# **Patapsco PacketBand-TDM** Clocking Options for CESoIP, pseudowires or TDM over IP circuits

This document provides an overview of the various clocking and clock recovery methods available on Patapsco's PacketBand-TDM range of equipment.

## 1. Overview

The PacketBand-TDM range delivers synchronous E1/T1 circuits over a variety of packet networks.

The PacketBand's clock-recovery processes are very advanced; delivering accurate and stable services complimented by robust recovery systems should the network not perform as expected.

Easy to use and configure, PacketBand also benefits from excellent performance and network statistics as well as network-wide visibility from DbManager.

Three versions of PacketBand-TDM are currently available: TDM-D; TDM-E; and TDM-MC. A 2U chassis-based solution is also available.

Each of the versions have different clocking capabilities, together with a number of enhanced features depending upon the model:

- Adaptive clock recovery
- Loop timing
- Internal clocking
- Distributed clocks
- Multicast clocking
- Plesiochronous clocking
- Asymmetrical clocking

Although not clock related, some versions also support RSTP and LACP.

Each product is identified below.

## 2. TDM-D

The PacketBand-TDM-D is the base version and our most popular model. All other PacketBands support the same functionality as the TDM-D versions plus have additional abilities.

The clocking or clock recovery processes supported by the TDM-D are:

- Adaptive Clocking

Adaptive clocking is where a remote clock source has to be recovered across the packet network.

In many instances one "end" of the circuit will have a PRC (Primary Reference Clock) or other good clock source, but the remote "end" has no available local clock supply. In this case the PacketBand at the central location will source clock from the PRC and the remote PacketBand will recover this clock very accurately across the packet network (see Technical Data Sheets for a more detailed description).

**Diagram 1**

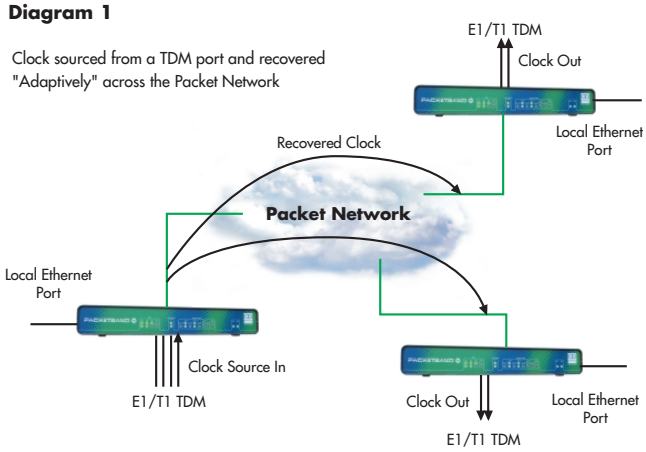



Diagram 1 shows two remote locations recovering their clocks from the centre. PacketBand has different oscillator options (covered in detail in the Technical Data Sheets) for remote units ensuring clock stability matches that required by the application.

On a good quality low latency, jitter, and packet-loss network, the PacketBand exceeds the G.823 Synchronisation Mask.

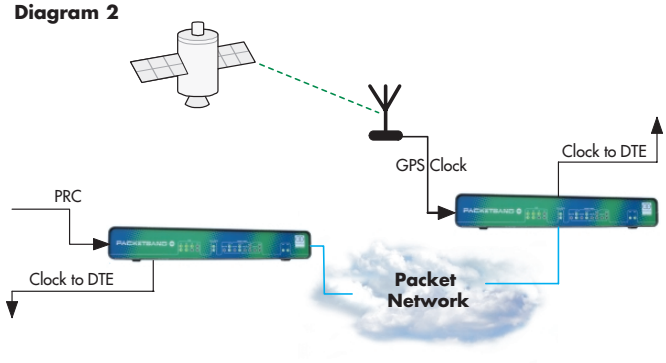
Please note that PacketBand-TDM-4D has (optional) Telecoms Approvals for direct connection to leased lines as well as the more general Safety and Emissions approvals (see Tech Spec). All approvals/testing has been completed in a UK Accredited facility.

PacketBand benefits from a number of user-selectable intelligent algorithms which enable the clock recovery to be "tuned" to the type of network and its particular performance characteristics so the best possible clock recovery can be obtained. This results in both excellent results and the ability for PacketBand to run over networks types that would otherwise present problems/issues.

• Loop-Timing

Very simply, this is where PacketBand has good common clocks at both "ends" of the E1/T1 circuit. The E1 T1 data is transported across the network and clocked out to the DTE using the local clock source.

**Diagram 2**




• Internal

Where a PRC is not available at either end of the E1/T1 link PacketBand will use its own internal clock on one of the devices with the other recovering the clock Adaptively as described above. Similar to diagram 1, but instead of using an external reference clock PacketBand can use its internal source. Different oscillators can be specified to meet accuracy/stability needs, again covered in detail in the Data Sheets.

## 3. Clocking Options TDM-C

- Adaptive (as above)
- Loop-Timing (as above)
- Internal (as above)

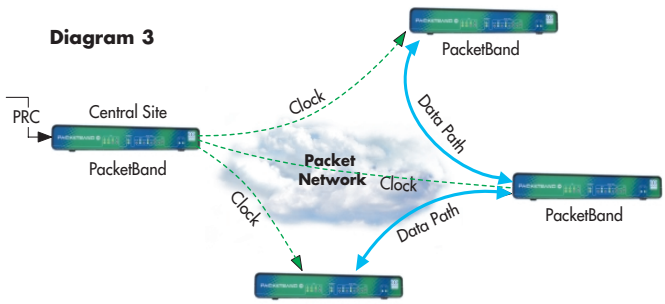
• Distributed Timing

As in the Internal Clocking example given above, there are instances where E1, T1 or X.21/V.35 over IP circuits are needed across a network, but where neither site has a clock source available. But a PRC may exist on the network at another location.

Rather than use an internal oscillator and potentially having all circuits being clocked slightly differently from each other (as each circuit is locked to an individual oscillator in a PacketBand), PacketBand-TDM-MC has the ability to source clocks from central locations without the need to have a physical interface and without having to use internal clocks.

The important advantage is that all circuits, even if they do not have their own clock sources at either end, are all locked and synchronised to one common source.

**Diagram 3**




In Diagram 3 bottem left the three remote units transfer their T1 E1 data circuits as usual, but each unit uses part of on internal E1/T1 to recover clock from the central site. Each remote unit is therefore locked to the central site's PRC, but without a data link.

Each central-site PacketBand can support up to 64 remote units.

Multiple PacketBand central units, perhaps in different locations, can be used by different remote units. It is then be possible to clock one end of an E1/T1 circuit from one PRC and the other end of the circuit from another central PacketBand and PRC. PacketBand's Primary, Secondary and Tertiary clock source configuration parameters means that if one of the central site sources failed the remote PacketBand-TDM-MC could then clock from its partner remote unit which still had clock from the alternate central site.

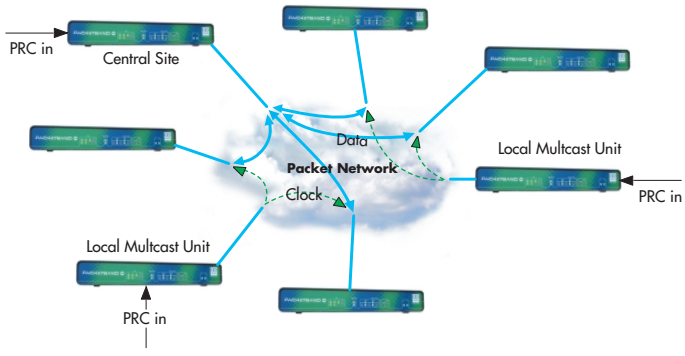
• Multicast

Similar in concept, but an alternative to "Distributed Timing", PacketBand-TDM-MC also supports Multicast Timing. This method is particularly suitable for larger networks with many hops, where clock recovery accuracy is paramount and where there are a number of potential PRCs at different points within the network.

Small low-cost PacketBands feed a single 64kbps timeslot to a multicast switch within the network. Remote TDM-MC units join the Multicast session via (IGMP) and use this clock for their local E1/T1 data circuits.

Long distance data-circuits with many hops and significant jitter can now have a more accurate clock by using a local clock source. PacketBand-TDM-MC can be configured with more than one Multicast destination so can switch should its primary source fail, greatly enhancing resilience.

**Diagram 4**




The Multicast circuits are low capacity and can be kept within a separate VLAN with QoS. Importantly, because the user data circuit is no longer used for clock extraction, it can be configured at a much lower QoS priority than may otherwise have been necessary, with the associated network load and design benefits.

Overall the PacketBand-TDM-MC's Multicast capability has significant advantages in clocking accuracy, flexibility and resilience.

TDM-MC also supports RSTP (Rapid Spanning Tree Protocol) and LACP (Link Aggregation Control Protocol) – see Data Sheets

## 4. TDM-E

- Adaptive (as above)
- Loop-Timing (as above)
- Internal (as above)

- Plesiochronous Timing

This means that the Transmit and Receive directions of a circuit can be separately clocked when in clear G.703 mode. Each E1/T1 can also be separately clocked. The solution is more like that found in a PDH network.

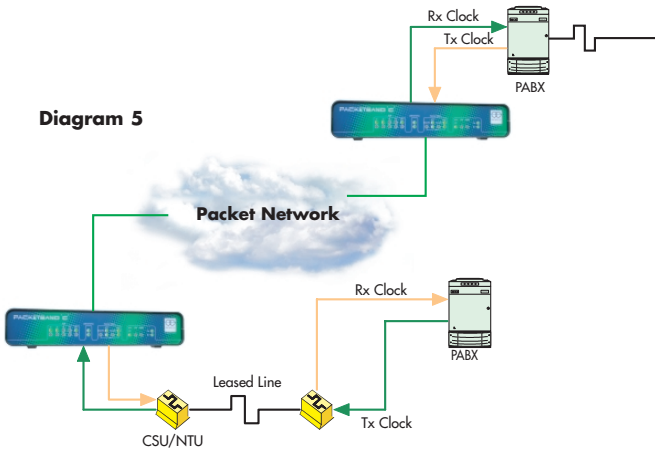



**Diagram 5**

It is ideal for where different clocks are being presented, such as when connections are being made to leased lines or when transporting data from differently clocked devices.

The TDM-E opens a number of unique clocking solutions for those applications where more than one clock is needed.

- Asymmetrical Working

Not strictly a clocking mode, but it does have significant impact on clock recovery in certain applications, such as circuits over wireless or WiMax networks.

E1 and T1 circuits are based around a clock cycle speed of 8KHz and this is also often the core frequency for many transport systems, especially wireless. Running the TDM circuits over the Ethernet/IP network using a 8KHz clock, which is then transmitted across a network based on 8KHz clocks can often cause an interaction between the transport clock and the 8KHz based clock of the E1 architecture. This undesirable condition will cause severe difficulties for accurate clock extraction algorithms as it generates large fixed pattern rhythmic jitter, known as "beating".

The TDM-E's configuration allows the packets to be sized to avoid the 8KHz transmit frequency and therefore not generate the "beating" effect. It has also been identified that running different packet sizes in each direction can further improve throughput and clock recovery.

## Summary

No only does the whole family of PacketBand products have exceptionally advanced clock recovery processes enabling them extract very accurate clocks across a packet network and be very robust, they have a number of unique capabilities to further enhance accuracy, stability and resilience. Contact us to discuss your application and requirements today.

For more information please see the appropriate Data Sheets or contact Patapsco or your supplier.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