



NS-CPRI-100: LTEENB Transceiver

Common Public Radio Interface (CPRI) Module

Features

The NS-CPRI-100, called a Swallow board, is a PCI-Express card that implements a specialized interface between the host computer and the wireless telecom industry-standard CPRI protocol. The board can be used to interface the software-running eNodeB (also known as REC for Radio Equipment Controller) to multiple Radio Heads (also known as RE for Radio Equipment) via fiber link, effectively forming the frontal portion of the Radio Access Network (RAN).

The board's highly flexible design makes it suitable for UMTS (3G), LTE (4G), LTE-A (4G+) and is also ready for 5G New Radio (5G NR) wireless technology standards. It supports both Frequency-Division Duplexing (FDD) and Time-Division Duplexing (TDD) transmission modes.

Using optimized Direct Memory Access (DMA) bus mastering over the PCI subsystem, the board transfers baseband I/Q samples directly from the host computer's memory into the CPRI frames for Downlink direction, and vice-versa for Uplink direction. The board also offers Control and Management (C&M) side-band channels for RE configuration and monitoring, via Ethernet interfaces through the CPRI links.

The board can also optionally synchronize itself on diverse types of external synchronization signals (such as GPS) to provide time and frequency synchronization. This allows minimizing interference between different adjacent cells and RAN nodes, which is almost mandatory when using the TDD mode of operation.

The board features the following components:

- Up to 4 independent master CPRI interfaces via SFP connectors. For each CPRI interface:
 - For type A board: support of up to CPRI line bit rate option 6 (6144 Mbps).
 - For type B, C, and D boards: support of up to CPRI line bit rate option 8 (10137.6 Mbps).
 - Fast C&M side-band channel (Ethernet) for the control plane.
 - Flexible mapping of ACC containers (I/Q data) into the CPRI frames.
 - Automatically detected star or daisy-chain topology configurations.
 - LEDs provide a visual indication of link status.
- Up to 6 independent radio cells, allowing Carrier-Aggregation and/or Multi-Sector applications. For each radio cell:
 - Any sample rate from 3.84 MSPs to 92.16 MSPs, in multiples of 3.84 MSPs. Suitable for:
 - UMTS,
 - LTE channel bandwidths (including oversampled NB-IoT),
 - 5G NR channel bandwidths.
 - Any I/Q component sample width up to 16 bits.
 - Optional I/Q compression (down-sampling and non-linear quantization).
 - Up to 8 Tx and Rx channels (carriers), allowing MIMO 8x8 applications. Each channel:
 - can be enabled independently,
 - can be mapped independently to any ACC container of any CPRI master interface,
 - Provides means of compensating for fiber link and RE internal delays.
- External input synchronization SMA connector with embedded GPS receiver supports either (software selectable):
 - Active GPS antenna, in which case the board synchronizes to the absolute time reference.
 - UMTS 10ms synchronization pulse allows synchronization in adjacent cells.
 - 15.36 MHz reference clock.
- Buffered output synchronization U.FL connector.
 - Forward the signal received on the input SMA connector (except GPS RF signal).
- Output reference connector (software selectable).
- Regenerated UMTS 10ms synchronization pulse.
 - 15.36 MHz reference clock.
- Internal PLL and Stratum-3 compliant crystal oscillator for very low jitter clocks that meet CPRI and LTE requirements.



Mechanical and connectors

The PCI-Express transceiver board (Swallow) is a PCI-Express card with a full-height, half-length form factor. The board's PCB top side and front panel views for hardware type A and type B are shown in [Figure 1](#).

Figure 1: PCB top side and front panel views for type A and type B boards (dimensions in millimetres)

Board hardware types and revisions

The board's hardware type and revision inform the state of the board's physical components and can play a role in the capabilities of the board. There are three hardware types of the board available:

- The type A board, also called SwallowV1 (PRB000058), is the entry-level version and can run CPRI line bit rate up to option 6 (6144 Mbps), using a 4-lanes Gen2 PCI-Express interface.
- The type B board also called SwallowV1.5 (PRB000119), is an upgrade to the type A board. It provides the same functionalities but can run the CPRI line bit rate up to option 8 (10137.6 Mbps).
- The type C board, also called SwallowV2 (PRB000116), is an upgrade to the type B board. It provides more programmable logic resources, can run CPRI line bit rate up to option 8 (10137.6 Mbps), and uses an 8-lanes Gen3 PCI-Express interface (quadrupling the PCI-Express bandwidth over type A and type B boards).
- The type D board, also called Lynx-R (IB), is equivalent to the type C board in terms of capabilities but is integrated inside the Lynx-R product.



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