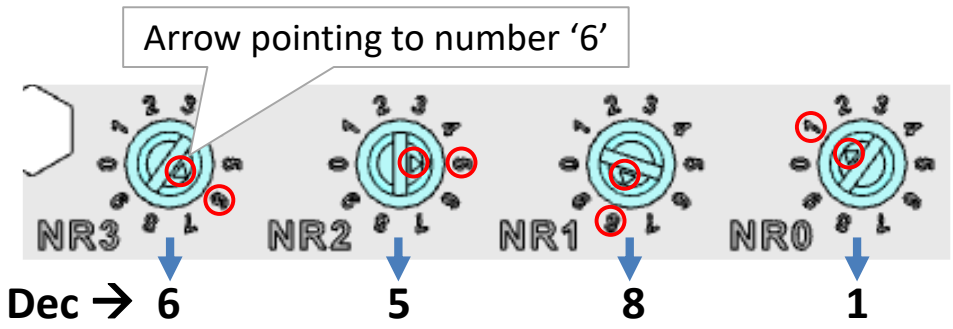

Figure 9 Example: Node Number 6581

NOTE: The node number rotary switches will only be read out at boot time when the SD card is empty (no configuration yet) or no SD card is plugged in. In any other case, the node number will be read from the SD card.

2.2.2 Digital Input / Digital Output (=DI/DO)

a. General

The XTD-2110-A provides two Digital Inputs (DI1 & DI2) and two Digital Outputs (DO1 & DO2) on the bottom of the node. DI1 and DO1 are combined in the left-hand connector1, DI2 and DO2 in the right-hand connector2.

The Digital Inputs can be used to detect external events and raise an appropriate alarm (e.g. 'door opened') in TXCare. These alarm properties can be assigned to the inputs via TXCare.

The Digital Outputs can be used to give a local indication of Major and Minor alarms (e.g. by means of external alarm lights or acoustic signals).

b. Connecting/Disconnecting Cables

- Connect a cable:
  - (first time only) Insert the wire into the PCB connector: The PCB connectors use push-in spring connections. Open the spring via inserting a screwdriver first (see picture below). Next, insert the wires of the open-end IO cable into the PCB connector. Remove the screwdriver to lock the inserted wire.
  - Plug in this wired PCB connector into the IO Connector at the bottom of the XTD node until it's fully fixed.
- Disconnect a cable:
  - Hold the PCB connector at the outer sides between your index finger and thumb and push inward to disconnect.

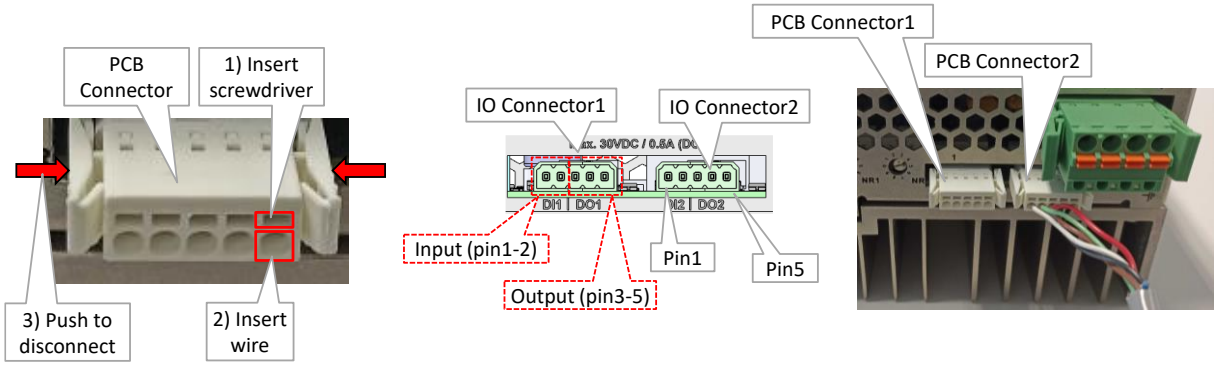

Figure 10 DI/DO Connectors

Table 6 DI/DO Pin Allocation

Pin	Pin Name	Description	Alarm
IO Connector1: DI1-DO1			
1	In1a	Input 1a	Raise Alarms in TXCare
2	In1b	Input 1b	
3	C1	Out Common 1	Output **Minor** Alarms
4	NC1	Out Normal Closed 1	
5	NO1	Out Normal Open 1	
IO Connector2: DI2-DO2			
1	In2a	Input 2a	Raise Alarms in TXCare
2	In2b	Input 2b	
3	C2	Out Common 2	Output **Major** Alarms
4	NC2	Out Normal Closed 2	
5	NO2	Out Normal Open 2	

c. Digital Input (=DI)

The normal behavior of the inputs can be configured as 'no current detected' or 'current detected' via TXCare. Table 6 shows the pin allocations for the digital inputs. Furthermore, two input LEDs DI1/2 are available, see §2.1.4. A DI LED is lit when current is detected on the input.

Inputs a and b are symmetrical. E.g. input1 (=In1): make a shortcut between pin In1a and In1b on the input to activate the input → current flows through the input, see figure below.

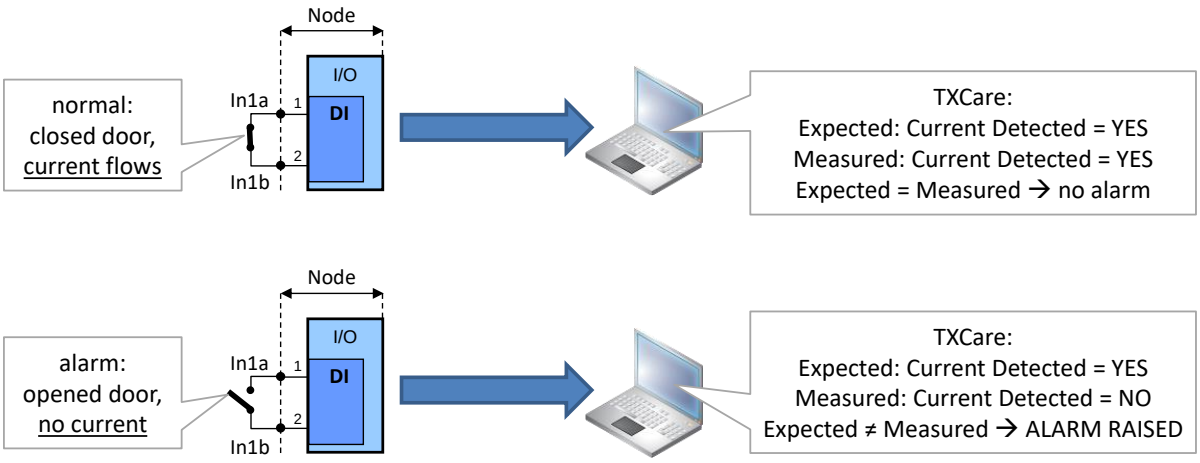

Figure 11 Example: Digital Input (=DI): Closed Input

d. Digital Output (=DO)

Two digital normal closed (NC) output contacts are available for outputting minor/major alarms, e.g. to activate an alarm siren. These contacts can be configured in TXCare, see Ref. [2Mgt] in Table 1. The output contacts can be monitored by the DO LEDs, see §2.1.4.

These contacts are change-over contacts on a relay activated by a logical '1'. The maximum current through such a contact is 0.5A DC and the maximum voltage is 30 VDC. How the DO contacts behave in normal or alarm situations can be found in the figure below. A powered off node is considered as an alarm situation as well.

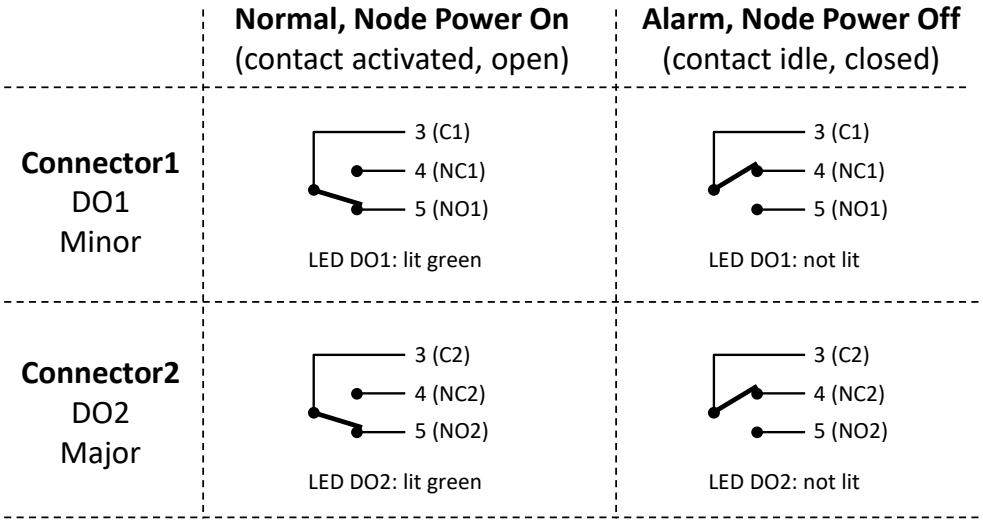

Figure 12 DO 'Normal Closed' Contact Behavior: Normal/Alarm

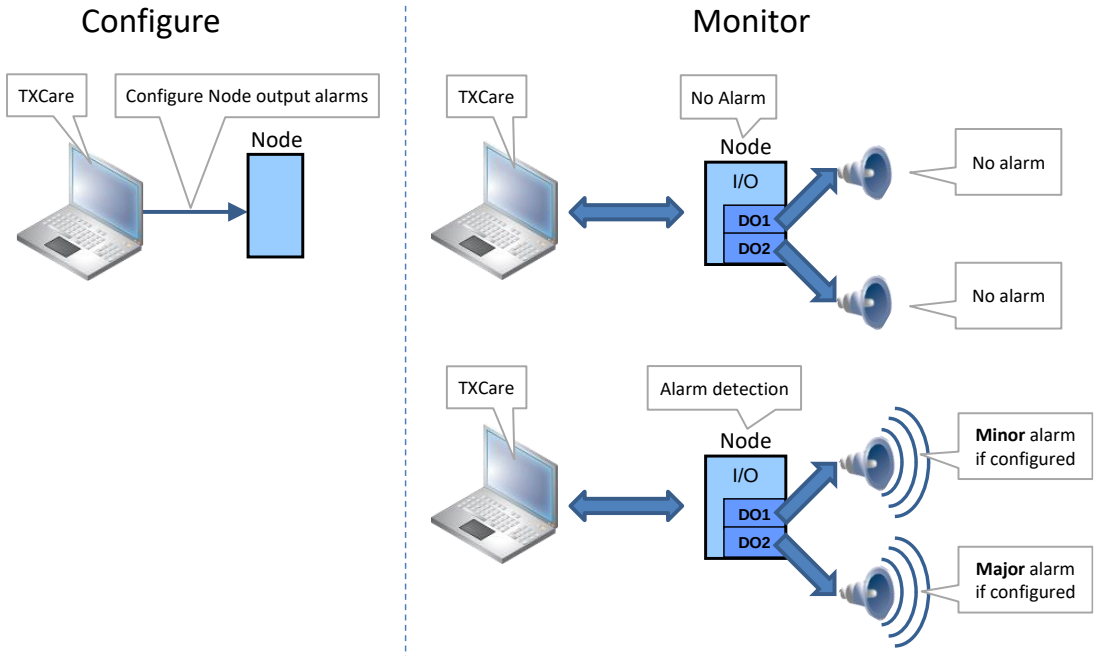

Figure 13 Alarming via Digital Output (=DO) Contacts

2.2.3 Power Supply - PSUs

a. General

The XTD-2110-A provides a redundant power input of 2x (24-57VDC) via the PS1/PS2 power supply connectors.

The PoE (=Power over Ethernet) capability of the node can be enabled on ports 7, 8, 9 & 10 to the connected devices (e.g. IP cameras or WiFi access points).

- For PoE operation (802.3af, 15W), node input voltage between 44-57VDC is required;
- For PoE+ operation (802.3at, 30W), node input voltage between 50-57VDC is required;

The XTD-2110-A is a power sourcing device that is compliant with IEEE 802.3af (PoE) and IEEE 802.3at (PoE+, maximum 30 W per port). The maximum aggregate PoE power budget is 120W (=4*30W).

Two connected PSUs will operate redundantly. When two PSUs are connected, the PSU with the highest output voltage will be the active PSU whereas the other PSU will be standby. The lowest power of both PSUs will be taken by TXCare to calculate the PoE power.

For the configuration in TXCare, see 'Power over Ethernet (PoE)' in the 'XTran Ethernet Services' manual in Ref.[2Eth] in Table 1. Power supply LEDs are available on the front panel.

CAUTION:
- Make sure that each individual PSU is able to deliver the full requested node power including the power for its connected PoE devices.
- Use the correct PSU connector depending on the used environment, see table below.

NOTE: The PS1/PS2 connectors are equivalent. For a single power supply connection, either PS1 or PS2 can be connected;

NOTE: Power aggregation and load sharing are not supported.

Table 7 PSU Connector Usage

Normal Environment	ATEX Environment (3)
 (1)  (2)	 (2)
(1): This connector can be used on any XTD hardware edition. (2): This connector can only be used on ATEX compatible XTD hardware as of hardware edition 9 and is meant to use in an ATEX environment but can be used as well in a normal environment. (3): More info on ATEX environment, see §5.3.	

b. Available PSUs/PSU Connection

If no DC power is available, an external AC/DC PSU can be used. The available PSUs that can be ordered and connected to this node are described in Ref.[11] in Table 1. The figure below shows a general example of a single and a redundant PSU connection.

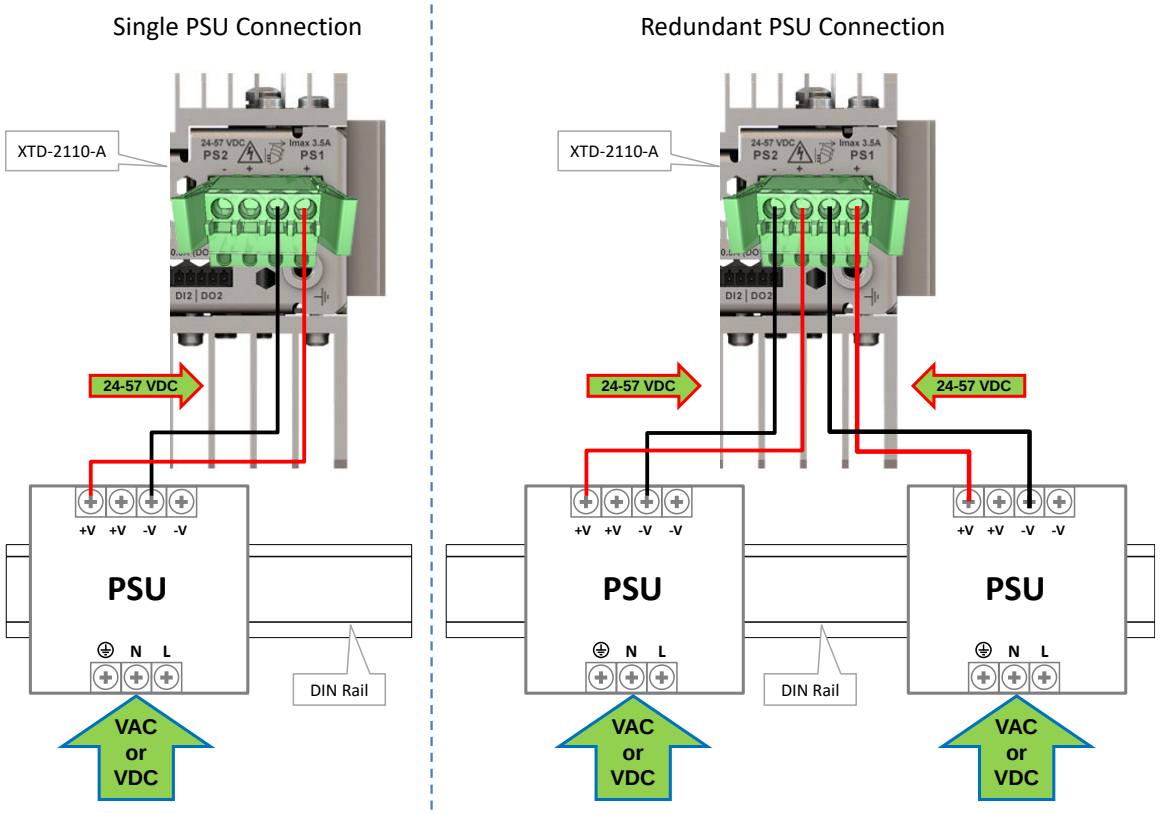

Figure 14 Single/Redundant PSU Connection

c. Power Supply Monitoring

The power supply presence is monitored in TXCare. By default, TXCare expects both power supplies PS1 and PS2 to be connected. If an expected power supply is not present, an alarm will be raised in TXCare. Whether a power supply input is expected can be configured in TXCare via the Network Settings Wizard → XTD/XTR Devices Expectations, see Ref.[2Mgt] in Table 1.

2.2.4 PE: Protective Earth

A PE (=Protective Earth) point is provided on the node bottom panel. The PE connection ensures that all exposed conductive surfaces have the same electrical potential as the surface of the earth.

It avoids the risk of an electrical shock if a person touches a device in which an insulation fault has occurred. An insulation fault (a "short circuit") will cause a very high current flow, which will trigger an overcurrent protection device (fuse, circuit breaker) and disconnects the power supply.

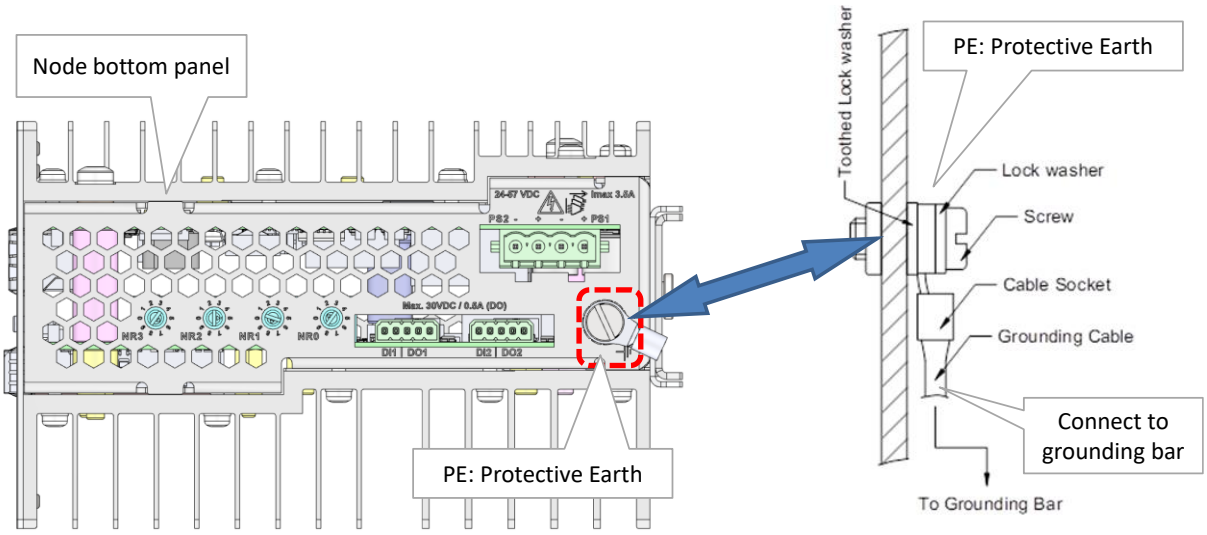

Figure 15 PE: Protective Earth (on Node Bottom Panel)

2.3 Back Panel

2.3.1 Node Replacement / Micro SD Memory Card

CAUTION:
- The node enclosure could be hot. Pay attention to it when replacing a node in operation.
- The SD card only becomes operational at node boot time.
- It is not allowed to plug in/unplug the SD card while the node is operational in the live network. Doing so could mess up your node configuration!
- The SD card should NOT be used for manually modifying the node configuration by editing files on this SD card. Doing so could mess up your node configuration!

The configuration of the XTD-2110-A node is stored on an SD memory card, which can be found on the back panel of the node. This SD card is by default available. When the device

needs to be replaced in the field, the SD card can be swapped to the new device to automatically copy all the configuration data.

The SD card has two purposes:

- Allow the easy and fast replacement of a broken node in the live network without further TXCare interaction. The SD card on the broken node always holds the latest node configuration downloaded via TXCare including the node number. Every time TXCare loads a new or updated configuration into the node, this SD card will be updated.
- Offer a container for 'network database' backups. When a backup of the database to this node has been initiated in TXCare via 'network backups', TXCare will store this database on this SD card. See also Ref. [2Mgt] in Table 1.

CAUTION: The SD card from a broken node can be reused in the new replacing node, provided that both nodes have the same firmware version.

Follow the steps below to replace a broken node with a new node:

1. Prepare the new node:
    1. Remove the SD card from the new node by pushing down and releasing the SD card;
    2. Make sure that the new node has the correct firmware for the network, upgrade the firmware (via TXCare) if needed;
    3. The new node must not be factory reset provided that the SD card (*) with the correct configuration from the broken node will be reused in the new node. A factory reset (see §2.1.2) is still recommended;
2. Identify the broken node, the node identification function can be used (§2.4);
3. Disconnect all application cables before disconnecting the PSU;
4. Power off the broken node by disconnecting its PSU(s);
5. Remove the broken node from the DIN rail;
6. Remove the SD card (*) from the broken node (by pushing down and releasing the SD card) and insert it into the new node;
7. On the new node, set the correct node number (same as in the broken node) via the rotary switches on the node itself;
8. Mount the new node on the DIN rail and reconnect all the cables;
9. The new node reboots with the correct node configuration that is read from the SD card (*). A new load of the node via TXCare will not be necessary.
10. Use TXCare Discovery to allow neighbours to talk to this node;

NOTE: (*) CAUTION: In the rare case that an SD card with the correct configuration is not available, a factory reset is absolutely required and loading the configuration again from TXCare will be necessary!

NOTE: This SD card is neither required nor essential for the node to operate, but it makes a possible node replacement in the future a lot easier and faster.

NOTE: If the SD card is present in the node and the reset button has been pushed at least for seven seconds (=factory reset, see §2.1.2), the SD card will be cleared.

NOTE: A new SD card (Micro SD 16 GB Class 10, UHS-I) can be ordered via order number: V30812-A6073-C3.

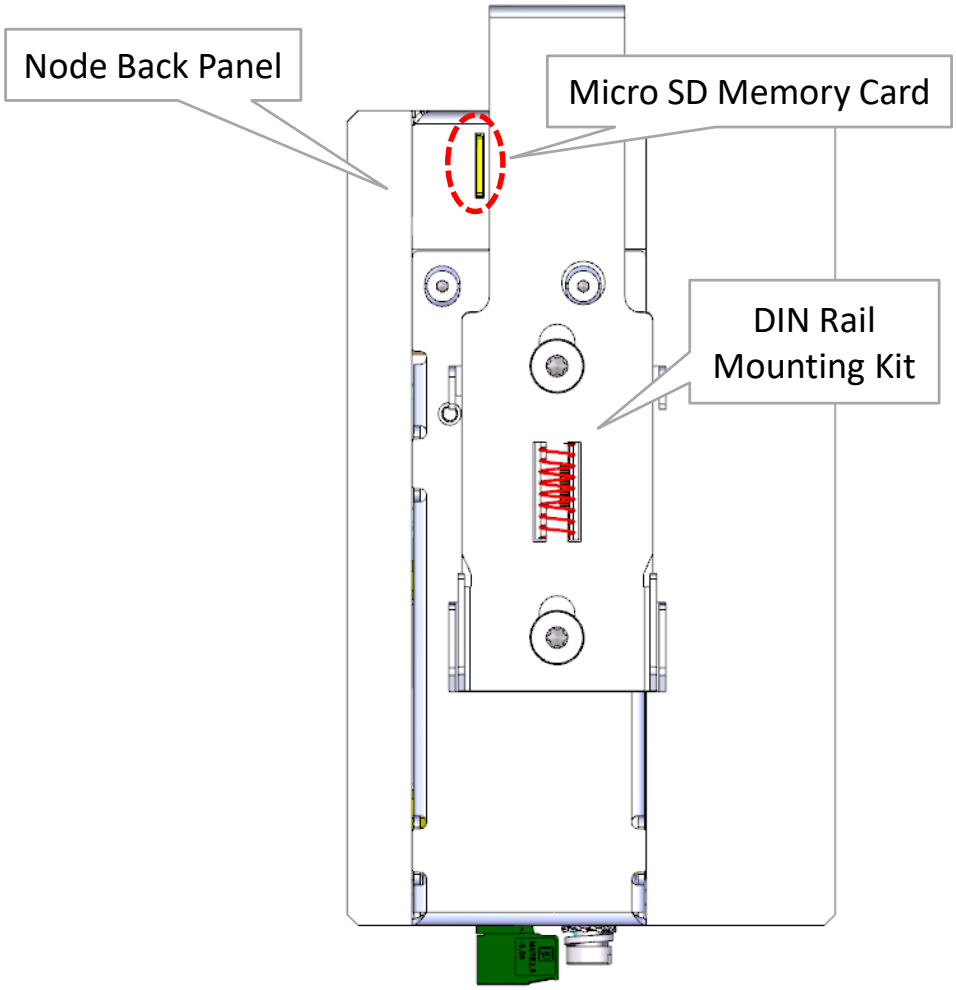

Figure 16 Node Back Panel: Micro SD Memory Card Interface

2.4 Node Identification, Front IP Address, I Am Here

It is possible for TXCare to identify your XTD node in the network by flashing its LEDs. Vice versa, a node can identify itself to TXCare and send out its front IP address at the same time. See paragraphs below.

2.4.1 TXCare Identifies a Node

Select an XTD node in TXCare and activate 'Device Identify' (TXCare → Network Hardware → select node → generic → Device Identify = True → Apply). The selected node will flash all its port LEDs for 300 seconds or until the ID button is pushed on the front panel of the node.

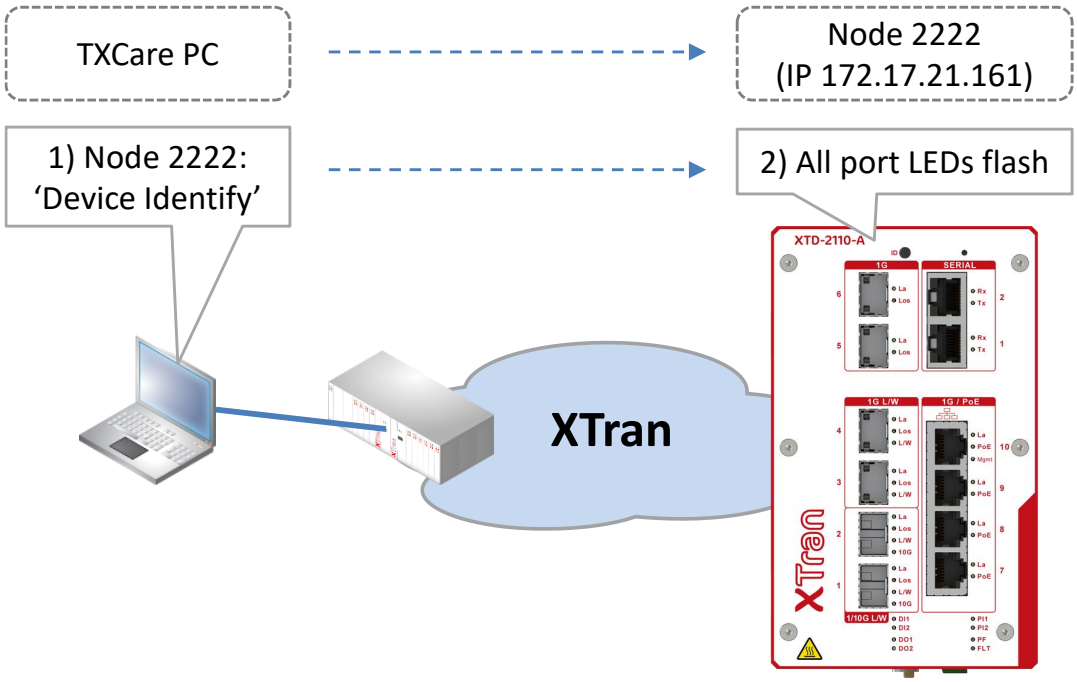

Figure 17 TXCare Makes Port LEDs Flash

2.4.2 Node Identifies itself to TXCare, Sends out IP Address

A node can be identified to TXCare by a short push on the node's front panel ID button. When the ID button is pushed:

- The Mgmt LED (port 10) flashes approximately 3 seconds.
- The Mgmt port sends out a GARP (=Gratuitous ARP) message with the front IP address of the XTD node. Note: Also works for a stand-alone node not part of an XTran network.
- A node notification (trap) will be sent to TXCare. TXCare will show an alarm with message 'I am here' for the node which node's ID button has been pushed.

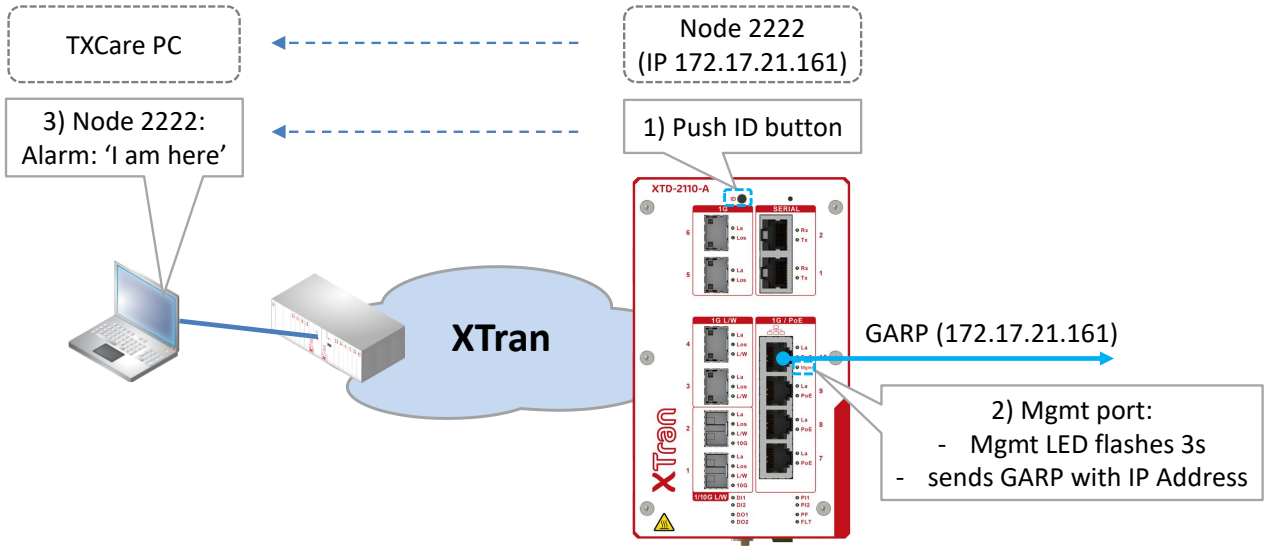

Figure 18 Node Identifies itself to TXCare

2.5 Functional Operation CSM-XTD

2.5.1 General

The CSM-XTD is the Central Switching module (=CSM) inside the node. It is the heart of the node which provides the main processing within via an Integrated Ethernet Multilayer Switch and onboard Traffic Manager.

2.5.2 Exchange Data with the Outside World

The node exchanges services data (Ethernet, MPLS-TP, Serial data) with the outside world. This means that this node communicates with other XTran nodes via its WAN ports and with applications via its LAN ports.

2.5.3 Central Node Switching

The CSM-XTD switch in the node is non-blocking and has following data bus:

- CSM-XTD:
  - 4 x '1 Gbps / 10 Gbps' ports;
  - 24 x '1 Gbps' ports.

2.5.4 Management Channel / DCN Channel / TXCare Interface

The management or DCN channel (=Data Communication Network) is a dedicated channel needed by TXCare to configure, monitor and manage the XTran network.

The management channel is built up dynamically over each link of the entire network when physically connecting the nodes to each other. This channel is a collection of inter-node MPLS-TP WAN connections. All the XTran management packets travelling over the XTran network will have a high priority QoS (=Quality of Service) to ensure that these packets always reach their destination.

Only if port 10 is converted to a management port, the TXCare PC can have local access to the DCN Channel via port 10.

NOTE: See also §2.1.9, for the Discovery function, see Ref. [2Mgt] in Table 1;

2.5.5 Self-test

When switching on the supply voltage, the node goes through a self-test, before switching itself into the network. During this test, the main function blocks are tested e.g. processor, memories etc.…

2.5.6 Alarming: Hardware Device Alarms

The CSM-XTD supervises all the hardware in the node and generates the necessary device alarms when something goes wrong in the node. These alarms are collected by TXCare. It can be configured in TXCare via the Device Settings to output one or more of these alarms to the digital output contacts (=DO) on the node, see also Ref. [2Mgt] in Table 1.

2.5.7 Health Monitor

If there are problems with a specific node, a service in a node, responsiveness of a node, possible traffic loss in a node, the Health Monitor in TXCare can be checked. (See also Ref. [2Net] in Table 1). This monitor shows more info on the CSM-XTD usage in a node:

- CPU usage;
- Memory usage;
- Disk (=Flash, SD memory card) usage.

2.6 Functional Operation Ethernet Ports

2.6.1 Ethernet Interface: Interfacing to a LAN or WAN Network

WAN ports interconnect nodes within the XTran network (MPLS-TP) whereas LAN ports interconnect the nodes with their applications.

Ethernet ports[1..4] can be configured individually as LAN or a WAN port in TXCare whereas ports[5..10] can only be configured as LAN. By default, each port[1..4] is configured as WAN port. A LAN port talks Ethernet and a WAN port talks MPLS-TP. As a result, the node can serve as an edge node (or LER = Label Edge Router) where traffic is received on a LAN port, mapped into pseudowire and forwarded to the correct label switched path on a WAN port.

For a configured application service, the node can operate as a:

- LER = Label Edge Router or access node: The node is located on the edge between the LAN and WAN. The node converts Ethernet into MPLS-TP and vice versa;
- LSR = Label Switching Router: The node is fully located in the WAN. The node has no end-points for the configured application service, it only forwards MPLS-TP traffic via label switched paths;

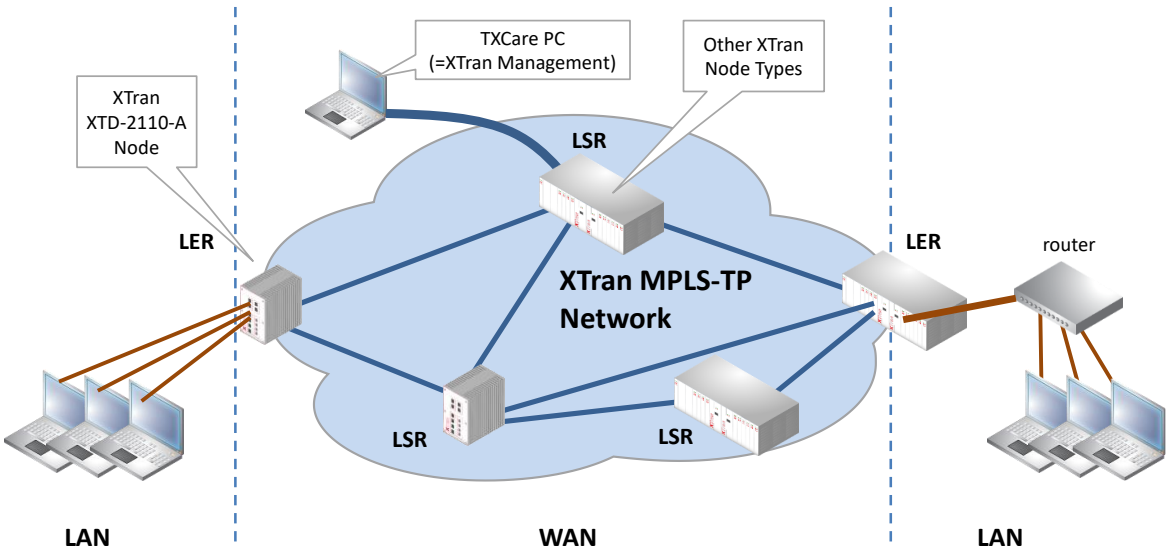

Figure 19 General Example: LAN/WAN

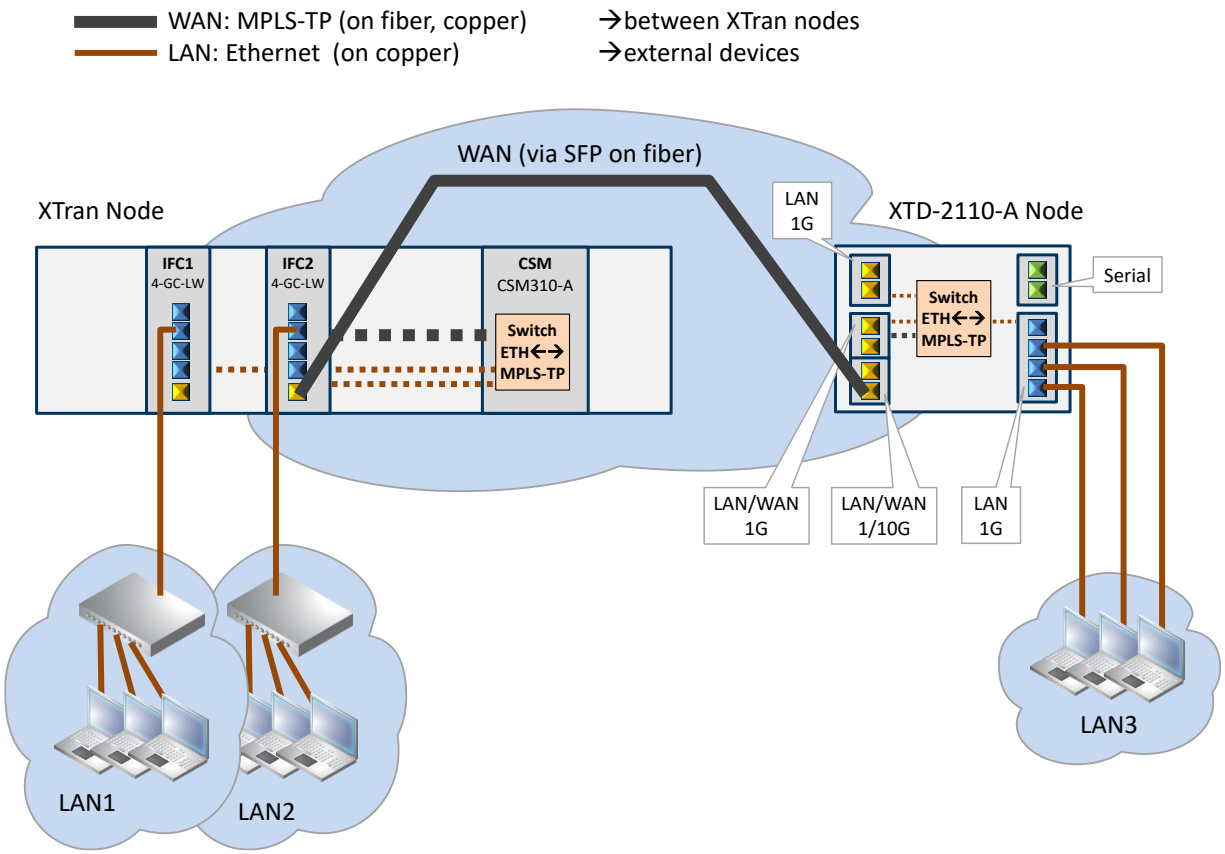

Figure 20 Detailed Example: Interfacing to a LAN or WAN Network

2.6.2 L2/L3 Back End Port

The XTD node has one 10Gbps L2/L3 back end port.

The L2/L3 functionality on the XTD nodes have both front ports and back end ports. The External LAN or network is connected to the front ports while the back end port is connected to the CSM functionality. When configuring an Ethernet service with L2/L3 ports, the service goes via the L2/L3 back end port to the CSM functionality.

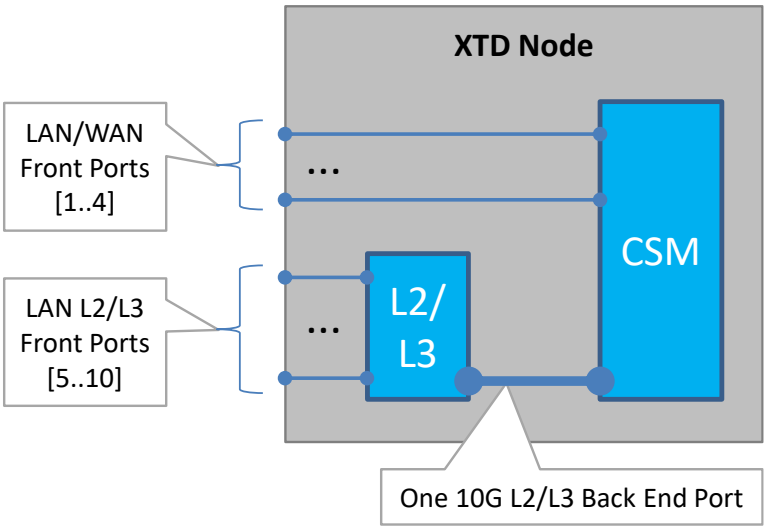

Figure 21 L2/L3 Back End Port

2.6.3 Ethernet Service

a. General

The Ethernet ports[1..10] communicate over the XTran network via an Ethernet service. This service must be configured via TXCare. This service can operate port or VLAN based. An optional E-Tree can be configured as well on this Ethernet service.

b. Port Based / VLAN Based

- Port based: Use this mode if all the traffic on a port must be transported transparently in one and the same service;
- VLAN based (Single VLAN) /VLAN ID: Use this mode if each VLAN (ID) on a port must have its own service. Ethernet packets with the configured VLAN ID will be forwarded in this service, other VLAN IDs and untagged packets will be dropped. This behavior can be overruled by a more advanced VLAN processing in the 'VLAN Tagging/Untagging' feature in TXCare. This feature also supports VLAN translation which replaces VLAN ID 'x' into VLAN ID 'y'.
- VLAN based (Multi VLAN)/outer VLAN ID (can only be used when L2/L3 ports are included in the service): With Multi VLAN, a VLAN based service can carry multiple VLANs instead of just one. Multi VLAN is a feature that operates at the L2/L3 back end ports. For incoming traffic (IN: LAN to WAN), this feature adds an outer VLAN (=outer VLAN, with EtherType 0x8100) around the existing VLANs resulting in double VLAN tagged Ethernet packets towards the CSM. For outgoing traffic from the CSM (OUT: WAN to LAN), the outer VLAN is removed. Each L2/L3 back end port can carry multiple VLAN based services. The non-L2/L3 ports are not able to add/remove the double VLAN tags. Non-L2/L3 ports will process incoming double VLAN tagged packets as if it was a single VLAN tagged packet meaning that only the outer VLAN will be processed. Detailed examples can be found in Ref. [2Eth] in Table 1. A switch that supports QinQ should be connected to non-L2/L3 ports to process double VLAN tagged packets on these ports;

c. E-Tree (LAN Ports [1..4])

An E-Tree is a rooted (not routed) point-to-multipoint partial service within a programmed Ethernet service. E-Tree can be used as a security precaution to separate different customers (=leafs) using the same Ethernet service while accessing one or more ISPs (=roots).

When an E-Tree is used, each service endpoint is designated as either **leaf** or **root**. A leaf can only communicate with a root. A root can communicate with all the roots and leafs.

2.6.4 Voice Service

The Ethernet port in this node can be configured in the Ethernet part of the Voice service. See Ref. [2Leg] in Table 1 for more information on the Voice service.

2.6.5 PoE (=Power Over Ethernet)

PoE is a technology that allows a Powered Device (=PD, e.g. IP telephones, IP cameras etc.) to receive power from 'Power Sourcing Equipment' (=PSE, e.g. the XTran node). The PoE (=Power over Ethernet) capability of the node can be enabled on these ports to the connected devices (e.g. IP cameras or WiFi access points). Make sure the required input voltage is connected to the PS1/PS2 input connectors.

- For PoE operation (802.3af, 15W) node input voltage between 44-57VDC is required;
- For PoE+ operation (802.3at, 30W) node input voltage between 50-57VDC is required;

One or two external PSUs can be used for this (*). How to connect PSUs can be found in §2.2.3.

NOTE: (*) The available PSUs are described in Ref.[11] in Table 1.

The PD receives power in parallel to data, over the existing CAT-5 (or higher for more power) Ethernet infrastructure without it being necessary to make any modifications to it. PoE integrates data and power on the same cable, it keeps the structured cabling safe and does not interfere with concurrent network operation, see figure below.

PoE delivers a minimum of 48V of DC power over shielded/unshielded twisted-pair wiring for terminals consuming less than 25.5 Watts of power.

Before the power is delivered to a connected device, a protocol measures whether that device is a PoE device and how much power it needs (power classification). If required, the necessary power will be delivered by the PSE with a maximum of 30 Watts per port. PoE is supported on ports [7..10]. All these ports can deliver power according to the 802.3af (PoE) and 802.3at (PoE+) standard.

Via TXCare it is possible to enable/disable PoE per port and to verify which ports in each node are PoE enabled.

Power management is supported, i.e. the XTran node decides in an intelligent way which PoE ports will get power and which ones will not. There are a lot of possible scenarios in which power management must tune its delivered power on each port. Some configuration/status parameters in TXCare used by power management are:

- External PoE PSU power
- Available power budget
- Power Priority / Port Priority
- Power Class (class 0, 1, 2, 3, 4 configured and detected)
- Power management also offers PoE diagnostics in TXCare.

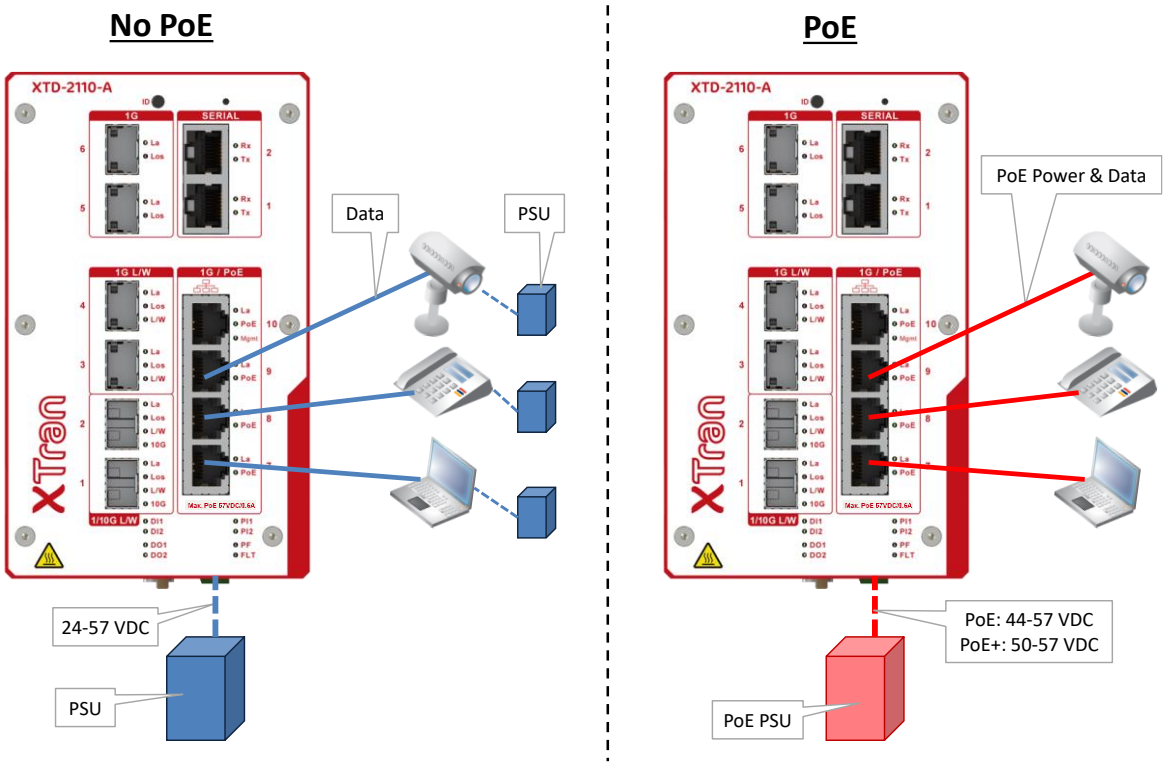

Figure 22 General PoE Example

2.6.6 Storm Control on Ethernet LAN Port

NOTE: Storm Control is not relevant/supported on WAN Ports;

A traffic storm is the growing of excessive network traffic due to Ethernet packets flooding the LAN. Such a storm can for example occur because of a data loop in the network due to the absence or misconfiguration of MSTP. These storms degrade the network performance and must be avoided whenever possible.

The storm control feature:

- is an extra protection against these traffic storms;
- can be configured on the LAN ports;
- limits the amount of unlearned received data (Unicast, Broadcast, Multicast) on the LAN port ingress or input side;
- limits the amount of transmitted data (all data) on the LAN port egress or output side;
- Data that exceeds the configured limitations will be dropped. As a result, a possible data storm cannot overload the node processor or the node will limit outgoing data.

See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

2.6.7 Ports[1..4]: BPDU Guard on Ethernet LAN Port, MSTP Interaction

NOTE: BPDU Guard is not relevant/supported on WAN Ports;

BPDU Guard (=Bridge Protocol Data Unit) is a LAN port property or feature that:

- shuts down the LAN port when a BPDU packet enters this port;
- sends out dummy BPDU packets.

As a result, this feature protects the network against possible loops created on this node through MSTP interaction.

See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

2.6.8 Layer2: VLAN handling

Both port based and VLAN based Ethernet services are supported in which VLANs can be handled (tagging/untagging behavior, QoS, ...). See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

2.6.9 Layer2: QoS (=Quality of Service)

Each Ethernet service can be assigned its own quality of service (bandwidth, priority, burstsize, priority mapping on queues…). See chapter 'Traffic Engineering' in Ref. [2Eth] in Table 1 for more configuration information in TXCare.

2.6.10 Layer2: MSTP (=Multiple Spanning Tree)

MSTP originally defined in IEEE 802.1s and later merged into IEEE 802.1Q-2003, defines an extension to RSTP to further develop the usefulness of VLANs. This MSTP instance configures a separate Spanning Tree for all VLANs included in this instance and blocks all but one of the possible alternate paths within each Spanning Tree.

If there is only one VLAN in the network, single (traditional) STP works appropriately. If the network contains more than one VLAN, the logical network configured by single STP would work, but it is possible to make better use of the alternate paths available by using an alternate spanning tree for different VLANs or groups of VLANs. More than one VLAN can be assigned to one MST instance. Multiple MST regions can be operational, each having its own MSTP instances. The IST (MSTP) instance monitors the entire Region, the CST (MSTP) instance monitors the links between the regions.

MSTP in a port based service is supported network wide whereas MSTP in a VLAN based service is supported only locally (not over this L3 back end ports). CAUTION: using MSTP over a VLAN based service over the back end ports causes a loop!

MSTP is fully supported on XTD nodes. By default, MSTP is enabled on XTD nodes even if no MSTP is configured in TXCare. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

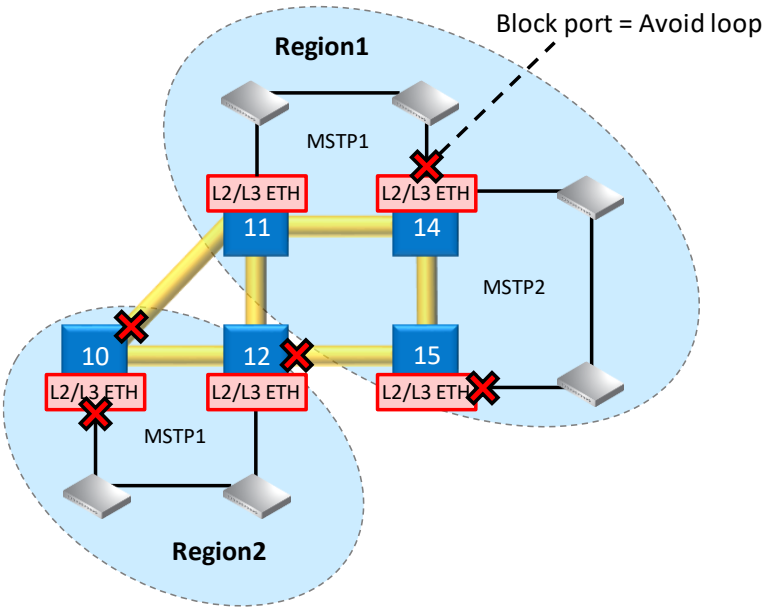

Figure 23 MST Example

2.6.11 Layer2: Link Aggregation/LAG (=Link Aggregation Group)

NOTE: LAG on the L2/L3 ports is supported, not supported on the CSM Ethernet ports.

NOTE: LAG on the back end ports is not supported.

NOTE: LACP (=Link Aggregation Control Protocol) is supported: LACP provides a method to control the bundling of several physical ports together to form a single logical channel. LACP allows a network device to negotiate an automatic bundling of links by sending LACP packets to the peer (directly connected device that also implements LACP).

Link Aggregation is the bundling (=aggregation) of multiple physical Ethernet ports between a source and destination side into one combined logical Ethernet port. A LAG is a combination of multiple Ethernet LAN ports with the same port speed within one logical port group, maximum 8 ports per LAG and 8 LAGs per node. The Link Aggregation is the communication between two LAGs. E.g. one LAG in one XTran node and the second LAG in a third party switch/application. For 1G ports, all the ports of the source and destination LAG must be in autonegotiation.

LAG is configured in TXCare. See Ref. [2Eth] in Table 1 for more configuration information in TXCare and an overview of all the IFMs/ports that can be combined in the LAG.

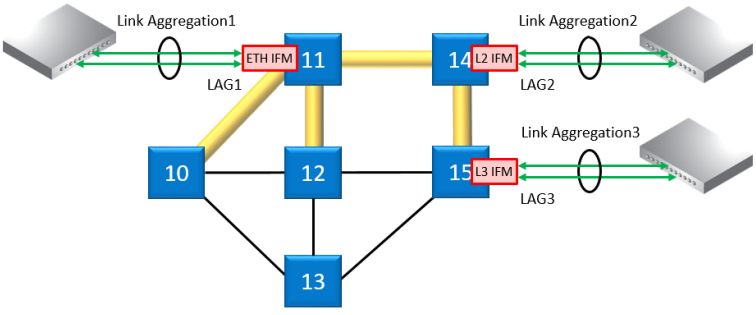

Figure 24 Link Aggregation and LAGs

2.6.12 Layer2: IGMP Snooping (IGMP = Internet Group Management Protocol)

IGMP snooping is designed to prevent hosts on a local network from receiving traffic for a multicast group they have not explicitly joined. Via IFMs that support IGMP snooping (see the 'Protocol and Feature Support Matrix' in Ref. [2Net] in Table 1), it provides the XTran nodes with a mechanism to diminish multicast traffic from links that do not contain a multicast listener (an IGMP client). The XTran node will, by default, flood multicast traffic to all the ports in a broadcast domain (or the VLAN equivalent). Multicast can cause unnecessary load on host devices by requiring them to process packets they have not solicited.

CAUTION: IGMP Snooping is IP based on XTD nodes.

IGMP snooping allows the XTran node to only forward multicast traffic to the ports that have solicited them. IGMP snooping is not a protocol but a layer 2 optimization for the layer 3 IGMP protocol (see §2.6.17). IGMP Snooping takes place internally on IFMs that support it.

Snooping is therefore especially useful for bandwidth-intensive IP multicast applications such as IPTV. IGMP Snooping is configured in TXCare. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

MC = Multicast / RP = Rendez-Vous Point / BSR = Bootstrap Router / Q = Querier

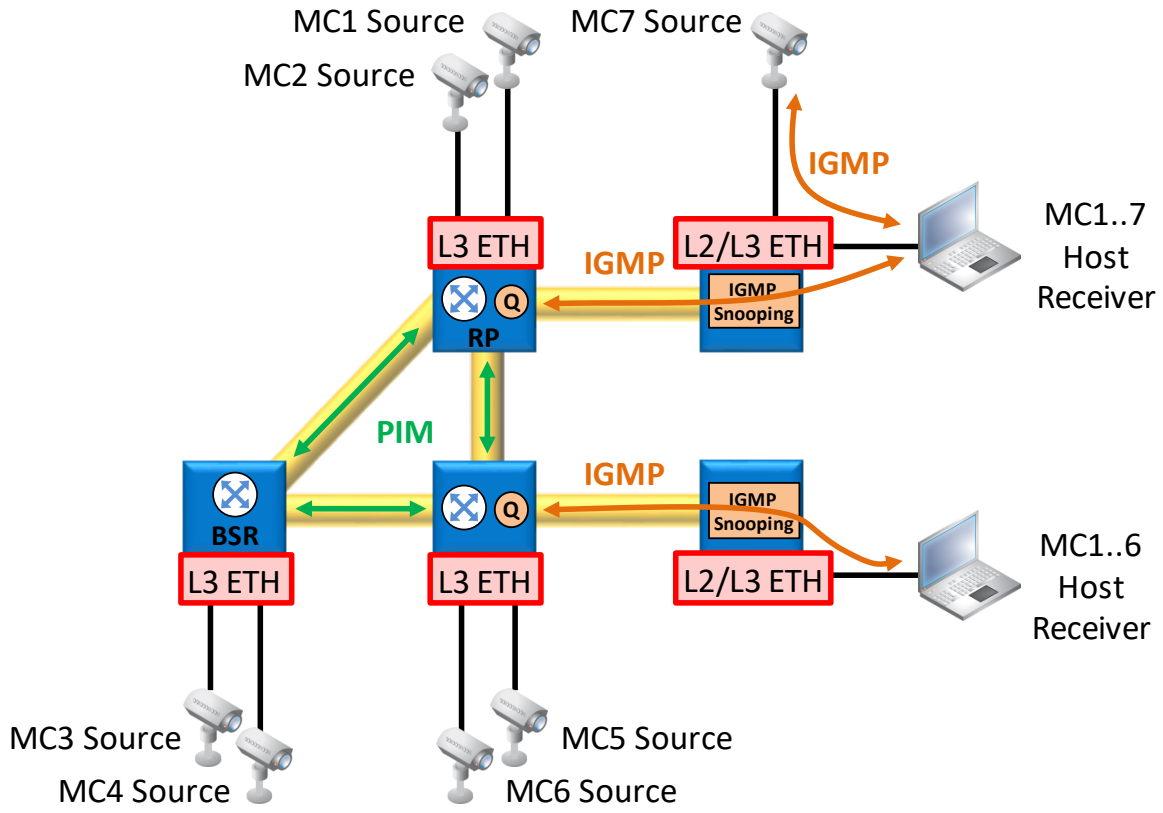

Figure 25 PIM/IGMP/IGMP Snooping Overview

2.6.13 Layer3: VRF (=Virtual Router Forwarding)

NOTE: Configuring one or more Virtual Routers on XTD nodes requires a L3 license per XTD node.

Virtual Router is a router (instance) created by TXCare within the XTD node. 'Virtual' in this context refers to the fact that it is created programmatically and that multiple routers can be created within the same XTD node, with each Virtual Router having its own independent routing table. Because the Virtual Routers are independent, the same or overlapping IP addresses can be used without conflicting with each other. These routing tables initially only have IP addresses/masks of directly connected networks. Later on, these routing tables will be extended by using Static Routing, OSPF. See example figure below. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

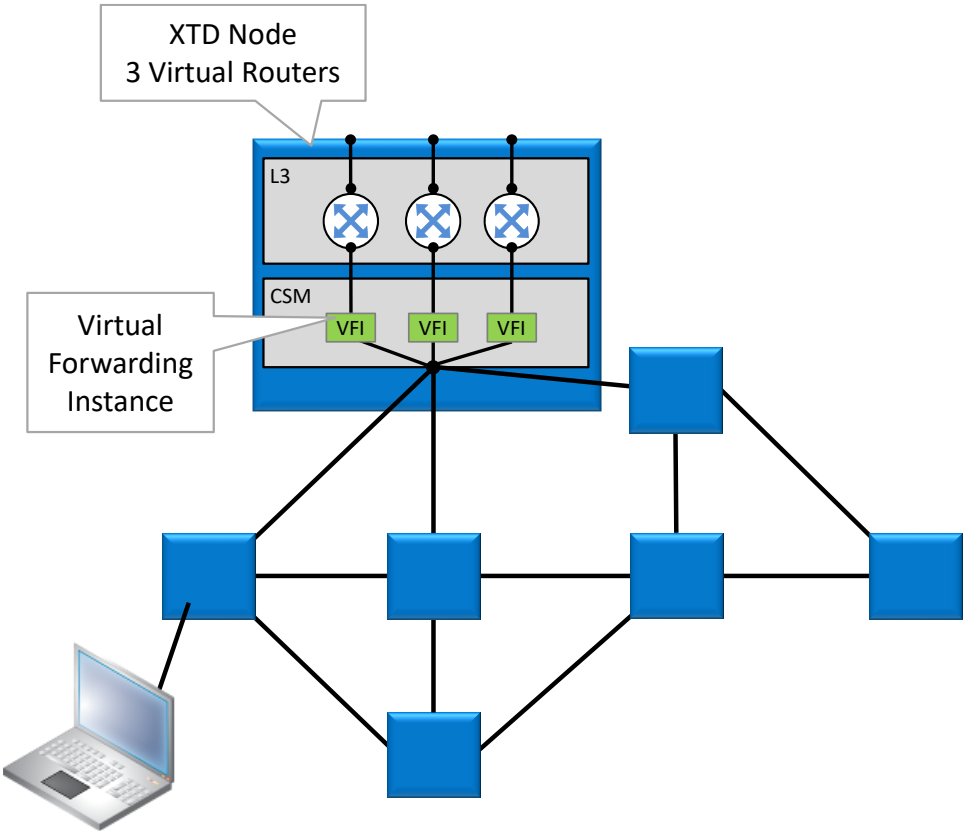

Figure 26 Virtual Router Example

2.6.14 Layer3: VRRP (=Virtual Router Redundancy Protocol)

VRRP (=Virtual Router Redundancy Protocol) is a protocol which increases the availability of the router of a subnet. This redundancy technology is based upon the **sharing** of a **virtual IP Address** amongst all the router interfaces being part of the same VRRP **Group**. This is achieved by combining a master and one or more backup router interfaces into one **Group**. The actual routing within the Group is done by the master (=active) router interface whereas the others act as backup. A router interface becomes master after a master election process.

All the router interfaces within a Group use the same unique virtual IP address, e.g 10.10.10.1. The virtual IP address and router interfaces must be in the same subnet. The virtual IP address will be the default gateway for its associated VLAN e.g. VLAN with VID 150.

The VRRP wizard in TXCare can create one or more VRRP instances. Each VRRP instance can be configured between two or more routers. As a result, a Group will always have one or more backup router interfaces whenever its active router goes down. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

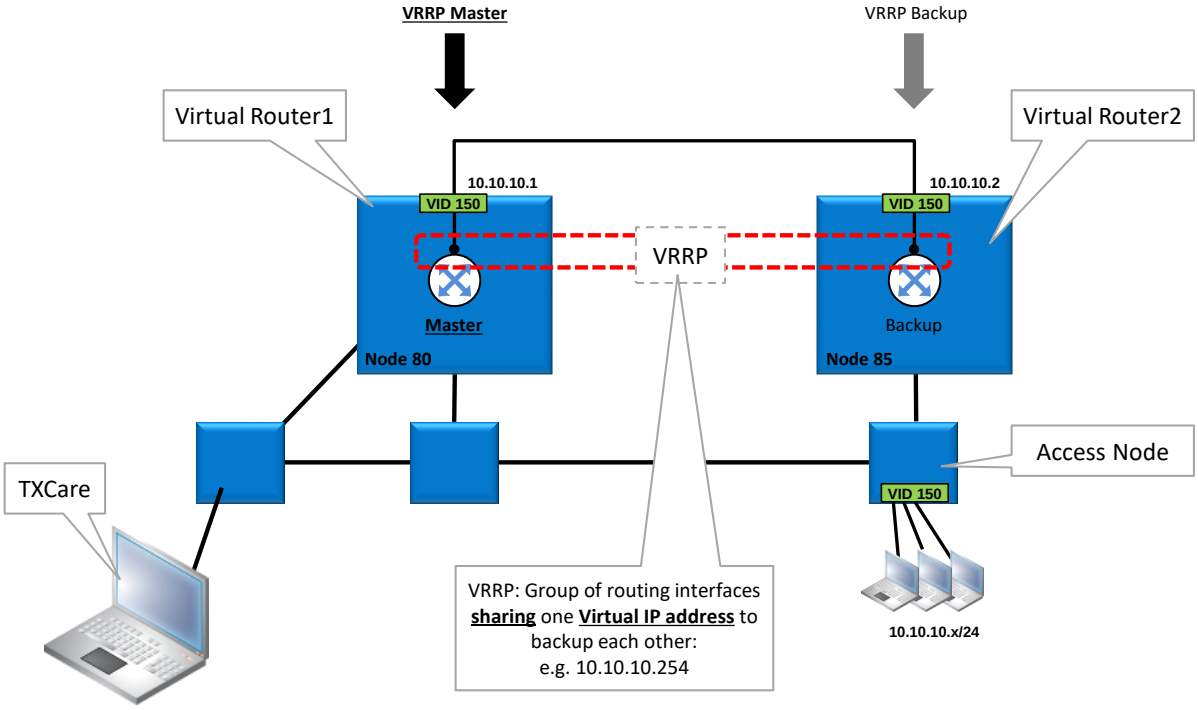

Figure 27 VRRP Example

2.6.15 Layer3: Static Routing

The static routing wizard in TXCare configures or creates static routes (on the virtual routers) throughout the network. A route is a path from a source towards a destination via which the message has to travel to reach the destination IP network. There can exist multiple paths from source to destination, but only one path will be the most efficient one. Routes (with a same destination) can be favored via a distance parameter. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

2.6.16 Layer3: OSPF (=Open Shortest Path First)

OSPF is a dynamic routing protocol for IP networks. A dynamic routing protocol always determines the best possible routing path. For example, determined routes may dynamically change because a specific route becomes less or more preferred than before.

The concept of OSPF is that routers advertise **updates** of their **link states** to neighboring routers. And the neighboring router does the same to its neighboring router and so on…. In other words, each router learns from the other routers based on **link state advertisements** (=LSA). OSPF is a fast protocol because only updates are advertised. OSPF checks the availability of others routers in the network by sending 'Hello' packets. If the other router does not respond then that router is assumed to be down. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

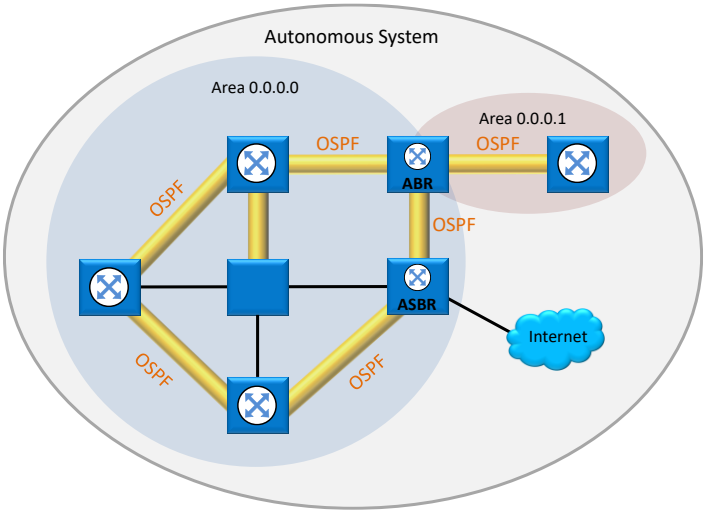

Figure 28 OSPF Example

2.6.17 Layer3: PIM (=Protocol-Independent Multicast)

PIM is a multicast routing protocol. It is protocol independent because PIM does not have a network topology discovery mechanism like other routing protocols have. PIM uses routing information supplied by other routing protocols. PIM builds up Multicast Distribution Trees for each IP Multicast Group Address. As a result, data packets from senders to a multicast group reach all receivers that have joined the group via IGMP. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

MC = Multicast / RP = Rendez-Vous Point / BSR = Bootstrap Router / Q = Querier

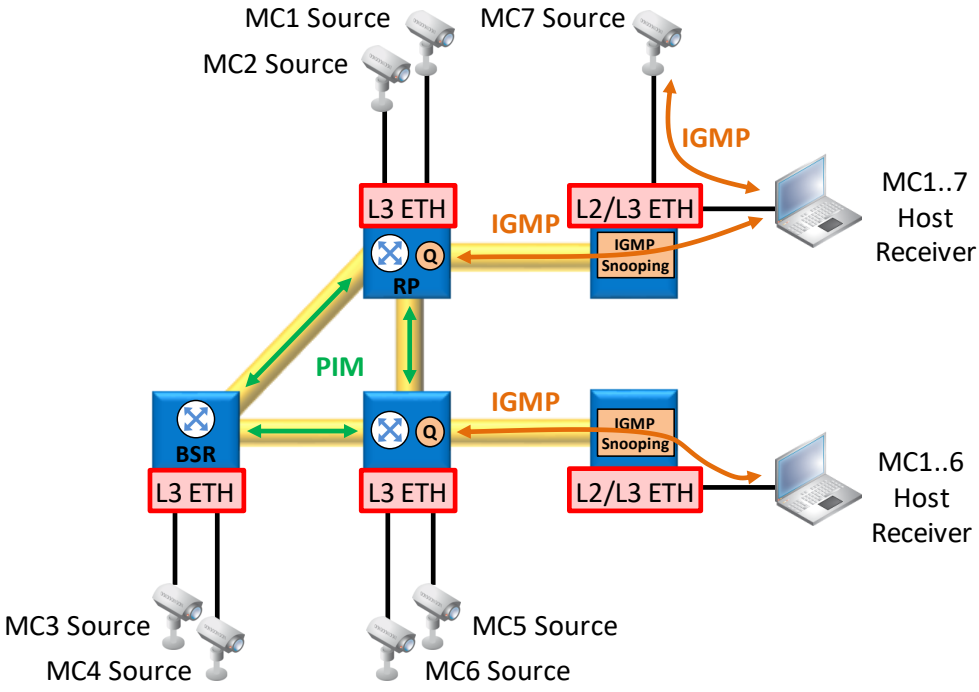

Figure 29 PIM/IGMP/IGMP Snooping Overview

2.6.18 (Future Support) Layer3: DHCP Relay (DHCP = Dynamic Host Control Protocol)

DHCP (=Dynamic Host Control Protocol) is a network configuration protocol in IP networks which allows that IP clients at start-up automatically request IP configuration data from a DHCP Server. This data is necessary for the client to be able to communicate with other IP clients within the IP network.

In TXCare, a DHCP Relay agent can be configured on XTD node to forward IP address requests/responses towards external DHCP Servers/DHCP Clients. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

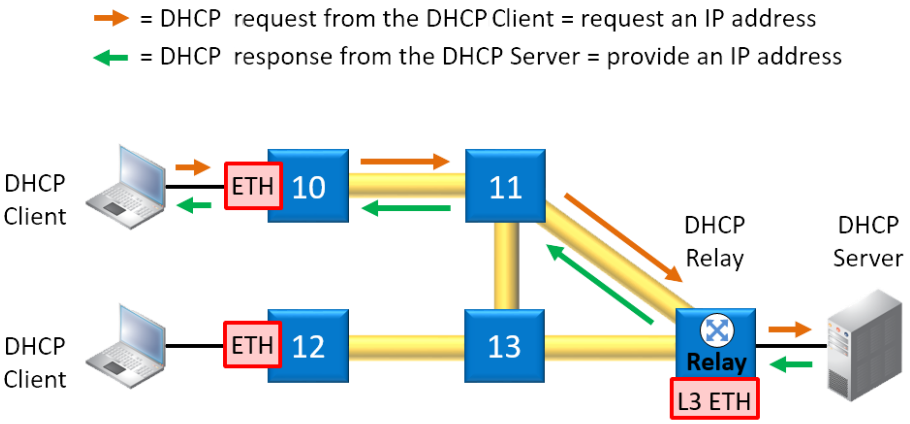

Figure 30 DHCP Overview

2.6.19 Layer3: IGMP (=Internet Group Management Protocol)

IGMP is a protocol used between hosts and neighboring local multicast routers. This protocol manages multicast-group memberships. If a host wants to receive a multicast stream, the host must be member of the multicast group. IGMP can be used to manage/distribute multicast streaming video and allows more efficient use of the available bandwidth and resources. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

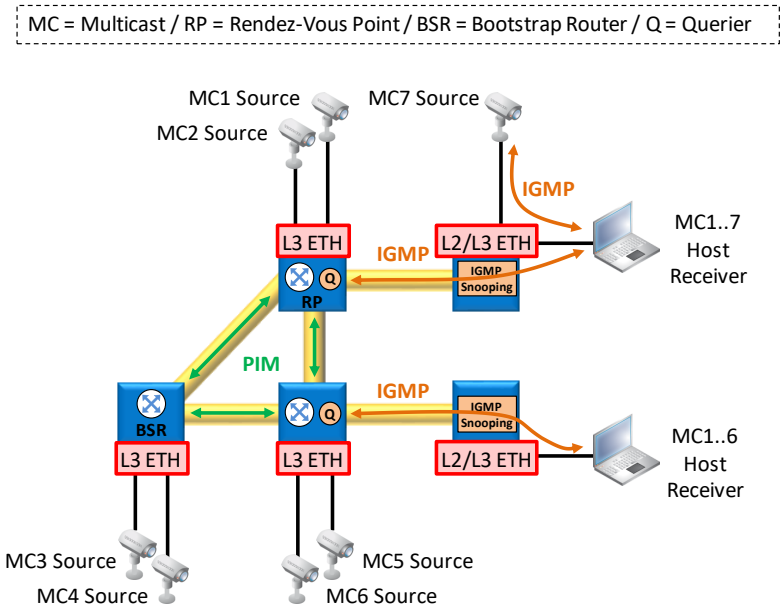

Figure 31 PIM/IGMP/IGMP Snooping Overview

2.6.20 VLAN routing (IPv4) / L3VPN

A L3VPN (or Layer3 VPN) is a routed network within XTran that interconnects one or more IP subnets via the MPLS-TP backbone. One or more Ethernet LAN ports from one IP subnet will be able to communicate with one or more Ethernet LAN ports in another IP subnet. The L3VPN is created via configuring an MPLS-TP service and one or more local LAN serivces interconnecting them via a virtual router on a XTD node. See Ref. [2Eth] in Table 1 for more configuration information in TXCare.

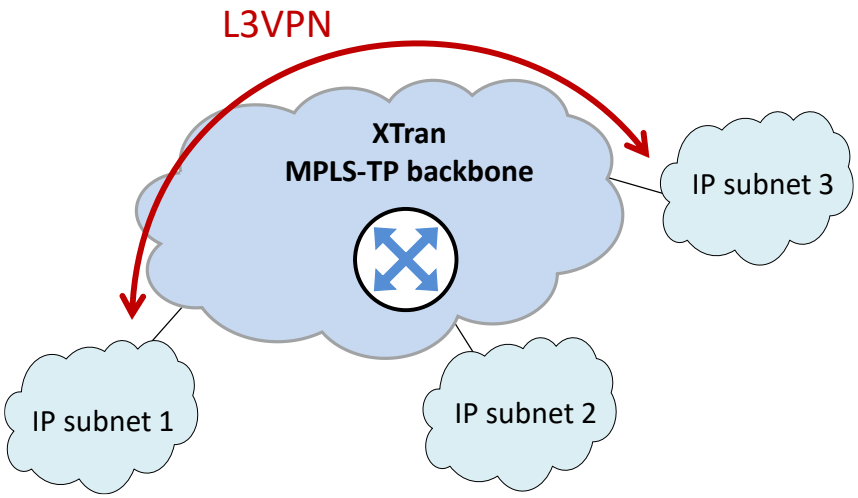

Figure 32 L3VPN Example

2.7 Functional Operation Serial Ports

2.7.1 General

This node has two serial ports:

- Supported interface types or protocols: see §2.7.2;
- Port role DTE/DCE: see §2.7.3;
- Synchronization (Asynchronous): see §2.7.4;
- Services: Serial Ethernet and Serial Port Server: see §2.7.5;

2.7.2 Port Interface Types, Duplex Mode

Each serial port can be configured via TXCare (=XTran Management System) in one of the interface types listed below. This setting occurs at service creation. As a result, both end points or ports will have the same setting after the service creation.

- RS232 (=full-duplex) / RS422 (=full-duplex) / RS485 (=half-duplex);

CAUTION: Both serial ports will always run in the same duplex mode. If both ports are available and you configure one port in RS232 or RS422(=full-duplex), the other port will be automatically configured in full-duplex as well. As a result the other port can not be configured in RS485. If both ports are available and you configure one port in RS485(=half-duplex), the other port will be automatically configured in half-duplex as well.

2.7.3 Serial Port Role DTE/DCE

For the protocols RS232, RS422 each serial port can be configured via TXCare in the port role DTE or DCE. By default, when a service is configured on a port, its port role is set automatically to DCE. If it must be changed to DTE, it must be done later on via changing the port settings in the Network Hardware tab.

- DTE (=Data Terminal Equipment): Example: PC, RTU, terminal, printer, etc.
- DCE (=Data Communication Equipment): modems etc.

NOTE: Not relevant for RS485;

2.7.4 Synchronization

Serial Ethernet and Serial Port Server are always asynchronous. No clock is exchanged between the transmitter and receiver. Only data is exchanged. Both the transmitter and receiver use start and stop bits to indicate the start and stop of data.

2.7.5 Services

Serial communication can be configured in TXCare via creating a 'Serial Ethernet' or a 'Serial Port Server' service.

- **Serial Ethernet**: Use this service when **Point-to-Multipoint** (e.g. SCADA) is needed. Serial data will be encapsulated directly into Ethernet packets and sent over the XTran network. Both serial ports can transport such a service. Serial Ethernet packets will be converted back into serial data at the destination IFM. Serial Ethernet packets will never leave the XTran network. Master(s)/slave(s) must be configured in this service.
- **Serial Port Server**: Use this service when you want to packetize your serial connection and transfer it over Ethernet TCP/IP. It can then be used from any TCP/IP device to connect to this remote serial device. In this service, multiple serial ports (*) and ethernet ports (4-GC-LW IFM,…, L2/L3 IFM) can be combined.

  NOTE: (*): Serial ports on products that support Serial Port Server, see Ref.[2Leg] in Table 1.

CAUTION for 'Serial Port Server':
The serial ports can operate as an Ethernet TCP/IP Server or Client. Multiple Servers/Clients can be configured in one service. In a service with multiple Servers/Clients, only point-to-point connections between Server and Client are possible.
- When continuous traffic is sent over the 'Serial Port Server' service:
- Some ports in the 'Serial Port Server' service will have a limited bitrate;

Following parameters are needed per service:

- Serial Ethernet:
  - (Always Asynchronous)
  - Interface Type: RS232/RS422/RS485
  - Bitrate, Data Bits, Parity, Stop Bits
  - Multidrop Consistency
  - Advanced Mode (Block Size, Transmit Timer, Delimiter Line Termination Character)
  - Master(s)/Slave(s) selection

- Serial Port Server;
  - (Always Asynchronous)
  - VLAN ID
  - Interface Type: RS232/RS422/RS485
  - Bitrate, Data Bits, Parity, Stop Bits
  - Advanced Mode (Block Size, Transmit Timer, Delimiter Line Termination Character)

2.7.6 Serial Ethernet (Point-to-Multipoint)

Serial Ethernet is a point-to-multipont service between two or more serial ports, e.g. for SCADA systems. One such service can be configured per port. This service converts the incoming serial data directly into Ethernet packets, to transport it over the MPLS-TP XTran network.

The destination module will receive the Ethernet packets from the XTran network and regenerate the serial data from it. As a result, the destination sends out the regenerated serial data on its serial port.

2.7.7 Serial Ethernet: Master/Slave

A Serial Ethernet service is typically used for a point-to-multipoint service, e.g. SCADA systems. In this service, at least one master (maximum two masters) and one or more slaves (maximum 156 slaves) must be selected.

When two masters are selected, one of them will be the active one and the other one will be the backup master. Which one is the active/backup master will be decided by the serial protocol itself.

The (active) master will initiate commands or requests to their slaves. The backup master and all the slaves will see this request. Only the addressed slave will process the request and send a response back to the (active) master. The backup master and all the other slaves will see the slave response.

Only the (active) master will process the slave response. The backup master (if any) will be synchronized with the active master and will take over when the active master gets out of service.

2.7.8 Serial Ethernet: Advanced Mode - Bandwidth Optimization

At service creation, fine-tuning the bandwidth and delay through the network is done via the Advanced Mode parameter. It groups payload data more efficiently in the transmit process resulting in less overhead. Note that less bandwidth results in more delay and vice versa.

Serial data is collected at the front ports and buffered until one of the events below is triggered. After the trigger, the payload data is packetized and sent over the XTran network.

- Amount of payload bytes received at the front (Fixed Block size);
- Periodic transmit timer expires (Fixed Transmit Timer);
- Detection of a line termination character (Delimiter: Line Termination Character);
- Timeout occurs after the last received byte (Delimiter Timeout);

See manual Ref.[2Leg] in Table 1 for more info;

2.7.9 Serial Ethernet: Multidrop Consistency

Multidrop Consistency is a polling mechanism, within a Serial Ethernet service, between the master(s) nodes/IFMs and the slave nodes/IFMs to check whether the slave nodes/IFMs are still alive. The master node/IFM is the node/IFM connected to the master application, the slave node/IFM is the node/IFM connected to the slave application.

When the feature is activated in TXCare, the polling occurs every 500 ms. If a polling failure occurs, the necessary alarms will be raised. Deactivate the feature to stop the polling.

More info in manual Ref.[2Leg] in Table 1;

2.7.10 Serial Port Server: VLAN ID

Set the default VLAN ID in the range [2-3699, 3802-4000] for this service. Ethernet packets with this VLAN ID will be forwarded in this service, other VLAN IDs and untagged packets will be dropped. This behavior can be overruled by a more advanced VLAN processing in the 'VLAN Tagging/Untagging' feature.

2.7.11 Serial Port Server: TCP/IP Connection

If you want to connect to a serial port via the Serial Port Server service to send/receive data, a TCP/IP connection must be used on the specified port.

To troubleshoot, a tool like 'Tera Term, Putty' client can be used. Use TCP/IP → Other → TCP Port 1024. Make sure port 1024 is configured.

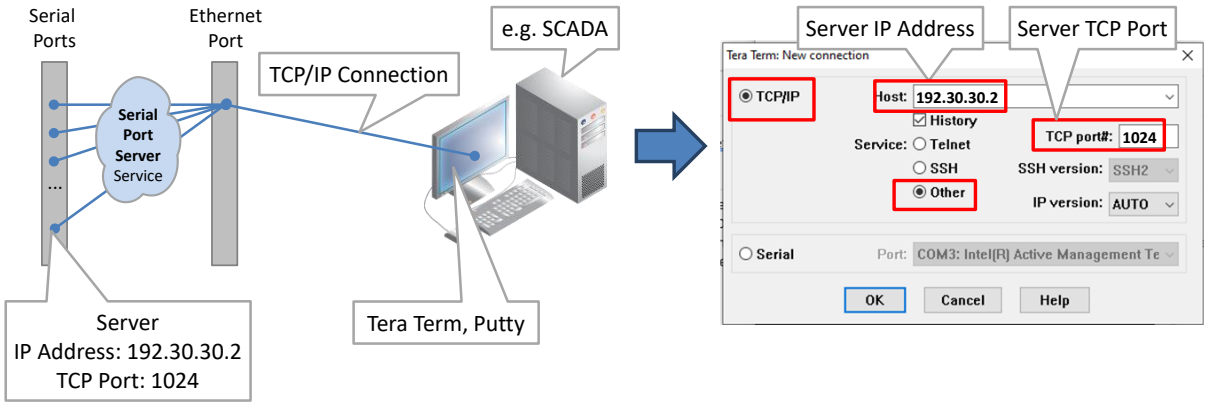

Figure 33 Serial Port Server: TCP/IP Connection

2.7.12 Serial Port Server: Server/Client

- Required: At least one serial port together with another serial port or an Ethernet port.
- Each serial port in the service can either act as Ethernet TCP/IP Server or Client. This must be configured in TXCare.
- An external Ethernet TCP/IP Server or Client, connected to an Ethernet Port, must be configured in the external connected application.
- A serial port will convert incoming serial data into Ethernet TCP/IP and vice versa in the outgoing direction.

- Multiple Servers/Client can be configured in one service, but each Server can only be connected to one Client and vice versa at the same time. Only TCP/IP point-to-point connections between Servers/Client are allowed. Example: If you have configured 3 Servers and 3 Clients in one service, 3 TCP/IP point-to-point connections (Server1 → Client1 / Server2 → Client2 / Server3 → Client3) are possible at the same time.
- This service operates VLAN based.
- Some general Server/Client examples can be found in the figures below.
- All tunneltypes (point-to-point, multipoint, logical ring) are possible.

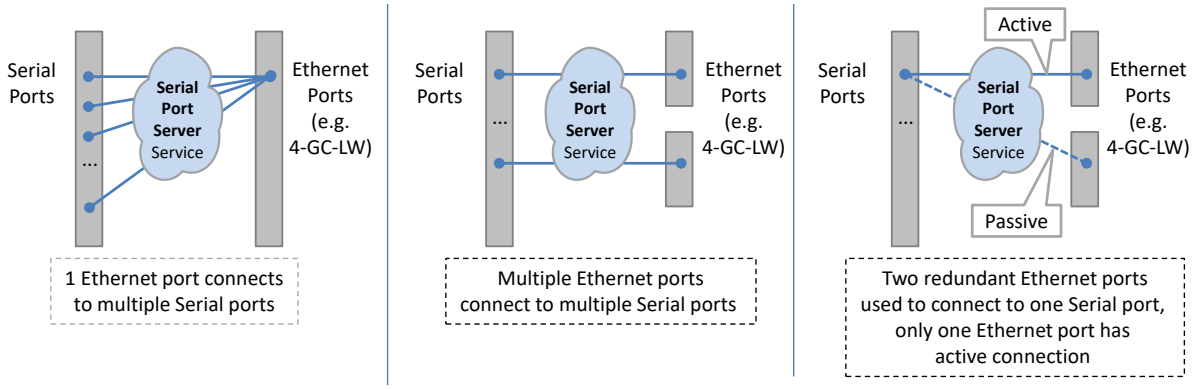

Figure 34 Serial Port Server Service: Port Combinations

2.7.13 I/O with the Central Switching Module (=CSM)

a. Serial Ports

Traffic received via these ports is converted into Ethernet packets (packetization). Next, these Ethernet packets are forwarded to the CSM. What happens next depends on the destination.

- Destination = WAN = remote node: The CSM embeds this Ethernet data into MPLS-TP packets, performs switching and transmits these packets onto a WAN (MPLS-TP network) via a WAN port in the node. On the destination side, the same processing occurs in reverse order.
- Destination = Local Legacy application = local node: The CSM performs switching and transmits these Ethernet packets towards the serial processor inside the own node. The serial processor converts the Ethernet packets into local application data (depacketization) and forwards this data via the serial ports towards the local application.

b. LAN/WAN Ethernet Ports

Ethernet (LAN) or MPLS-TP (WAN) traffic received via these ports is forwarded to the CSM. What happens next depends on the destination.

- Source = LAN = local node:
  - Destination = WAN = remote node: The CSM embeds this Ethernet data into MPLS-TP packets, performs switching and transmits these packets onto a WAN (MPLS-TP network) via a WAN port. On the destination side, the same processing occurs in reverse order.
  - Destination = LAN = local node: The CSM performs switching and transmits these Ethernet packets onto a LAN via a LAN port.

- Source = WAN = remote node:
  - Destination = WAN = remote node: The CSM performs switching and transmits these MPLS-TP packets onto a WAN via an IFM connected to a WAN.
  - Destination = LAN = local node: The CSM removes the MPLS-TP headers, performs switching and transmits these Ethernet packets onto a LAN (local application) via a LAN port.

c. L2/L3 Ports

LAN traffic received via these ports is forwarded to the onboard L3 switch in the node. What happens next depends on the destination.

- Destination = WAN = remote node: The L3 switch forwards this traffic via the L3 IFM back end port to the CSM. The CSM embeds this Ethernet data into MPLS-TP packets, performs switching and transmits these packets onto a WAN (MPLS-TP network) via a WAN port. On the destination side, the same processing occurs in reverse order.
- Destination = LAN = local node:
  - Local service: the L3 switch performs switching and transmits these Ethernet packets onto a LAN via a L2/L3 port.
  - Normal Ethernet service: The L3 switch forwards this traffic via the L3 back end port to the CSM. The CSM performs the switching and transmits these Ethernet packets onto a LAN via a LAN port.

2.7.14 Test and Loopback Selftests

Test and Loopback selftests can be performed in Serial Ethernet and Serial Port Server services, e.g. when configuring or troubleshooting your services. Following functions can be used:

- Loopbacks:
  - Serial Ethernet, Serial Port Server: front port loopbacks towards the line (=application) or network can be configured.
- UART Testing: test traffic generation and verification on the UART (=Universal Asynchronous Receiver/Transmitter) of the XTD node for Serial Ethernet and Serial Port Server with Mux/Demux Asynchronous;

CAUTION: Enabling selftests disables or disturbs normal service traffic on a port!

For more information and configuration settings, see 'Test and Loopback' in Ref.[2Leg] in Table 1.

2.8 Cooling / Temperature Sensing

This node has a rugged industrial fanless design and the cooling in this node occurs via natural convection cooling. This cooling is possible via the heat sinks on both sides of the node, and via the convection holes on the top and bottom panel.

This design allows to operate in a wide temperature range from -30°C to +65°C (-22°F to +149°F). Cold start is possible at -20°C/-4°F.

The node temperature can be read out via TXCare. When the node temperature goes beyond its allowed temperature range (see Ref. [5] in Table 1), an appropriate temperature alarm will be triggered via TXCare.

2.9 Add a New Node to a Live Network

See Ref.[1] in Table 1.

3. COMPATIBILITY

For the serial ports, see Ref.[2Leg] in Table 1 to see which products/ports can be configured in the same services in combination with this node.

4. SPECIFICATIONS

4.1 General Specifications

Table 8 Specifications

Specification	Value
Mechanical/Environmental	
Housing material	Aluminium
Mounting	DIN-Rail
Dimensions (WxHxD):	- Node without DIN rail bracket and PSU connectors: 90x150x144.2 mm / 3.54x5.91x5.68 inches - Node with DIN rail bracket and PSU connectors: 90x180x152 mm / 3.54x7.09x5.98 inches
Weight	1.41 kg / 3.11 lb
Fanless design	Passively cooled through natural convection
IP Class	IP20
Operating Temperature Range	-30°C to +65°C (-22°F to +149°F), Cold start is possible at -20°C/-4°F
Humidity (damp heat cycle)	95% (non-condensing), 25° (77°F) - 40°C (104°F)
MTBF	87.6 years
Other speficications	For more general specifications like temperature, humidity, vibration, EMI ... see Ref.[5] in Table 1.
Power Requirements	
Node Input Voltage	- Redundant Power input 24-57VDC, Imax 3.5A - PoE operation requires 44-57VDC node input voltage - PoE+ opreation requires 50-57VDC node input voltage
Power Consumption	- <40W (excluding PoE power) - No SFP, no PoE: 30W - With 6x SFP, no PoE: 40W - With 6x SFP and 4x PoE+: 160W - Maximum PoE+ Power = 4x30W = 120W (4 ports delivering PoE+)
Digital Output Contacts	- Maximum current: 0.5A - Maximum voltage: 30VDC - See also §2.2.2

4.2 Ordering Information

See Table 2.

5. INSTALLATION AND SAFETY INSTRUCTIONS

Full node installation instructions can be found in document Ref. [1] in Table 1. Below, some additional safety instructions are added.

5.1 Safety Instructions

CAUTION:
- The XTran equipment is not suitable for use in locations where children are likely to be present!
- Install the node by a 'skilled person' (§5.2) only in a 'restricted access' (§5.3) location.
- For ventilation purposes, povide at least 1 U free space above and below the node for heat dissipation. (1 U = 1 RU = 1 HU = 44.45 mm / 1.75 inches). Sideways (left/right), free space is advised but not required.
- Double pole/neutral fusing.
- The node power input connectors PS1 and PS2 are considered as the disconnect devices for the access nodes and as a result must be easily accessible after installation.
- Make sure that there is at least 4 cm / 1.58 inches free space between the node PS1/PS2 input connectors and external combustible materials.
- First connect the safety GND (Ground) to the housing of the node before powering the node. Never apply an excess input voltage (respecting the allowed input range) and respect the correct polarity. The PSU or node might get damaged when an incorrect voltage source has been connected!
- The XTD node can withstand surges, directly implied on the DC input terminals, up to ±1kV (any mode) without any extra precautions (test procedure EN 61000-4-5). Good practice is to keep the DC power lines as short as possible and internal. Also avoid parallel tracks with other cables, carrying heavy transients and voltages, which can cause coupling to the DC power lines. If protection is required against higher surge levels, external precautions have to be taken by placing adequate external surge arresters as close as possible to the inputs of the units.
-  **(Heat Icon): If powered on, the node can be extremely hot. Do not touch the heatsink while the node is powered on or just after switching off the node.**
-  **(PS1/PS2 connector icon): In case of redundant power supplies, ensure that both power cords are disconnected to remove all the electrical current from the node.**
- For operation in areas with explosive gases, see §5.3.

5.2 Skilled/Instructed Person

A 'Skilled Person':

- Is trained or posses experience;
- Is able to identify various energy hazards;
- Is able to take appropriate precautions;
- Should be protected from unexpected hazards.

An 'Instructed Person':

- Is instructed and trained by a 'Skilled Person' or supervised by a 'Skilled Person';
- Is able to identify Class 2 or greater energy hazards and take appropriate precautions;
- May have access to restricted locations;
- Should not be exposed to hazardous energy.

5.3 ATEX

5.3.1 General

The chapters below apply to XTD devices if you operate them in areas with explosive gases according to ATEX directive 2014/34/EU.

CAUTION:
-The ID Button, Reset Button and Node Number rotary switches are not allowed to be used during operational maintenance in a hazardous location.
- Connectors shall be connected or disconnected exclusively in dead voltage state.
- For ATEX compliancy with XTD-2110-A all SFP/SFP+ modules used in XTD should be class 1 laser products and comply with IEC 825-1 / EN 60825.
- Use the correct PSU connector for in the ATEX environment, see §2.2.3a.

5.3.2 ATEX

a. Specifications

- DEKRA 23ATEX0051X
- List of standards:
  - EN IEC 60079-0:2018
  - EN IEC 60079-7:2015 + A1:2018
  - EN IEC 60079-15:2019
- Make sure that the XTD device has the following label:
  -  II 3 G Ex ec nC IIC T4 Gc

b. Specific Conditions of Use

- The ID Button, Reset Button and Node Number rotary switches are not allowed to be used during operational maintenance in a hazardous location.
- The equipment shall only be used in an area of not more than pollution degree 2, as defined in EN 60664-1.
- The modules shall be installed in a suitable enclosure providing a degree of protection of at least IP54 according to EN IEC 60079-0, taking into account the environmental conditions under which the equipment will be used.
- Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 119 V.

5.3.3 UKEX

a. Specifications

- DEKRA 23UKEX6006X
- List of standards:
  - EN IEC 60079-0:2018
  - EN IEC 60079-7:2015 + A1:2018
  - EN IEC 60079-15:2019
- Make sure that the XTD device has the following label:
-  II 3 G Ex ec nC IIC T4 Gc

b. Specific Conditions of Use

- The ID Button, Reset Button and Node Number rotary switches are not allowed to be used during operational maintenance in a hazardous location.
- The equipment shall only be used in an area of not more than pollution degree 2, as defined in EN 60664-1.
- The modules shall be installed in a suitable enclosure providing a degree of protection of at least IP54 according to EN IEC 60079-0, taking into account the environmental conditions under which the equipment will be used.
- Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 119 V.

5.4 Restricted Access Area

This is an area accessible only to skilled persons and instructed persons with the proper authorization. Certain equipment is intended for installation exclusively in restricted access areas. For equipment intended only for use in a restricted access area, the instructions shall so state.

6. WEEE GUIDELINES

The XTran nodes are compliant with the European guidelines 2012/19/EC (WEEE = Waste of Electrical and Electronic Equipment). This compliancy is indicated at the back of the node by a crossed-bin symbol in Figure 35.

Figure 35 Crossed-Bin Symbol

The equipment that you bought required the extraction and use of natural resources for its production. It may contain substances that are hazardous to human health and the environment. In order to avoid the dissemination of those substances in our environment and to reduce the pressure on the natural resources, we encourage you to use the appropriate take-back systems. These systems will reuse or recycle most of the materials of your end-of-life equipment in a sound way.

The crossed-bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration. You can also contact us for more information on the environmental performances of our product.

7. ABBREVIATIONS

AC	Alternate Current
ARP	Address Resolution Protocol
ATEX	Equipment for potentially EXplosive ATmospheres
CE	Conformité Européenne
CSM	Central Switching Module
DC	Direct Current
DHCP	Dynamic Host Control Protocol
DI	Digital Input
DIN	Deutsches Institut für Normung
DO	Digital Output
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
GARP	Gratuitous ARP
GND	Ground
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol
LACP	Link Aggregation Control Protocol
LAG	Link Aggregation Group
LAN	Local Area Network
MPLS-TP	Multiprotocol Label Switching – Transport Profile
MSTP	Multiple Spanning Tree Protocol
MTBF	Mean Time Between Failures
OSPF	Open Shortest Path First
PE	Protective Earth

PI	Power Input
PIM	Protocol-Independent Multicast
PoE	Power Over Ethernet
PSU	Power Supply Unit
QoS	Quality of Service
TXCare	XTran Management System
U	Rack Unit
VLAN	Virtual LAN
VPN	Virtual Private Network
VRF	Virtual Router Forwarding
VRRP	Virtual Router Redundancy Protocol
WAN	Wide Area Network
WEEE	Waste of Electrical and Electronic Equipment
XTran	eXcellence in Transport