PacketBand®-ISDN-4B-B

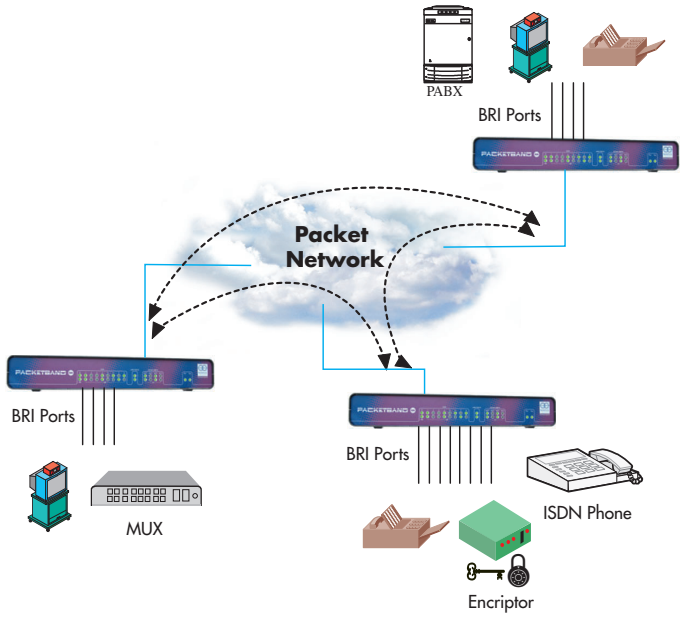
Technical Overview

PacketBand-ISDN-B delivers transparent switched ISDN services across packet networks. All ports are synchronised with central, or network clocks, providing a fully clock-locked environment across asynchronous packet networks - no there is no data loss due to free-running and slipping clocks. This system provides ISDN over Ethernet/IP networks for both voice and, more critically, data applications.

(For single-port BRI unit see the PacketBand-ISDN-1B)

(For PRI units see the PacketBand-ISDN-P range)

(For non-switched (leased line) TDM services see PacketBand-TDM.)



Main Features:

- Product supports 4 x ISDN BRIs
- 4-wire "S" interface (NT or TE)
- 2-wire "U" interface (NT-User presentation))
- US-ANSI and Euro-ETSI ISDN available
- Field-upgradeable to support additional PRI port
- 2 x 10/100/1000 Base Ethernet ports
- 1 x 1GE SFP cage
- Internal AC and DC power options
- Power Feed (Phantom Power) on "S" interfaces
- Transmits all/any data and voice protocols over packet networks
- Totally transparent to all data formats
- All PacketBands and interfaces locked to the same clocks
- SIP Server option for centralised call routing
- Various clocking options with high quality clock recovery
- Any "B" channel can dial any other on the packet network, or "break-out/in" to the PSTN via a PRI/BRI "gateway"
- Provides low-cost migration to IP networks for legacy equipment
- Low data overheads
- Configurable packet size
- Compensates for "jitter" or packet delay variation
- Re-orders packets
- Very low latency or processing delay
- Local Ethernets support Rate Limiting
- Quality of Service (QoS) options
- VLAN and Double VLAN tagging
- Full cross-connectivity
- a-Law to μ-Law conversion
- Support for contention or over-booking
- Call Progress Tone generation
- Number manipulation/conversion/LCR
- Automatic Primary/Secondary/Tertiary routes
- Routing profiles can be scheduled at different times of the day/week
- ISDN Layer 2 and Layer 3 message capture and log for analysis
- Easy and intuitive to configure via GUI management package
- Very attractive pricing
- Compact table-top with optional rack-mount extenders

1. Connectivity Overview

The PacketBand-ISDN range provides an important and unique method for transporting ISDN traffic across packet networks. For some types of device it is the only reliable and error-free solution.

This document focuses on the 4 port BRI PacketBand. Other versions are shown on the last page.

ISDN networks from carriers deliver clocked transparent 64k channels which can transport any type of traffic anywhere in the world; PacketBand does the same. ISDN "B" channels are set up dynamically across the packet network giving inter-connectivity between any device, and can "break-out" into the global ISDN PSTN, accessing any other device world-wide.

All PacketBands are locked and synchronised to the network clock via an advanced clock-recovery system ensuring reliable slip-free services for all applications. This means not only can high-quality voice be transported over low-cost packet networks using existing PBXs, but so can synchronous applications such as videoconference units, voice codecs, encryptors, fax machines, PoS terminals etc.

Not only does PacketBand deliver high-quality clock-locked transparent channels as and when needed, it also has great flexibility in terms of adding CLIs for billing, converting numbers and alternate routing and resiliency options.

For larger networks a low-cost SIP Server solution is available.

If you are a carrier looking to deliver reliable ISDN to customers, a military, governmental or broadcast organisation needing to transport or distribute synchronous ISDN, or perhaps in another vertical or a corporate with some specific ISDN/IP issues, PacketBand may be able to assist.

2. Routing and Features

- **Type of User Traffic** – Any. PacketBand passes all "B" traffic transparently in a clock-locked or synchronous environment. All PacketBands in the network are synchronised to common clocks.

- **Connectivity** – Any "B" channel on any ISDN port can connect to any other. Full inter-connectivity with any other PacketBand-ISDN equipment, PRI or BRI.

- **" Break-Out"** – PacketBand can be connected to the real ISDN network as a "gateway", giving devices connected via the Packet Network access to/from all other ISDN devices in the world.

- **In-Coming Call Routing** – ISDN traffic can be routed based on DDI (MSN), CLI, Sub-address, type of call (voice, fax, video etc.), the port or channel number of an ISDN call or a combination of these fields. Calls can be routed to a specific ISDN port, group of ISDN ports, an individual "B" channel, timeslot or into the Packet Network.

- **Out-Going Call Routing** – ISDN calls are routed to a remote PacketBand over the IP network either by user-configured rules or by using Patapsco's SIP Server.

  Calls can be connected to the correct PacketBand (identified by IP address) based on internal tables which use all or part of the number dialled. If the number is not recognised the call can be routed to a "Gateway" PacketBand with access to the national/international ISDN.

- **Call Conversion** – This feature enables PacketBand to add, edit or remove the digits in any part of a call before it is forwarded.

  An example application might be where emergency numbers may need to be routed to a specific regional office and PacketBand can convert, for example, "112" into the correct regional telephone number for that location. Another example would be where the dialled number needs to be forwarded to a "hidden" destination number.

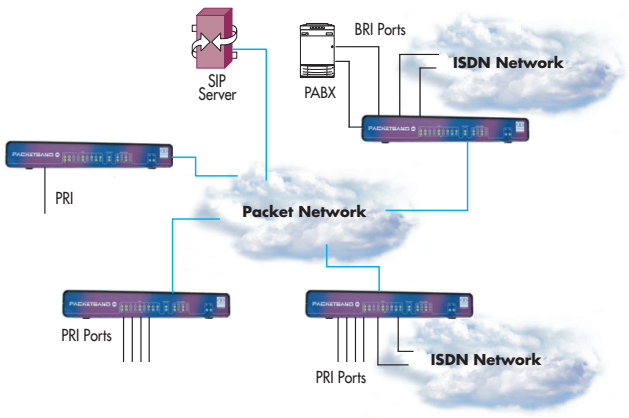
- **Call Barring** – Block calls from certain CLI and/or calls with a certain DDI.

- **Alternate Routes** – PacketBand supports Primary, Secondary and Tertiary routes. Should the primary destination be unavailable, the call will be routed to the Secondary etc. This is not visible to the user.

- **BRI Port Options** – Order 4-wire "S" NT only or switchable NT/TE ports, alternatively 2-wire "U" NT ports. User selectable ETSI/ANSI on a per-port basis with conversion. Tone generation, SPIDs and the ability inhibit particular information elements on a per-port basis is standard. There are advanced options to allow connection to a wide range of ISDN devices supporting specific operating protocols and features.

- **Sip Server** – An optional Patapsco-supplied SIP Server can help with network configuration and routing parameter maintenance in larger systems where attached devices may need to call any or many locations as opposed to routing to a few central sites.

  The SIP Server provides a central repository for all ISDN and IP routing tables, simplifying the requirements in individual PacketBands. Multiple SIP Servers can be configured for systems requiring exceptional resilience.



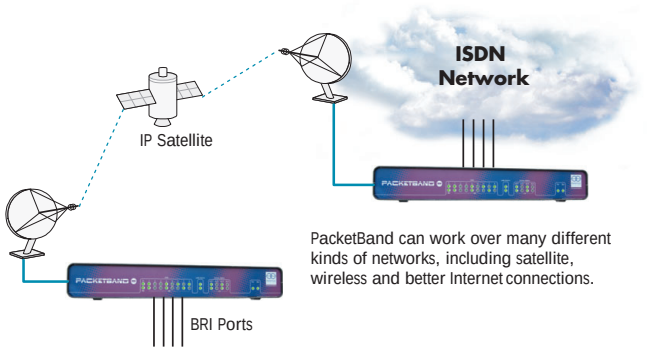
3. Clocking

- **Adjustable Clock Recovery** – PacketBand's clock recovery is very accurate and based on a number of software algorithms. Customizable options enable optimum clock recovery across the network.

- **Clock Sourcing** – Dynamic negotiation between PacketBands to select the best clock source available. See separate document.

- **" Hold-Over"** – When calls are established PacketBand stores the accurate recovered clock in a sophisticated PLL (Phase Locked Loop). This "stored" clock is used as the reference when no calls are connected to the PacketBand (unless it has an ISDN network port connected which provides clock), still delivering an accurate clock to attached devices.

- **Clock Accuracy** – Typically 40-250ppb (parts per billion).



4. Transparency

Data 'B' channels are passed transparently under all circumstances so any type of traffic can be carried.

Signalling channels are capable of being converted between BRI and PRI and between different types/formats of BRI and PRI and this means the signalling "D" channel is not completely transparent end-to-end as different protocols support different capabilities.

The PacketBand-ISDN-4 offers a completely transparent mode for "D" channels when connecting between dedicated BRI ports, both 4-wire to 4-wire and 4-wire to 2-wire, as shown in the diagram below.

5. Packet Network Features

- **Selectable Protocol** – Choose from Pseudo-wire over IP or Pseudo-wire over IP including UDP/RTP.
- **Frames Per Packet** – User-selectable size of packets to optimise performance.
- **VLAN** – Configure a VLAN by adding tags to packets on a per Logical Link basis. Management can have a separate tag.
- **Packet Prioritisation** – Set priorities for the handling of packets based on port, Diff Serv/ToS codepoint value or 802.1p value. Supports 4 egress queues for prioritisation.
- **Rate Limiting** – Limit packet rates from/to any Ethernet port by port or priority.
- **NAT Traversal** – Set a Public IP Address to allow NAT traversal.
- **Sniffer Port** – Configure a spare Ethernet port to receive RX and/or TX packets mirrored from any/all other PKT Port(s). This allows for connection of another device to monitor Packet traffic.
- **Auto Negotiation** – Configure PacketBand to Auto-Negotiate speed and duplex settings, or force the unit to use Full/Half Duplex and 10/100M/1GE.

Auto-MDIX – Automatically caters for crossed cable requirements on all Ethernet ports.

6. Management etc

- **Clock Recovery and Accuracy**

The accuracy and stability of recovered clocks across the Packet Network is the key to this application. PacketBand employs intelligent algorithms to look at trends/hysteresis, the receipt of special "timing packets" from its partner PacketBand as well as the use of the jitter buffer.

Additionally, a sophisticated and dynamic method of dynamically sourcing the best available clock reference is employed.

The overall outcome is all PacketBands are, in effect, locked to common clocks, meaning any device can communicate with any other, and communicating via gateways into/out of the real ISDN can be performed error-free.

- **End-to-End Delays**

The total end-to-end delay between two DTEs using PacketBand is made up of three elements; the delay to data when building a packet prior to shipping over the IP network ; necessary buffering to handle "jitter" within the network (the difference in transit time for a fast packet and a slow one); and the actual delay across the managed IP network. These are described below.

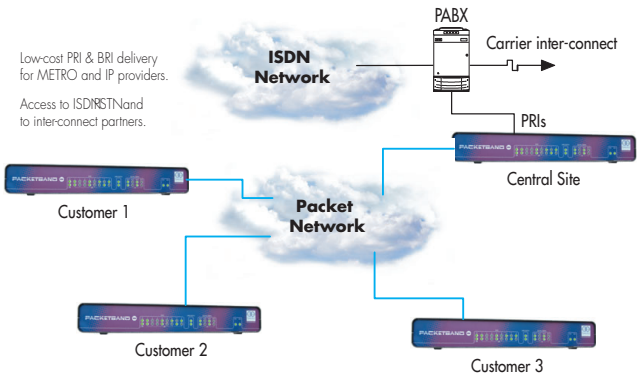
1. Configurable Packet Sizes - An IP packet has a fixed overhead so the larger the data element of a packet, the smaller the overhead but the longer the user traffic is delayed waiting for sufficient data to form the packet. The size of packets is user-configurable. This delay is typically in the 0.5-4msecs range

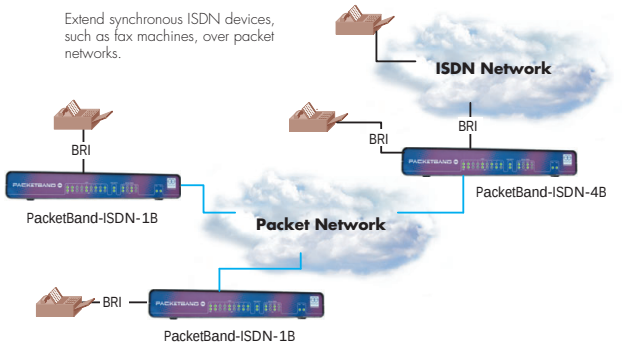
2. Jitter - IP networks differ in how consistently packets traverse the cloud. Some packets take less time than others. PacketBand provides a synchronous clocked circuit to the DTEs and therefore has to have data available with the steady clock pulse.

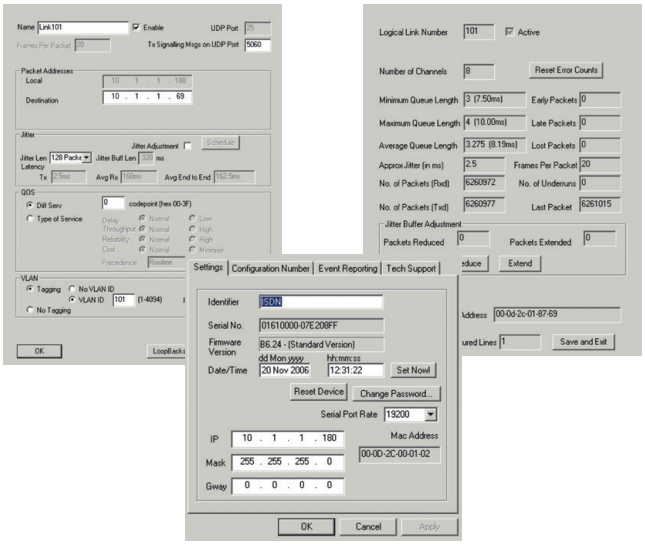
PacketBand buffers the fastest arriving packets so as to make sure the slow ones have the necessary time to arrive. The amount of buffering is user-configurable and will depend upon the performance of the IP network. Note this is only required on the receiving side of the data path from the IP network. See also below.

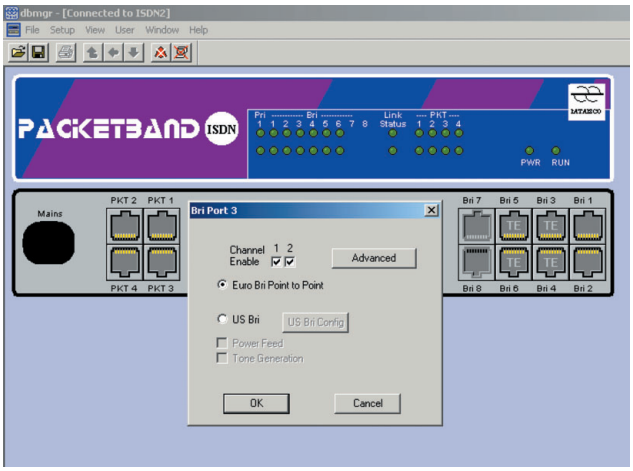
3. Transit Delay - All IP networks have a different average transit delay. This varies depending upon the number of "hops" and if satellites are involved. Typically domestic links are very fast, intercontinental, long distance or multi-hop links have longer latency, and a satellite links can be considerably longer adding up to 250msecs per "hop". Please consult your network supplier.

Summary: between any pair of PacketBands the most significant element contributing to latency is the size of the Jitter Buffer (user configurable) and this varies as a direct result of the performance of the network.









- **Overhead**

The ISDN B-channel frames are encapsulated into IP packets for transmission on the packet network. These packets have various headers to support the packet network protocols. Therefore there is always some overhead in addition to the ISDN bandwidth in transporting this data over the packet network.

Overhead can be minimised by maximising the ISDN payload content of each packet either by increasing the number of "B" channels and/or increasing the number of ISDN frames in each packet.

PacketBand's flexible configuration and automated link allocation allow the bandwidth to be minimised to suit the user's requirements. A detailed spreadsheet is available from Patapsco and Transition Networks showing bandwidth requirements and overhead sizes on the packet network.

- **Jitter**

"Jitter" or Packet Delay Variation (PDV) is the difference in time that the fastest and slowest packets take to transit over the IP network. To take an example, the fastest packets could take 10msecs and the slowest 30msecs, giving a "jitter" of 20msecs.

PacketBand can compensate for different amounts of jitter depending upon configuration. This can be up to 400msecs depending on configuration…

Packets that arrive outside the jitter buffer's capacity (late/early packets) cannot be included in the re-assembled data stream. In this case PacketBand can re-transmit the last byte sent or a fixed user configurable patter.

PacketBand has the ability to automatically adjust the Jitter Buffer periodically to match network requirements. A manual feature for minimising the latency of the Jitter Buffer is also available and this is particularly useful at installation time.

7. Management

- Management via serial port in the PacketBand, ISDN call or via the Packet Network.
- Patapsco's DbManager LITE is shipped free of charge with each product.
- There are chargeable versions of DbManager available which support multiple PacketBands and multiple simultaneous workstations.
- Optional automatic event reporting to DbManager.
- SNMP Traps & Alarms option.
- Intuitive GUI for fast and easy configuration.
- Each PacketBand has a battery-backed real-time clock for time-stamping all events.
- Each PacketBand has dual FLASH banks where new software is loaded to the off-line sector (with CRC). Software banks can be switched at any time.
- Low-level ISDN Layer 2/3 trace facility.
- Set remote or local loop backs for test purposes.
- Monitor the status of links between PacketBand devices via DB Manager. View detailed information on sent and received packets, lost/late packets and jitter buffer usage. Graphical presentation of some of the above.

  Generate alarems/Events for port/interface/device failures, excessive packet losses, out of spec clock recovery, configuration changes etc.
- Ping/Trace Route functions to determine latency between PacketBands and the number of hops (routers) on the journey. Ping facility towards the attached CPE.
- DCO/Jitter Capture – Capture information on the DCO (Derived Clock Offset) and amount of Jitter on a network and display this information in graph format via DB Manager.
- Various other configuration and diagnostic tools.

Technical Specifications:

BRI Interfaces
Support for 4 BRIs – order as 4-wire "S" or 2-wire "U":

4-wire "S" interfaces
Switchable NT/TE in pairs of ports.
Crossed cable required for TE mode (can be supplied by TN)
Typical driving distance – 500m (depending on attached devices).
Order Phantom Power option if required – factory fit.
Support for α-Law to μ-Law conversion and α-Law and μ-Law tones (ring/busy etc)
Overlap to En-Bloc conversion
Support for Dual TEIs
ETSI (Euro-ISDN) ANSI (US-ISDN)
Point-to-Point and Point-to-Multipoint
ETSI-DSS1 (Euro-ISDN)
ETSI Q.931/921
ETSI 300-011 (Layer 1)
ETSI 300-125 (layer 2)
ETSI 300-102 (layer 3)*
Support for SPIDs and Auto-SPID
NI-1 North American National
DMS-100 and 5ESS switch variants
AT&T TR-62411 and ANSI T1.403

2-wire "U" interfaces
Available as NT (User) only
Typical driving distance – 500m
ETSI (Euro-ISDN) ANSI (US-ISDN)
Support for SPIDs and Auto-SPID
NI-1 North American National
DMS-100 and 5ESS switch variants
AT&T TR-62411 and ANSI T1.403

PRI Interface
E1
RJ45 120Ohm balanced
G.703 HDB3 encoded ESF or D4 framing
ETSI-DSS1 (Euro-ISDN)
ETSI Q.931/921
ETSI 300-011 (Layer 1)
ETSI 300-125 (layer 2)
ETSI 300-102 (layer 3)
Selectable CRC4 or non-CRC4 Framing

T1
RJ45 100Ohm balanced
B8Zs or AMI line coding
NI-2 North American National
DMS-100 and 5ESS switch variants
AT&T TR-62411 and ANSI T1.403

Special Hong Kong variant available

Fiber Port (x1)
Standard SFP cage
Driving distance dependant upon SFP fitted
Supports data rates up to 1GE full-duplex between two units

Packet Ports (x2)
RJ45 standard twisted-pair CAT5E cable
Supports data rates up to 1GE full-duplex between two units
Provides management access to all units.

Serial Control Port
Local management
Access password protected
Asynchronous, 8 data, 1 stop bit, no parity, speed 19.2 to 115kbps

Power
(1) Internal AC PSU
Standard IEC connector
95-264 VAC; 15W; 47-63Hz
Auto-sensing
Max consumption 0.1Amps RMS @230VAC (without Phantom Power)
Max consumption 0.2Amps RMS @230VAC (with Phantom Power)

(2) Optional internal DC PSU (alt to AC)
Screw terminals
24 to 72VDC
Meets ETS300-132-2
Max consumption typically 0.35Amps @ nominal 48VDC Input.

Mechanical & Environmental
Metal chassis 292w x 200d x 44h mm-1U
Weight 1.1Kg
Optional 19" rack-mount kits
Temperature -20 to 55 deg C
Humidity 10-90% non-condensing

Maintenance
No user-serviceable parts

Ordering Information

Hardware

Quad BRI port unit 4-wire "S" interface NT side only. Internal AC PSU	PB-ISDN-4B-B-NT
Quad BRI port unit 4-wire "S" switchable TE/NT in blocks of 2 ports	PB-ISDN-4B-B-SW

Hardware Options

Addition of PRI port E1/T1 switchable NT/TE	PB-ISDN-4B-PRI
1 x GIGE SFP port for fibre connectivity.	PB-ISDN-4B-B-SFP
Phantom Power on 4-port unit for NT ports.	PB-ISDN-4B-B-PP
Module to convert 2 ports of 4-wire to 2-wire BRI NT protocol only.	PB-ISDN-4B-2U
DC PSU option (replaces internal AC)	PB-ISDN-B-DC
Rack Mount Kit	PB/RMK/2

PacketBand-ISDN Model Comparison Chart

	ISDN-1B	ISDN-4B	ISDN-1P	ISDN-4P
Number of BRI	1	4	-	-
Possible Number "S" TE* BRI Ports	1	0/2/4	-	-
Possible Number "S" NT* BRI Ports	-	0/2/4	-	-
Possible Number of "U"** BRI Ports	-	0/2/4	-	-
Number of PRI	-	-	1	4
Possible Number TE* PRI Ports	-	-	-	1.5/2/3/4
Possible Number NT* PRI Ports	-	-	-	1.5/2/3/4
Max Number Logical Links	2	8	32	64
ANSI (US) BRI Signalling - Nat-1, DMS, 5ESS	✔	✔	-	–
ANSI (US) PRI Signalling - Nat-2, DMS, 5ESS	-	-	✔	✔
ETSI (Euro) BRI or PRI versions	✔	✔	✔	✔
ANSI to ETSI Conversion	x	✔	✔	✔
Maximum Call Rate (Calls/Sec)	2.5	2.5	2.5	2.5
Point-to-Point or Multi-Point BRI	✔	✔	-	-
Dual SPIDs	✔	✔	-	-
Local Tone Generation	x	✔	✔	✔
A-Law to µ-Law Conversion	x	✔	✔	✔
Transparent "B" channels	✔	✔	✔	✔
Transparent "D" channels	x	✔	x	x
Clock Recovery/Synchronisation	✔	✔	✔	✔
Number Conversion/Translation	✔	✔	✔	✔
Power-Failure Relay between pairs of PRIs NT/TE	-	-	-	✔
VLAN Handling	✔	✔	✔	✔
QoS	✔	✔	✔	✔
TCXO Oscillator fitted as standard	✔	✔	✔	✔
Enhanced TCXO Option	✔	✔	✔	✔
Compatible with SIP Server Option	✔	✔	✔	✔
Number of local Ethernet Ports	2	3***	3***	3
Local Ethernet Port "Rate-Limiting"	✔	✔	✔	✔
On-Board Event Log	✔	✔	✔	✔
AC Supply	✔	✔	✔	✔
Optional DC Supply	✔	✔	✔	✔
Optional POE	✔	x	x	x
Optional Phantom Power	x	✔	x	x
Network Stats & Graphs	✔	✔	✔	✔
Free DbLite	✔	✔	✔	✔
Dbmanager Options	✔	✔	✔	✔

* 4 wire "S" "TE" ports look like a carrier-delivered interface and usually connect to user devices; NT looks like a user interface and normally would connect to an ISDN network.
**2 Wire "U" "NT" interfaces look like a user interface and normally would connect to an ISDN network.
*** When using optional SFP port (2 ports otherwise)