



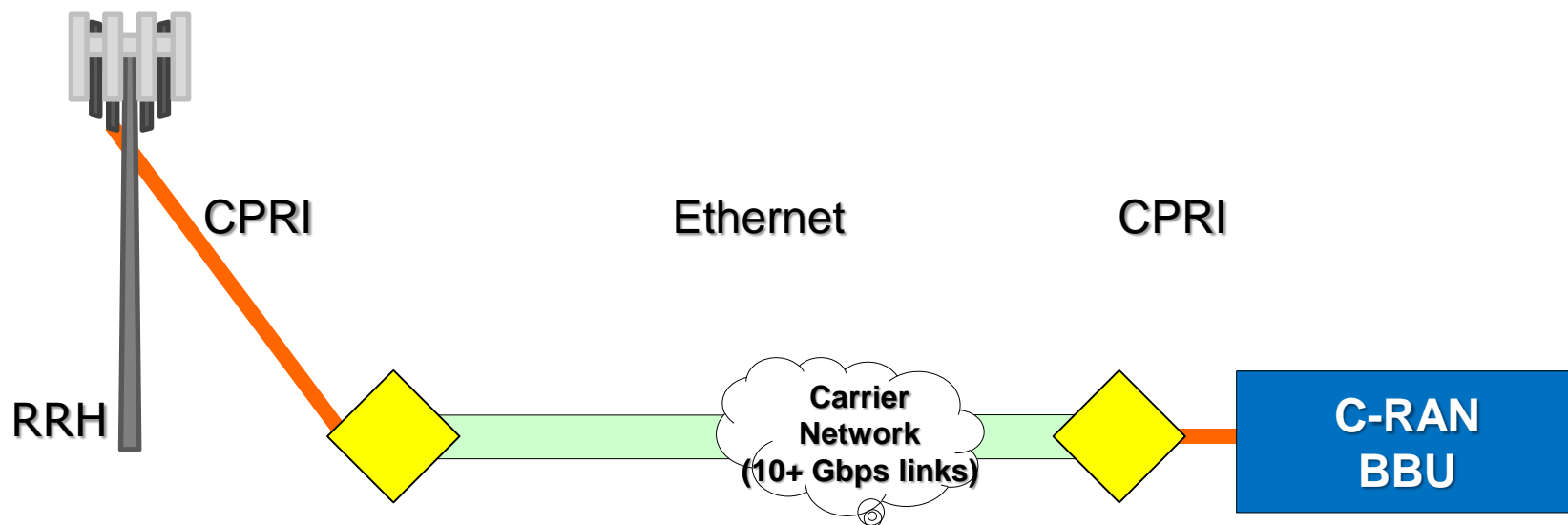
Structure-agnostic Encapsulation

Kevin Bross
October 29, 2015

Structure-agnostic Encapsulation

□ Presentation purpose:

- Provide recommendations for how to handle encapsulation of RoE data without needing to understand the details of the encapsulation
- Focus is on CPRI (especially rates 1-7)



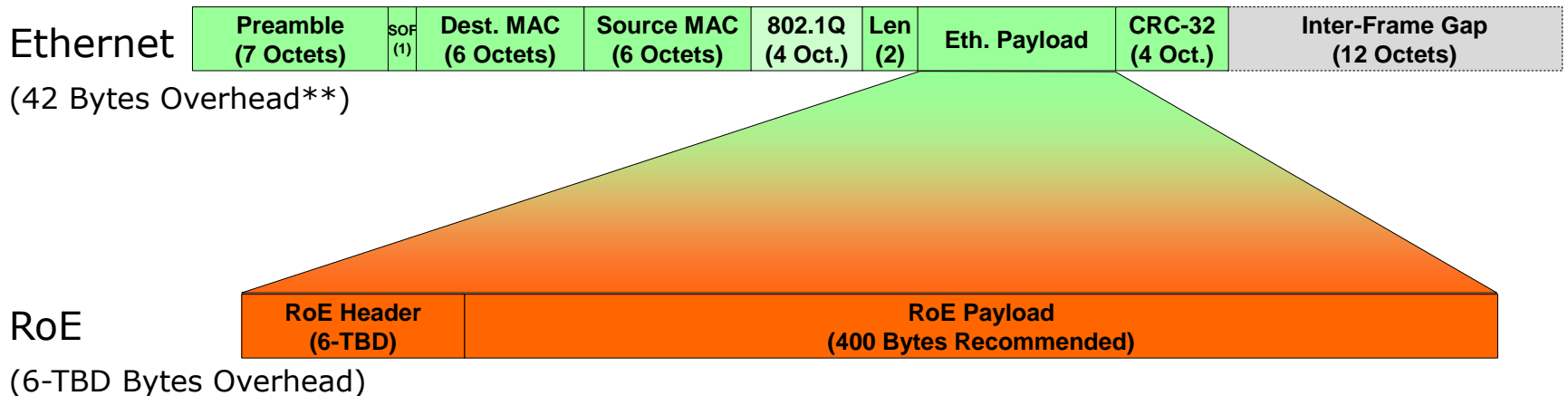
CPRI Rates 1-7

- ❑ 10GbE is 64b/66b encoded
- ❑ Can remove CPRI 8b/10b encoding used in rates 1-7 to save 20% bandwidth
 - RoE packets don't need both 8b/10b and 64b/66b encoding

Rate Index	CPRI Data (Gbps)	Gbps After 8b/10b
1	0.6144	0.4915
2	1.2288	0.9830
3	2.4576	1.9661
4	3.0720	2.4576
5	4.9152	3.9322
6	6.1440	4.9152
7	9.8304	7.8643

Packetization Overhead

- ❑ Ethernet adds 42 bytes of overhead
 - Assuming 1 802.1Q header is added
 - Counting inter-frame gap in overhead
- ❑ RoE adds 6 or more bytes to the packet
 - Total overhead likely 48-98 bytes per packet



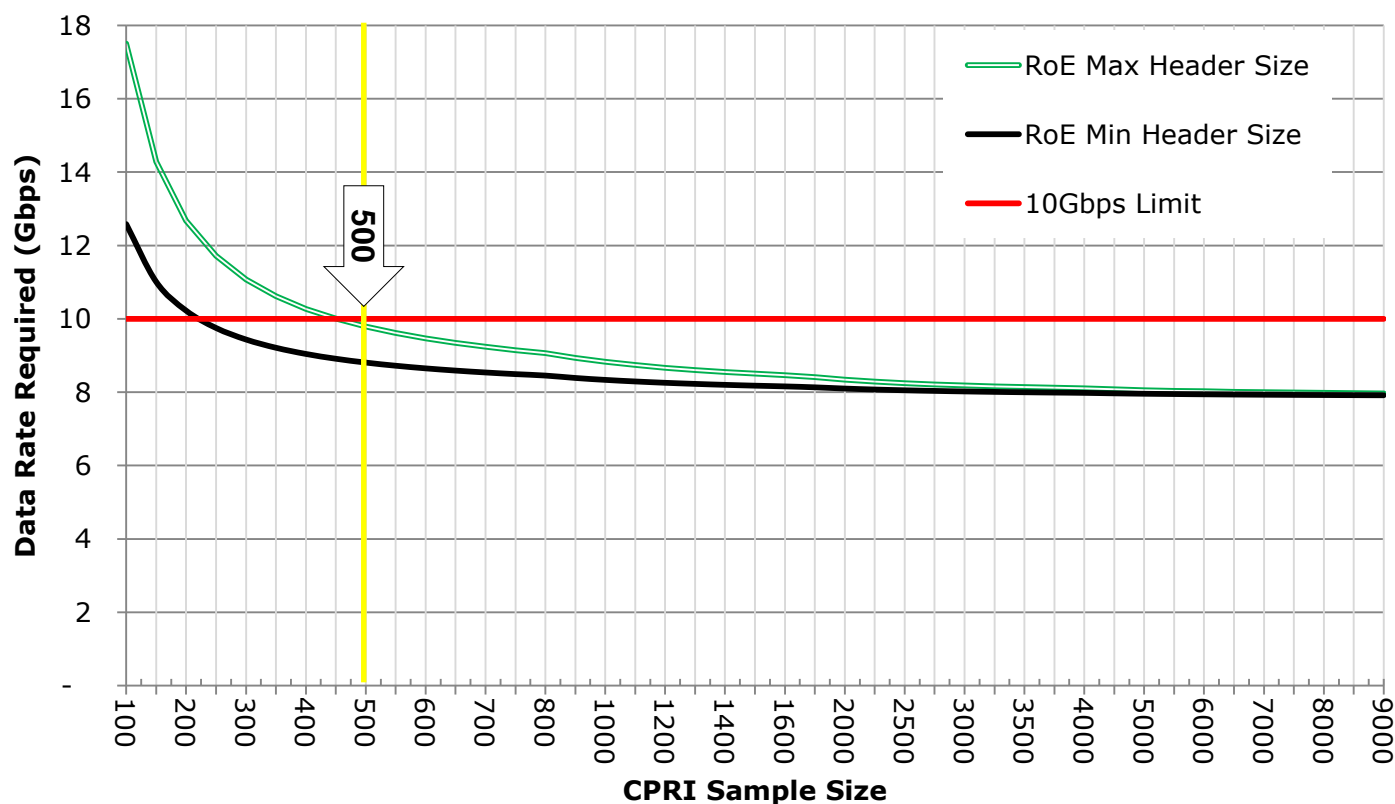
SOF = Start of Frame (8 bits)
LEN = Length/Ethertype (16 bits)

** Inter-packet gap (12 bytes) is included in these calculations

CPRI Sample Size Analysis

- Sample size of 300-500 bytes recommended to ensure RoE packets @ 9.8 Gbps take <10 Gbps**

CPRI Sample Size vs. 10GbE



** Inter-packet gap (12 bytes) is included in these calculations

CPRI Rates 1-7 w/RoE Overhead

□ Modeling:

- 500-byte CPRI data → 400-byte payload
- RoE headers of 6 bytes and 56 bytes shown

□ Even 9.8 Gbps CPRI fits within 10GbE

Rate Index	CPRI Data (Gbps)	Gbps After 8b/10b	Gbps w/ 6-byte RoE Header**	Gbps w/56-byte RoE Header**
1	0.6144	0.4915	0.55	0.61
2	1.2288	0.9830	1.10	1.22
3	2.4576	1.9661	2.20	2.45
4	3.0720	2.4576	2.75	3.06
5	4.9152	3.9322	4.40	4.90
6	6.1440	4.9152	5.51	6.12
7	9.8304	7.8643	8.81	9.79

** Inter-packet gap (12 bytes) is included in these calculations

Constant Payload Size

- ❑ Recommend requiring a constant payload size for the tunneled data
 - 8b/10b data should have sample data in increments of 5 bytes, yielding “cooked” data at increments of 4 bytes.
 - Recommend 500 byte sample sizes for 400 byte payloads as preferred size
- ❑ Sequence # can be masked as “mailbox” location for data in circular queue
 - Allows out-of-order packets to be automatically slotted in the egress queue
 - Time can be determined from sequence #

Handling Special Characters

- ❑ Some 8b/10b symbols have no 8b analog
 - So-called “K-characters”
 - CPRI (1-7) only uses K28.5 (start of frame)
 - K-characters used infrequently (≤ 1 time per packet)
- ❑ Different radio encodings (OBSAI, etc.) may use different K-characters
- ❑ Suggest adding 16-bit field:
 - 4 bits: dictionary of special characters
 - Up to 15 symbols available (0 = nil)
 - 12 bits: location of special character in packet
 - All 0 = no special character in packet

Feedback: use 8 bits of K-character position in place of dictionary; allow up to 14 bits for location of K-character—or use byte index in sequence.

Handling Transmission Errors

- ❑ RoE should be able to pass along errors from intermediate steps, such as SFP+
- ❑ Suggest adding 1-byte Link Info field:

Designator	Bits	Len (bits)	Meaning
over	7	1	Data over-run
under	6	1	Data under-run
temp	5	1	Device too hot
los	4	1	Loss of signal
errors	3:0	4	Encoding error count

Consensus: Do not put this in RoE header; put in out-of-band management channel if needed.

Other Complications

- CPRI rates 7a and above use 64b/66b encoding
 - Don't get 20% savings like with 8b/10b
 - Start of Frame symbol and encoding is more complex

Consensus: Add “Simple Tunneling” mapper that does not remove CPRI/whatever encoding; use Simple Tunneling for 64b/66b-encoded data.