The PacketBand-ISDN-B-4 delivers transparent switched ISDN data services across packet networks.

All ports are locked with central, or network clocks, providing a fully synchronous environment across asynchronous networks.

(For single-port BRI unit see the PacketBand-ISDN-1B)  
(For PRI units see the PacketBand-ISDN-P range)  
(For non-switched TDM services see PacketBand-TDM.)
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. 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 importantly can “break-out” into the global ISDN PSTN and access 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 etc.

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

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

This document focuses on the 4 BRI versions of PacketBand.

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 synchronized to a common clock.

- **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.

- **Logical Links** – Each PacketBand-ISDN can be purchased supporting different numbers of Logical Links. Each Logical Link is a connection between any two PacketBands. For example, if there was one “B” channel established between two PacketBands that would be one Logical Link. If a second call is established, from either direction between the same two units, this “B” channel will be incorporated into the same Link to reduce overheads. Logical Links are only assigned when in use so once a connection has been cleared, the Link is available for use to any other PacketBand.

- **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 a 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.

- **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.

- **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** – Order NT, TE ports or a combination. Userselectable 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 also 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 SIP Server can help with network configuration and routing parameter maintenance in larger systems where attached devices may need to call any or many other locations as opposed to routing to a few central sites. The SIP Server gives 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 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).

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4. **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.

- **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.

- **Oscillator Modules** – Select between two different Stratum 3 oscillators to match clocking accuracy requirements across the packet network.

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5. **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 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 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. 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, intercontinental 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.

- **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 either 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.

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6. Management etc

- Management via serial port in the PacketBand, 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.
- Each PacketBand has a battery-backed real-time clock for timestamping 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.
- 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.
Technical Specifications

BRI Interfaces
- Support for 4 or 8 BRIs
- Order NT/TE in pairs of ports. Uses straight cables
- Typical driving distance – 500m
- Support for a-Law to μ-Law conversion
- and a-Law and μ-Law tones (ring/busy etc)
- Overlap to En-Bloc conversion
  Support for Dual TEIs

ETSI (Euro-ISDN)
- RJ45 1200ohm balanced
- Point-to-Point and Point-to-Multipoint
- ETSI-DSS1 (Euro-ISDN)
- ETSI 0.931/921
- ETSI 300-011 (Layer 1)
- ETSI 300-125 (layer 2)
- ETSI 300-102 (layer 3)*
  Approved to TBR3

Packet Ports (x4)
- 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

Approvals
- All approvals completed in UK
- Accredited laboratory - reports available
- Telecoms
- TBR3:1995, 1997 Amendment
- TIA/EIA-958
- CS03 Canada
- EMC
- EN55022:1988
- EN55024:1988
- EN61000-3-2/3:1995
- AS/NZS CISPR22:2000
- Safety
- ACS/NZS60950:2000
- AS/NZS3260:1993
- ACA TS001:1997
- IEC60950-1:2002 including National differences

ANSI (US-ISDN)
- RJ45 1000hm 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

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

Power

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

(2) Optional internal DC PSU (alt to AC)
- Screw terminals
- 37 to 67VDC
- Meets ETS300-132-2
- Max consumption typically 0.35Amps

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

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

RoHS Compliant

*Not all Supplementary services. Most common are supported but some more
usual unusual ones may not be. Call for specifics.
PacketBand-ISDN Model Comparison Chart

<table>
<thead>
<tr>
<th>Feature</th>
<th>ISDN-1B</th>
<th>ISDN-4B</th>
<th>ISDN-1P</th>
<th>ISDN-4P</th>
</tr>
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<td>Number of BRI</td>
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<tr>
<td>Possible Number TE* BRI Ports</td>
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<td>0/2/4</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Possible Number NT* BRI Ports</td>
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<td>0/2/4</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Number of PRI</td>
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<td>4</td>
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<tr>
<td>Possible Number TE* PRI Ports</td>
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<td>1/2/3/4</td>
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<tr>
<td>Possible Number NT* PRI Ports</td>
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<td>-</td>
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<td>1/2/3/4</td>
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<td>Max Number Logical Links</td>
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<td>ETSI (Euro) BRI or PRI versions</td>
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<td>ANSI to ETSI Conversion</td>
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<td>Maximum Call Rate (Calls/Sec)</td>
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<td>Point-to-Point or Multi-Point BRI</td>
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<td>Dual SPIDs</td>
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<td>Local Tone Generation</td>
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<td>Transparent “B” channels</td>
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<tr>
<td>Clock Recovery/Synchronisation</td>
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<td>Number Conversion/Translation</td>
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<td>Power-Failure Relay between pairs of PRIs NT/TE</td>
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<td>VLAN Handling</td>
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<td>QoS</td>
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<td>Optional DC Supply</td>
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<tr>
<td>Optional POE</td>
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</table>

* “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.