PacketBand®-ISDN-1B

Technical Overview

Deliver switched, transparent, synchronous, ISDN data services across asynchronous packet networks.

(For 4 and 8 port BRI unit see the PacketBand-ISDN-B)

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

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

Main Features:

- Product version supports a single ISDN BRI
- Provides low-cost migration to IP networks for legacy equipment
- Low-cost solution for carriers wanting to deliver ISDN services
- US-ANSI and Euro-ETSI ISDN available
- Transmits all data and voice protocols over packet networks
- Totally transparent to all data formats
- Any "B" channel can dial any other on the packet network, or "break-out/in" via a "gateway" PacketBand to national/international ISDN
- All PacketBands and interfaces synchronised to the same clocks
- Internal AC, DC and POE power options
- SIP Server option for centralised call routing
- Various clocking options with high quality clock recovery
- Configurable packet size
- Compensates for "jitter" or packet delay variation
- Re-orders packets
- Very low latency or processing delay
- Two 10/100 Base Ethernet ports; one to WAN (Packet Network) and one to a local Ethernet port
- Ethernet ports support Rate Limiting
- Quality of Service (QoS) options
- VLAN and Double VLAN tagging
- Full cross-connectivity
- Supports NT presentation (connects to local equipment and acts like a network)
- Support for contention or over-booking
- Call Progress Tone generation
- Sophisticated number manipulation/conversion/LCR
- Automatic Primary/Secondary/Tertiary routing options
- 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
- Attractive pricing
- Compact table-top with optional rack-mount extenders
- Approved (Telecoms, Emissions, Safety)
- RoHS compliant

Applications:

In its simplest form, PacketBand can be used to extend a BRI service across a packet network, maintaining synchronisation between the two units as illustrated in diagram 1.

Diagram 1

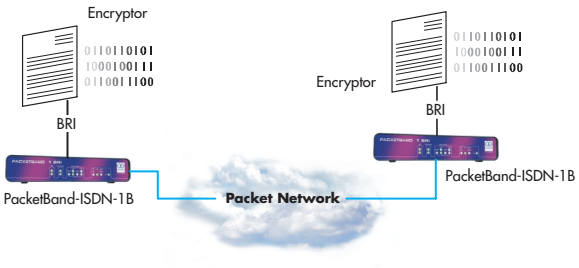
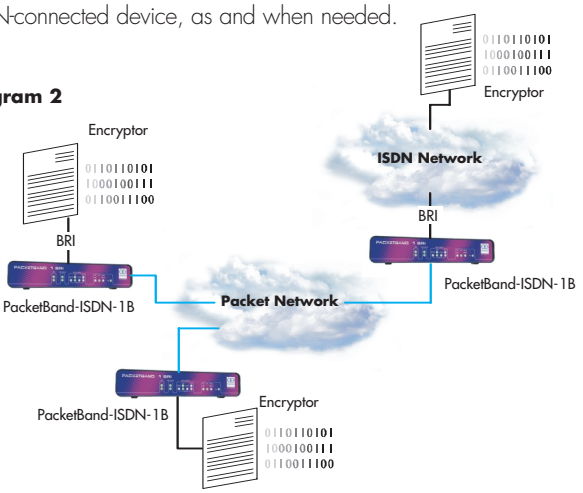


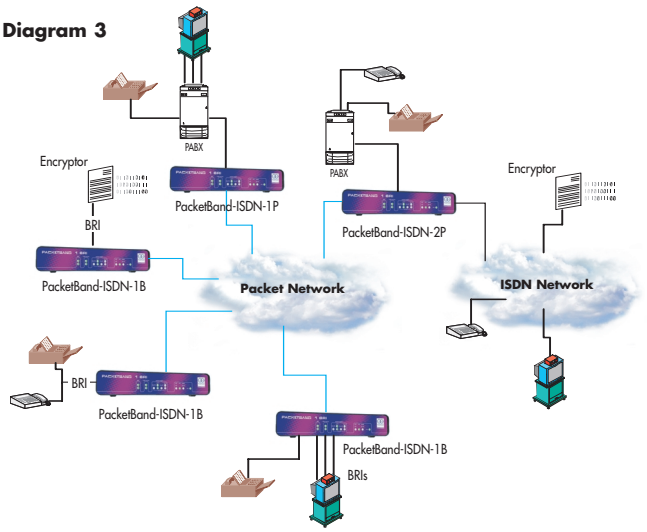
Diagram 2 shows the possibility of extending a BRI network service from a carrier across a network where the carrier's clock is recovered at the remote end, once again, maintaining synch. In this illustration, the two encryptors connected to the packet network can inter-communicate, or share the ISDN to establish a link with the remote ISDN-connected device, as and when needed.

Diagram 2



In larger networks, as shown in Diagram 3, inter-working with other versions of the PacketBand range gives many configuration opportunities. As all PacketBands have the ability to place calls dynamically, a PRI PacketBand could be communicating with up to 30 remote PacketBands on a single PRI.

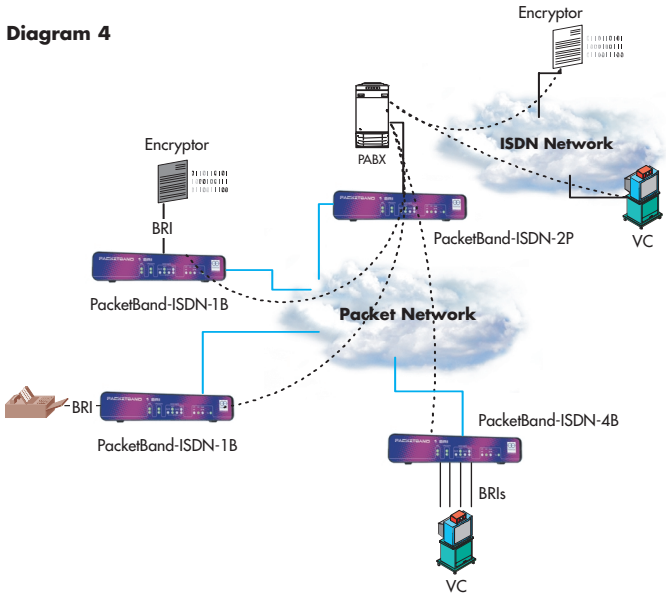
Diagram 3



In the diagram 3 below, any PacketBand can establish calls between any other, giving complete inter-connectivity for attached devices within the packet network, or "breaking in/out to or from the PSTN.

Alternatively, some applications or carriers want all calls to be routed to one or more central switches/PABXs. This switch then either returns the call back to a PacketBand on the packet network, or passes it to the PSTN or inter-connect partners as in Diagram 4.

Diagram 4



As calls are established dynamically, there are options for contention. Additionally, PacketBand's number translation capabilities means they can perform many kinds of manipulations, for example adding CLIs (perhaps for billing purposes), converting numbers (for emergency calls or for security reasons) or performing least-cost-routing functions.

Routing and Features:

- Type of User Traffic – Any. PacketBand passes all "B" channel traffic transparently in a clock-locked or synchronous environment. All PacketBands in the network are synchronised to a common clock.
- Connectivity – Full inter-connectivity with any other PacketBand-ISDN equipment, PRI or BRI. Full inter-connectivity with any other devices connected to the global ISDN/PSTN via a PacketBand IP/ISDN gateway (see below)
- "Break-Out" – PacketBand can be connected to the real ISDN network via a "gateway", giving devices connected to the Packet Network access to/from all other ISDN devices in the world.
- Logical Links – A "Logical Link" is a connection between any two PacketBands, irrespective of the number of "B" channels within the Link. Each PacketBand-ISDN-1B comes supplied with one Logical Link as standard. A second Logical Link can be purchased if required, giving the ability for each "B" channel to communicate to different devices.
- In-Coming Call Routing – ISDN traffic can be routed based on DDI (MSN), CLI, Sub-address, type of call (voice, fax, video etc.), or a combination of these fields. Calls can be routed to either of the "B" channels or one specifically.

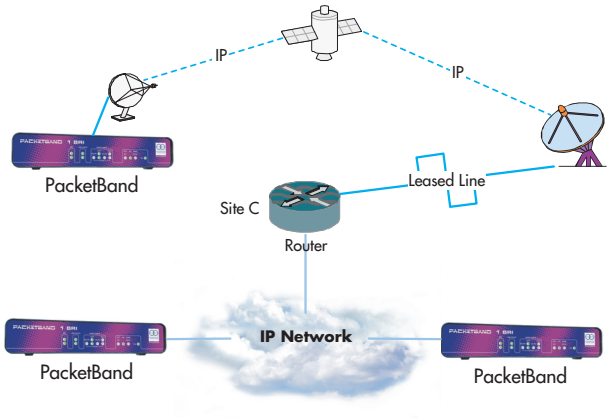
- **Out-Going Call Routing** – ISDN calls are routed to a remote PacketBand over the IP network either by user-configured rules or by using Patapsco's SIP Server.
  - Calls can be converted to the correct PacketBand (identified by IP address) based on internal tables which use all or part of the number dialled. If the number is not recognised the call can be routed to a "Gateway" PacketBand with access to the national/international ISDN.
  - For larger networks where there is a lot of inter-connectivity between different PacketBands, Patapsco's SIP Server provides a centralised IP/ISDN number repository. More information is available in a separate document.
- Call Conversion – This feature enables PacketBand to add, edit or remove the digits in any part of a call before it is forwarded on. 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.

  PacketBand can also add/manipulate CLIs which can be particularly useful for billing purposes.
- 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.
- BRI Port Options – User-selectable ETSI/ANSI. Tone generation, SPIDs and the ability inhibit particular information elements on a per-port basis is also standard. There are advanced options to allow connection to a wide range of ISDN devices supporting specific operating protocols and features.

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** – Pre-configured or, in a larger more dynamic network, an automatic negotiation protocol 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 is used as the clock reference when no calls are connected to the PacketBand (unless it has an ISDN port connected which provides clock), still delivering an accurate clock to attached devices.
- **Clock Accuracy** – Typically 40-250ppb (parts per billion) depending upon the network.

PacketBand can also be used in a variety of IP satellite configurations, this being just one example.PacketBand has a wide variety of uses and possible network configurations.



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.
- QOS – Configure QOS settings for each PacketBand unit, TOS and Diff Serv.
- Packet Prioritisation – Set priorities for the handling of packets based on port, Diff Serv codepoint value or 802.1p value.
- Rate Limiting – Limit packet rates from/to any Ethernet port by port or priority.
- Sniffer Port – Configure the spare Ethernet port to receive RX and/or TX packets mirrored from the network port for de-bug and analysis..
- Auto Negotiation – Configure PacketBand to Auto-Negotiate Speed and Duplex settings, or force the unit to use Full/Half Duplex and 10/100M.
- Oscillator Modules – Select between 2 different Stratum 3 oscillators for enhanced clocking across a packet network.

Performance:

- 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 always sourcing the best available clock reference is employed.

The overall effect is that all PacketBands are, in effect, locked to common clocks. This means any device can communicate with any other, and communicating via gateways into/out of the real clocked 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 four elements; the processing delay of the PacketBand

to perform the roles it undertakes, the delay to data when building and buffering a packet prior to shipping over the IP network and the opposite at the receive end, 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. Processing delay - The latency or processing delay through each PacketBand is optimised to be as low as possible. Typical processing delay is less than 1msec.
2. Configurable Packet Sizes - An IP packet has a fixed amount of overhead so the larger the data element of a packet, the smaller the overhead but the longer the user traffic is delayed whilst a packet is formed for transmission. The size of packets is user-configurable. This delay is typically in the 0.5-4msecs range
3. Jitter - IP networks differ in how consistently packets pass through (see description below). 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 fast packets so as to make sure the slow ones arrive in time. The amount of buffering is user-configurable and will depend upon the performance of the IP network. Note that this is only required on the PacketBand receiving data from the IP network.
4. Transit Delay - All IP networks have different average transit delay these vary depending upon the number of "hops" and if satellites are involved. Typically domestic links are very fast, inter-continental around 60msec and a satellite can add up to 250msecs. Please consult your network supplier.

Summary: between any pair of PacketBands on a terrestrial network, 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. There is therefore always some overhead over and above 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.

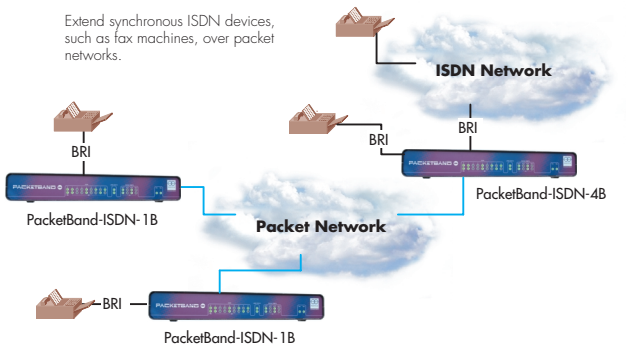
PacketBand's flexible configuration and automated link allocation allow the bandwidth to be minimised to suit the user's requirements. A detailed spreadsheet is available from Patapsco showing bandwidth requirements and overhead sizes on the packet network, but typically the overhead per Logical Link (so for any number of "B" channels) is between 30kbps and 60kbps

- **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. The PacketBands can compensate for different amounts of jitter depending upon configuration. This can be up to 1 second but more typically up to 250msecs without data loss.

Should the Jitter Buffer be exceeded, perhaps because of network failure, PacketBand can send various data patterns/options but the end-to-end connection recovers as soon as service is restored.

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.



Management etc:

- Management via serial port in the PacketBand, an ISDN call or via the Packet Network.
- Dry contact Alarm Relay available for use.
- 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.
- The PacketBand-1B 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 with ability to save to a file.
- Set remote or local loop backs for test purposes.
- Monitor the status of links between PacketBand devices via DbManager. View detailed information on sent and received packets, lost/late packets and jitter buffer usage. Graphical presentation of some of the above.
- Ping/Trace Route functions to determine latency between PacketBands and the number of hops (routers) on the journey.
- 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.

PacketBand®-ISDN-1B
Technical Overview

Technical Specifications:

BRI Interface

Support for one BRI
Typical driving distance – typically 500m
Overlap to En-Bloc conversion

ETSI (Euro-ISDN)

RJ45 120Ohm balanced
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)*

Packet Ports (x2)

RJ45 standard twisted-pair CAT5E cable
Typical driving distance 500m–1,500m per Link depending on data rate and cable
Supports data rates up to 50Mbps full-duplex between two units
Provides management access to all units with Ethernet card in PC

Serial Control Port

Access password protected
Asynchronous, 8 data, 1 stop bit, no parity
speed 9.6 to 115kbps

Approvals

All approvals completed in UK
Accredited laboratory - reports available

EMC

EN55022:1988
EN55024:1988
EN61000-3-2/3:1995
AS/NZS CISPR22:2000

Safety

IEC60950-1:2002 including National differences
AS/NZS3260:1993
ACS/NZS60950:2000
ACA TS001:1997

RoHS Compliant

Maintenance

No user-serviceable parts
Battery for Real-Time Clock and NV
RAM elements has a typical 10-year life
No maintenance required

NT presentation - uses straight cables
Support for Dual TEIs
Support a-Law and μ-Law tones (ring/busy etc)

ANSI (US-ISDN)

RJ45 100Ohm balanced
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

Power

(1) **Internal AC PSU**
Standard IEC connector
95-240 VAC; 15W; 47-63Hz
Auto-sensing
Standard IEC connector
Max consumption
0.2Amps RMS @230VAC

(2) **Optional Internal Telecoms DC Supply**
Ring terminals
37-67VDC
Meets ETS300-132-2
Typical consumption 0.35Amps

(3) **Optional 3-way Internal PSU**
1. AC as above
2. DC supply
2.1mm jack
12VDC to 57VDC
Consumption 0.3Amps @48VDC
3. POE (Power Over Ethernet)
Class 0
802.3af Compliant

(4) **Redundant Power**
Available by using two or more of the options in (3) above.
An optional AC to DC supply is available.
Alarms generated

Mechanical & Environmental

Metal chassis 225w x 200d x 44h mm-1U
Weight 0.85Kg
Optional 19" rack-mount kits.
Humidity 10-90% non-condensing

*Not all Supplementary services. Most common are supported but some more unusual ones may not be. Call for specifics.

PacketBand-ISDN Model Comparison Chart

	ISDN-1B	ISDN-4B	ISDN-8B	ISDN-1P	ISDN-2P	ISDN-4P
Number of BRI	1	4	8	-	-	-
Possible Number TE* BRI Ports	1	0/2/4	0/2/4/6/8	-	-	-
Possible Number NT* BRI Ports	-	0/2/4	0/2/4/6/8	-	-	-
Number of PRI	-	-	-	1	2	4
Possible Number TE* PRI Ports	-	-	-	1	1/2	1/2/3/4
Possible Number NT* PRI Ports	-	-	-	1	1/2	1/2/3/4
Max Number Logical Links	2	8	16	32	64	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	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	✔	✔	✔	✔	✔	✔
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	1	3	3	3	3	3
Local Ethernet Port "Rate-Limiting"	✔	✔	✔	✔	✔	✔
On-Board Event Log	✔	✔	✔	✔	✔	✔
AC Supply	✔	✔	✔	✔	✔	✔
Optional DC Supply	✔	✔	✔	✔	✔	✔
Optional POE	✔	x	x	x	x	x
Network Stats & Graphs	✔	✔	✔	✔	✔	✔
Free DbLite	✔	✔	✔	✔	✔	✔
Dbmanager Options	✔	✔	✔	✔	✔	✔

* "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.
** 128 end Q1'07.