

# Common Public Radio Interface

CPRI overview

Input requirements for CPRI

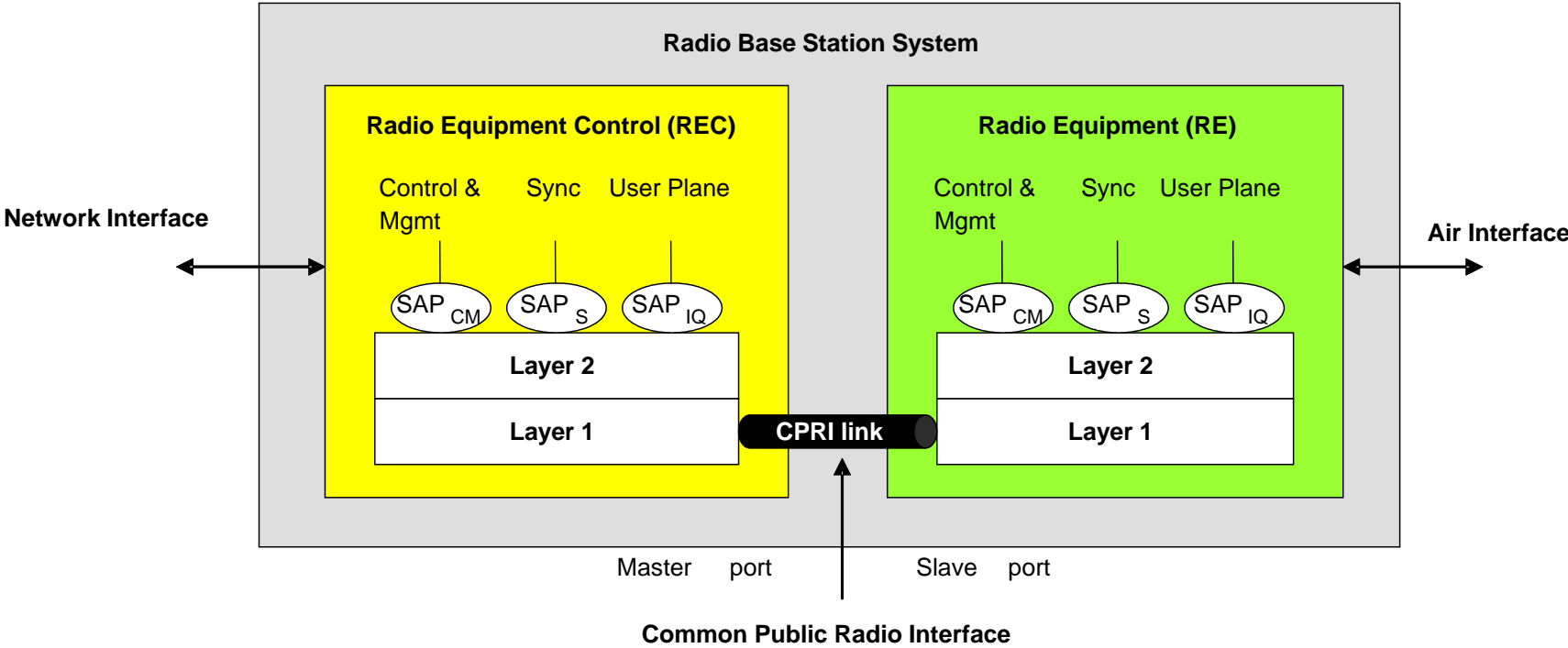
# Some history

- Industrial cooperation jointly created by 5 parties:
  - Ericsson,
  - Huawei,
  - NEC,
  - Nortel Networks,
  - Siemens Mobile
- Provide a framework to facilitate Radio Equipment products development for mobile telecommunications systems
- CPRI specification V1.0 published in 2003

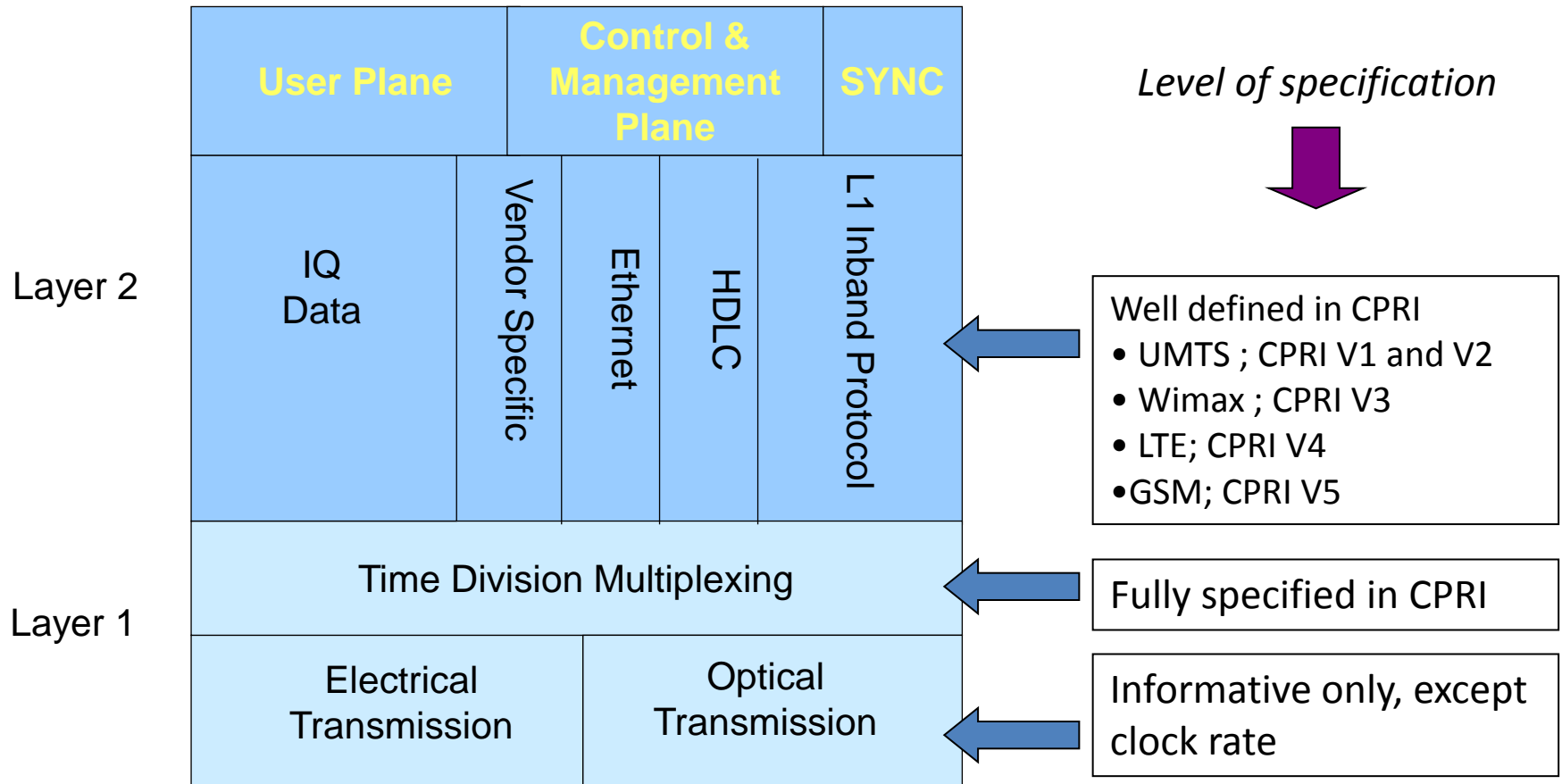
# CPRI Basic System Architecture

- Based on a Radio Base Station architecture dividing the Radio Base Station into a radio part and a control part
- CPRI specification defines the Radio Base Station internal interface between these two parts
- Simple
- Flexible

# CPRI Basic System Architecture



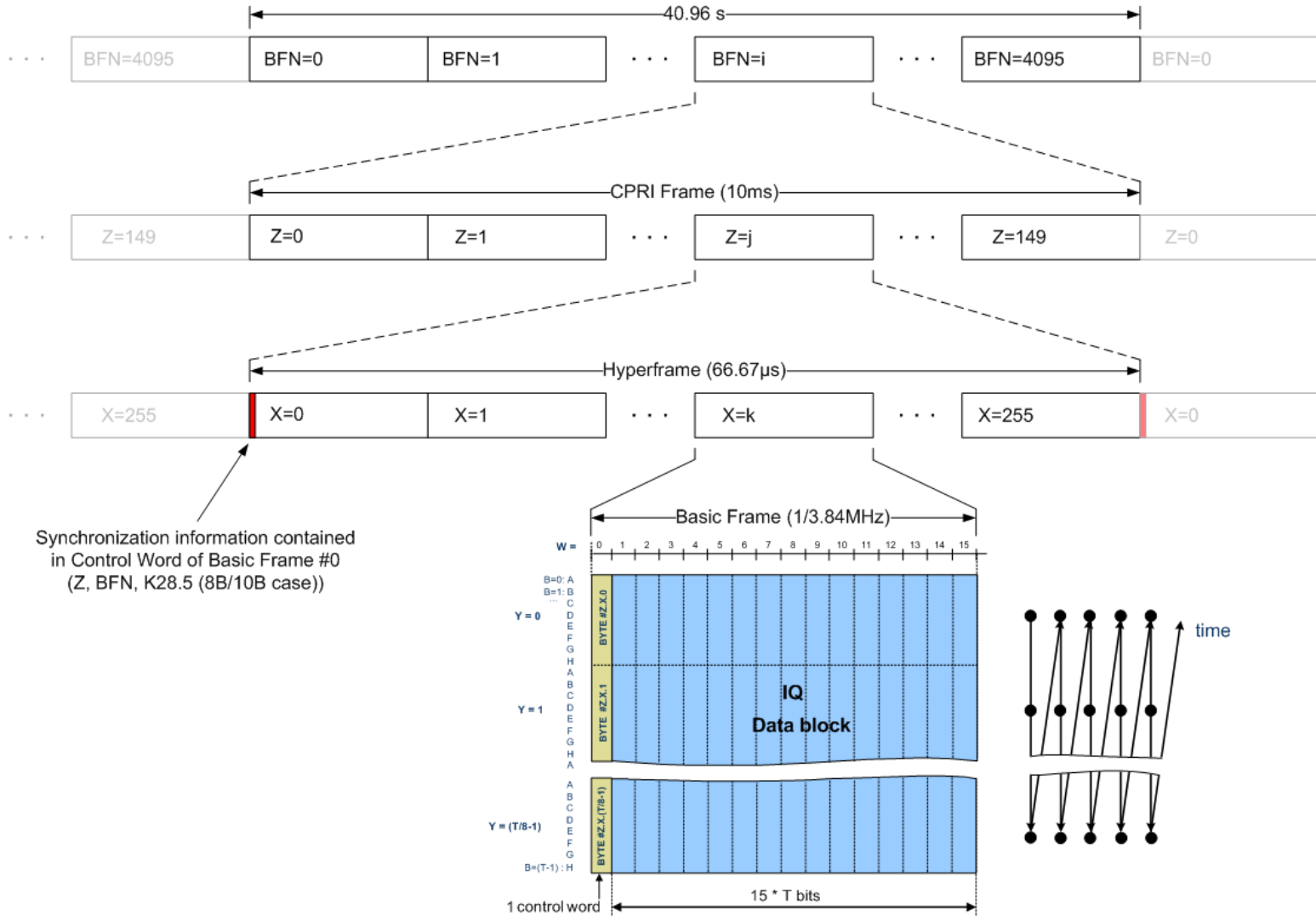
# CPRI Protocol Stack



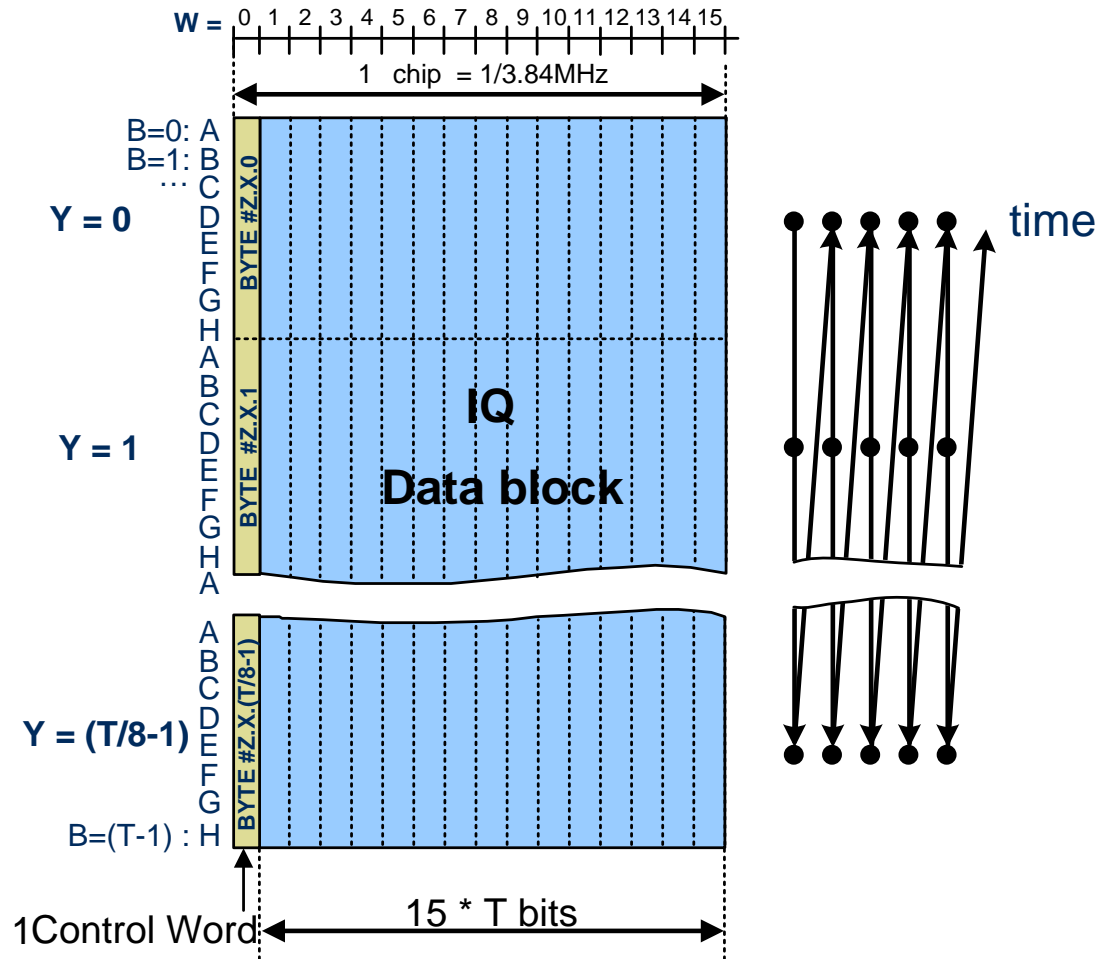
# CPRI Main Characteristics

- Bit synchronous interface
- Symmetrical serial data link between REC and RE
- Steady data stream, "Always on"
- Time Division Multiplexing (TDM) of Antenna data streams in form of In-phase (I) and Quadrature (Q) Samples
- Embedded Ethernet or HDLC streams (C&M plane data)
- BER= $10^{-12}$

# CPRI Frame Structure



# CPRI Basic Frame



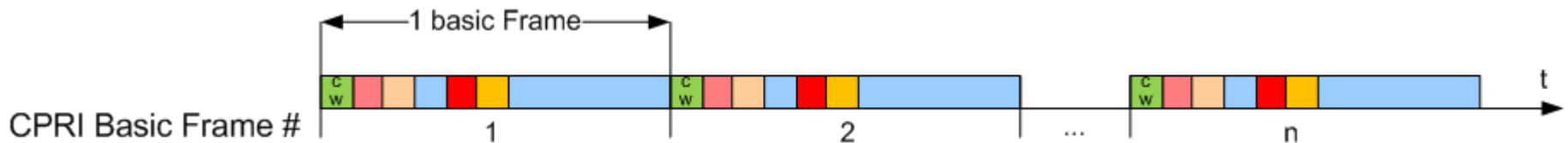
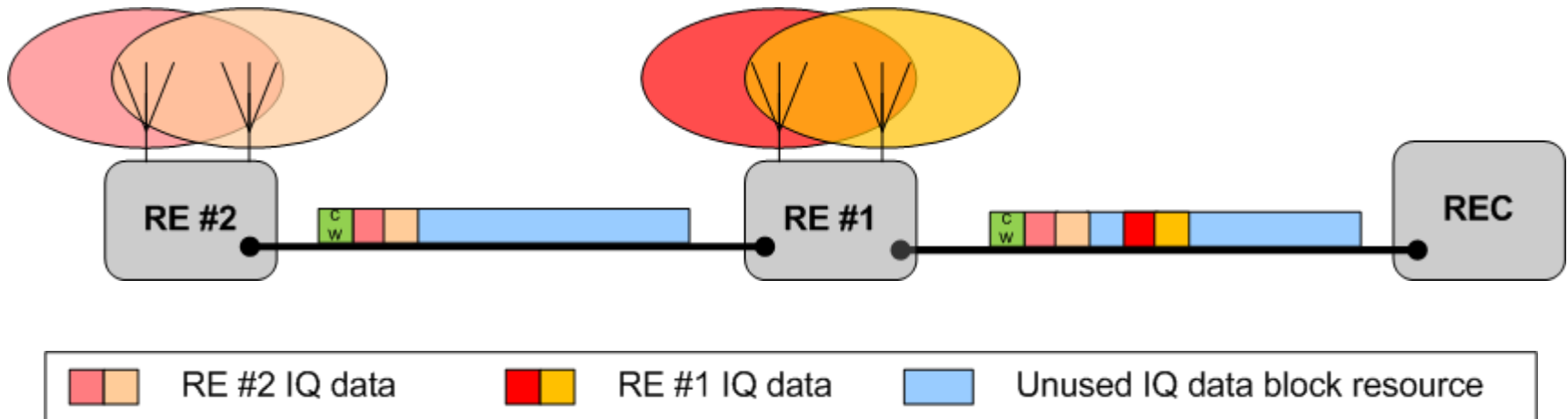


# CPRI Control Word usage

- 1/16 of the available CPRI bandwidth
  - Synchronization and Timing
  - Fast and/or Slow C&M channel
  - Low level link control (LOS/LOF/...)
  - Vendor Specific
  - Fast Real Time Control

# CPRI Transport Capacity allocation

- « static » allocation of the IQ data block resource



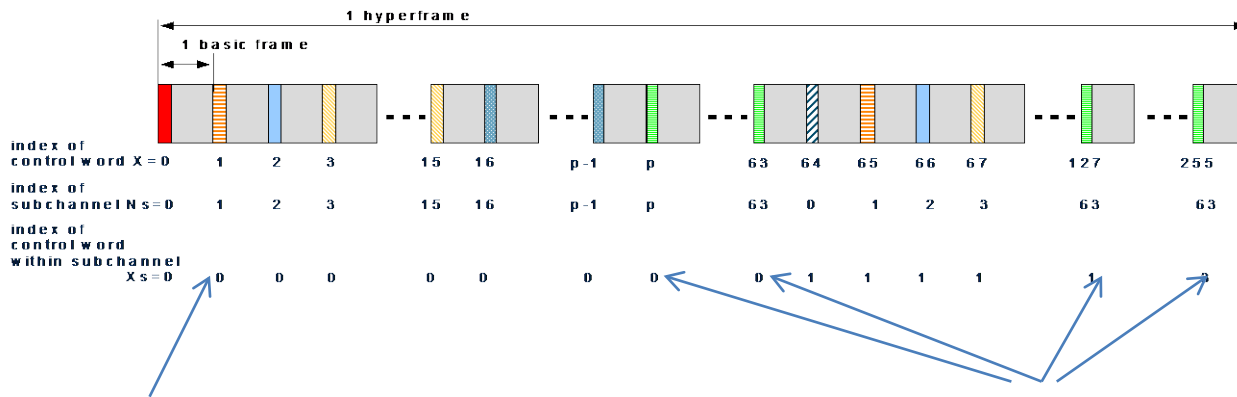
# CPRI Line Bit Rate Options and User-Plane Transport Capacity

| Line bit rate   | Line Coding | Transport Capacity (#WCDMA AxC) | Transport Capacity (# 20 MHz LTE AxC) |
|-----------------|-------------|---------------------------------|---------------------------------------|
| 614.4 Mbit/s    | 8B/10B      | 4                               | --                                    |
| 1228.8 Mbit/s   | 8B/10B      | 8                               | 1                                     |
| 2457.6 Mbit/s   | 8B/10B      | 16                              | 2                                     |
| 3072.0 Mbit/s   | 8B/10B      | 20                              | 2                                     |
| 4915.2 Mbit/s   | 8B/10B      | 32                              | 4                                     |
| 6144.0 Mbit/s   | 8B/10B      | 40                              | 5                                     |
| 8110.08 Mbit/s  | 64B/66B     | 64                              | 8                                     |
| 9830.4 Mbit/s   | 8B/10B      | 64                              | 8                                     |
| 10137.6 Mbit/s  | 64B/66B     | 80                              | 10                                    |
| 12165.12 Mbit/s | 64B/66B     | 96                              | 12                                    |

Each 20MHz LTE AxC stream requires ~1Gbps!

# C&M-Plane Transport

| Line bit rate         | Maximum Slow C&M Bitrate [Mbit/s] | Maximum Fast C&M Bitrate [Mbit/s] |
|-----------------------|-----------------------------------|-----------------------------------|
| 614.4 Mbit/s          | 0.48                              | 21.12                             |
| 1228.8 Mbit/s         | 0.96                              | 42.24                             |
| 2457.6 Mbit/s         | 1.92                              | 84.48                             |
| 3072.0 Mbit/s         | 2.4                               | 105.6                             |
| 4915.2 Mbit/s         | 3.84                              | 168.96                            |
| 6144.0 Mbit/s         | 4.8                               | 211.2                             |
| $\geq 8110.08$ Mbit/s | 7.68                              | 337.92                            |



**CPRI Slow C&M** channel transported in CW of second CPRI basic frame of each Hyperframe

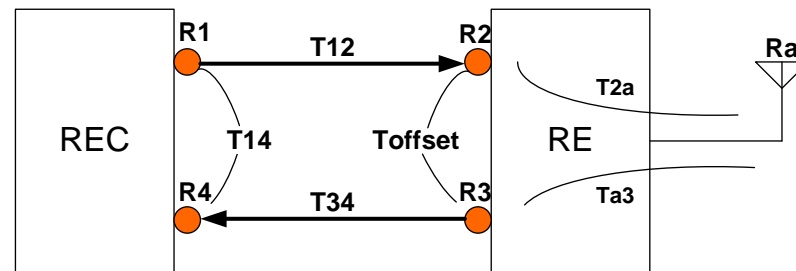
**CPRI fast C&M** channel transported in CWs of Basic frame with number p, p+1,...,63,64+p...127, 128+p...191, p+192,...,255 (p-pointer configurable from 16 ... 63)

# Synchronization and Timing

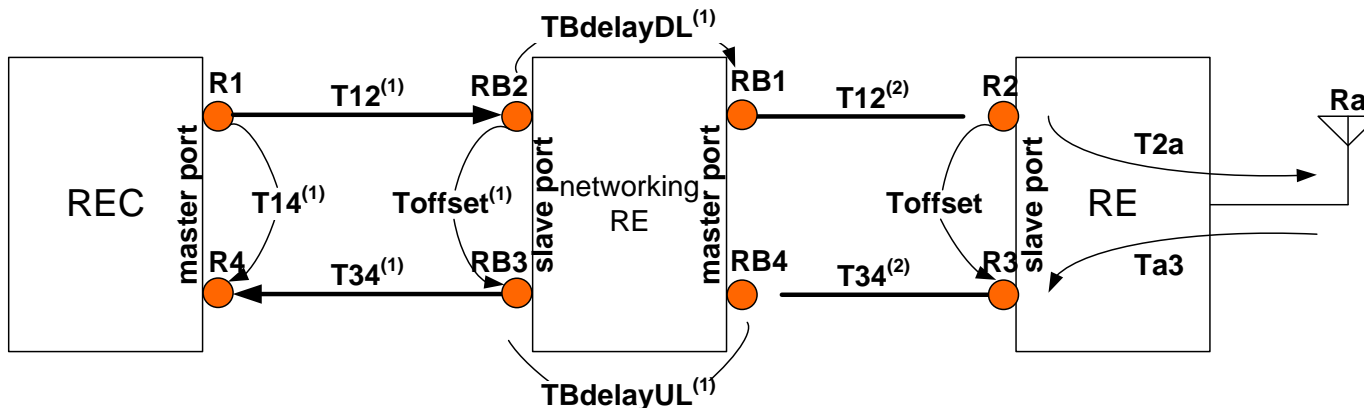
- Slave port side recovers the clock signal from the incoming serial bit stream (slave port “locked” to master port clock).
- Sync Control Word marks the start of a Hyperframe
- Time information (BFN, HFN) is obtained from specific control words
- Cable Delay calibration process delivers one-way delay values (T12 and T34 respectively) (assumes symmetrical cable delay values)

# CPRI Delays

- Single hop configuration



- Multi hop configuration



# CPRI documents

- CPRI specification
  - section 4 : defines mandatory and optional parts of the CPRI specification
  - Annex A: Specification details
    - Informative and normative sections
      - **Scrambling (Normative)**
      - **64B/66B line coding (Normative)**
      - Delay Calibration Example (Informative)
      - Electrical Physical Layer Specification (Informative)
      - Networking (Informative)
      - E-UTRA /GSM sampling rates (Informative)

# CPRI documents

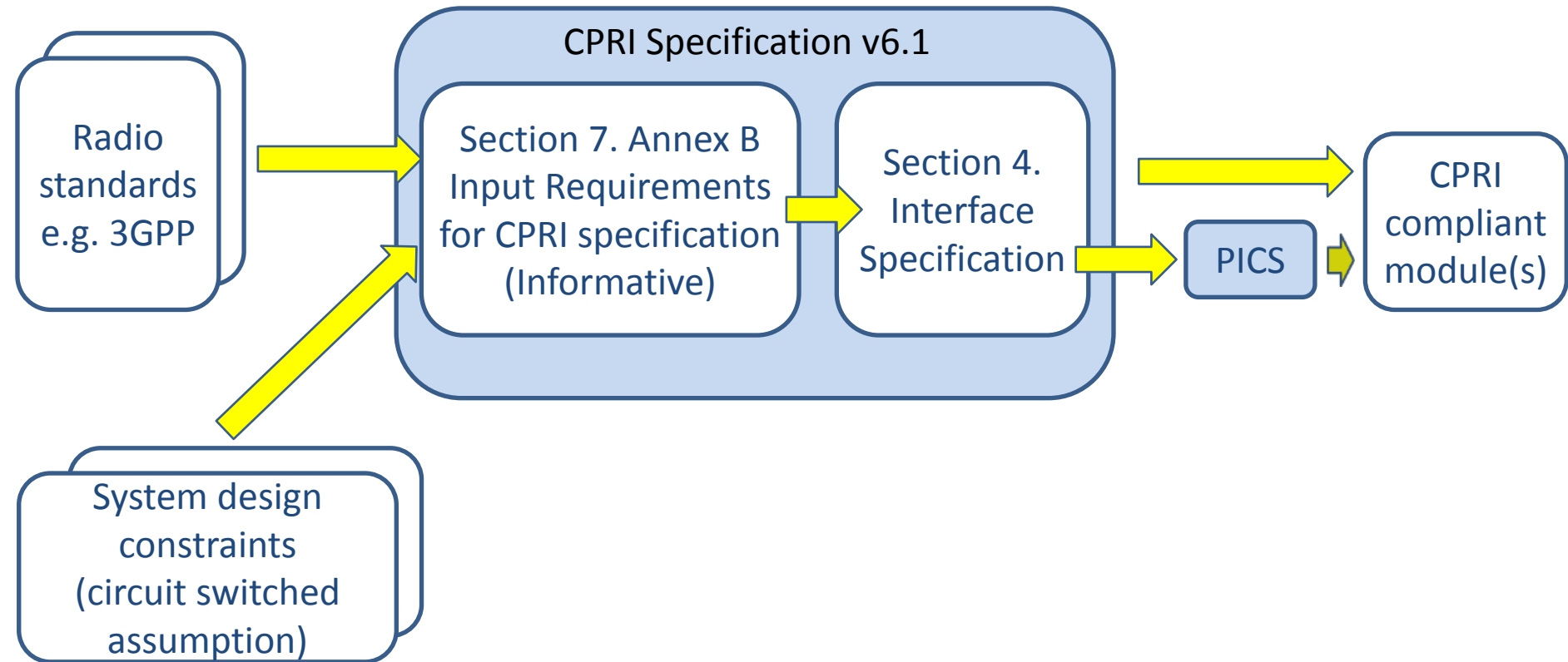
- CPRI specification
  - Annex B: Input Requirements for the CPRI Specification (Informative)
    - Used for the development of the CPRI specification
    - Requirements to be met by the CPRI specification and used as a baseline for future enhancements of the CPRI specification
    - Does not specify the requirements on a CPRI compliant device



# CPRI documents

- Protocol Implementation Conformance Statement (PICS)
  - Lists of CPRI capabilities and options implemented
  - Interoperability
  - Implementation, test and verification

# Relation between “input requirements” and “interface specification”



# Input Requirements for CPRI

- Timing and Synchronization relevant excerpt:
  - Max. Frequency Error contribution: 0.002ppm
  - Max. Bit Error Ratio:  $10^{-12}$
  - Link delay accuracy:  $\pm T_c/32$
  - Max. round trip delay (excl. cable):  $5\mu\text{s}$

# Input Requirements for CPRI

- R-17, R-18, R-18A: Frequency Synchronization
  - Requirement were written to provide a clean clock reference for the RE, the total frequency error budget being 50 ppb for RNC -> BASE Station -> Radio Equipment.

# Input Requirements for CPRI

- R-19, R-20 R-21, R-21A: Delay accuracy
  - These requirements are driven by 3GPP specifications

| Feature   | Timing accuracy | Source         |
|---|-----------------|----------------|
| UTRA-FDD Tx Diversity<br>UTRA-FDD MIMO              | +/- 32.5 ns     | 3GPP TS 25.104 |
| E-UTRA TDD  | +/- 1.5us       | 3GPP TS 36.133 |
| E-UTRA Tx Diversity<br>E-UTRA MIMO                  | +/- 32.5 ns     | 3GPP TS 36.104 |
| E-UTRA Intra-band contiguous<br>Carrier Aggregation | +/- 65 ns       | 3GPP TS 36.104 |
| UTRA RTT  | +/- 130 ns      | 3GPP TS 25.133 |

# Input Requirements for CPRI

- R-26: Maximum Delay
  - In order to have maximum signal processing time, the transport latency of the antenna data shall be minimized

# Input Requirements for CPRI

- R-27: Bit Error Ratio
  - This requirement is to define signal quality transport, the reason is to avoid FEC for this rate to minimize delay and cost

# Thank You

Time for questions





**NEC**

**NOKIA**

