IEEE 802.3cg d2.1 Comment #324

PLCA Burst Mode for In-cabinet Use Case

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Purpose of this document

- Present the benefits of using PLCA Burst Mode for In-cabinet use case
- Recommend adopting PLCA Burst Mode into 802.3cg specification

- IEEE 802.3cg PLCA Burst Mode, Piergiorgio Beruto
  - http://www.ieee802.org/3/cg/public/Nov2018/beruto_3cg_PLCA_burst_mode_revB%20.pdf

- Multidrop Ethernet for In-cabinet Applications, David Brandt
  - http://www.ieee802.org/3/cg/public/Mar2017/brandt_cg_01_0317.pdf

System Configuration

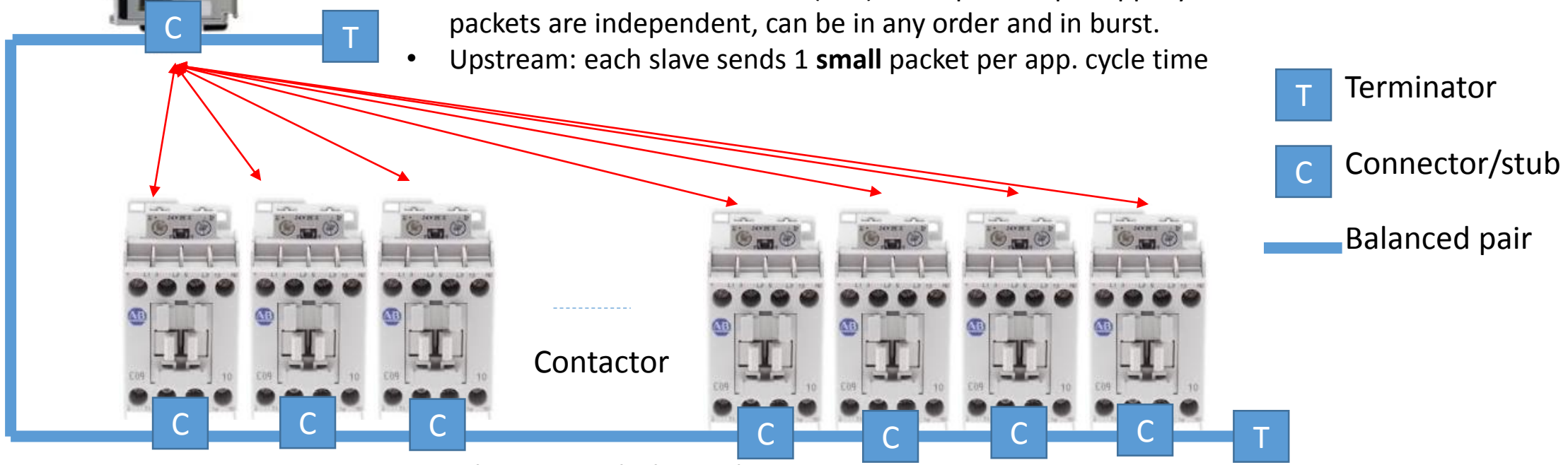
Controller (PLC or PAC)

Head-end, Master

Controller establishes one connection to each contactor. Every connection has the same application cycle time. One downstream and one upstream packet per connection per application cycle time. The packet size is small (e.g. 64 bytes layer 2 Ethernet packet).

Traffic Pattern

- Downstream: Master sends N(=32) **small** packets per app. cycle time. All packets are independent, can be in any order and in burst.
- Upstream: each slave sends 1 **small** packet per app. cycle time



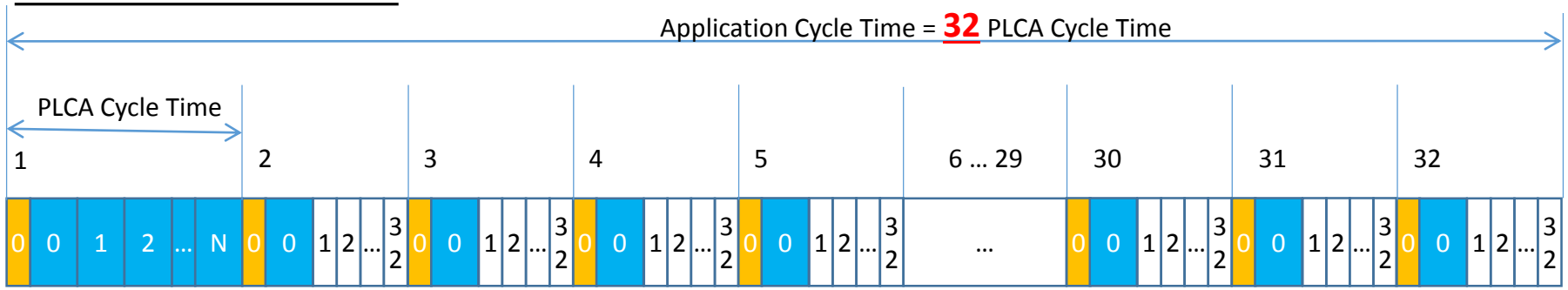
T Terminator

C Connector/stub

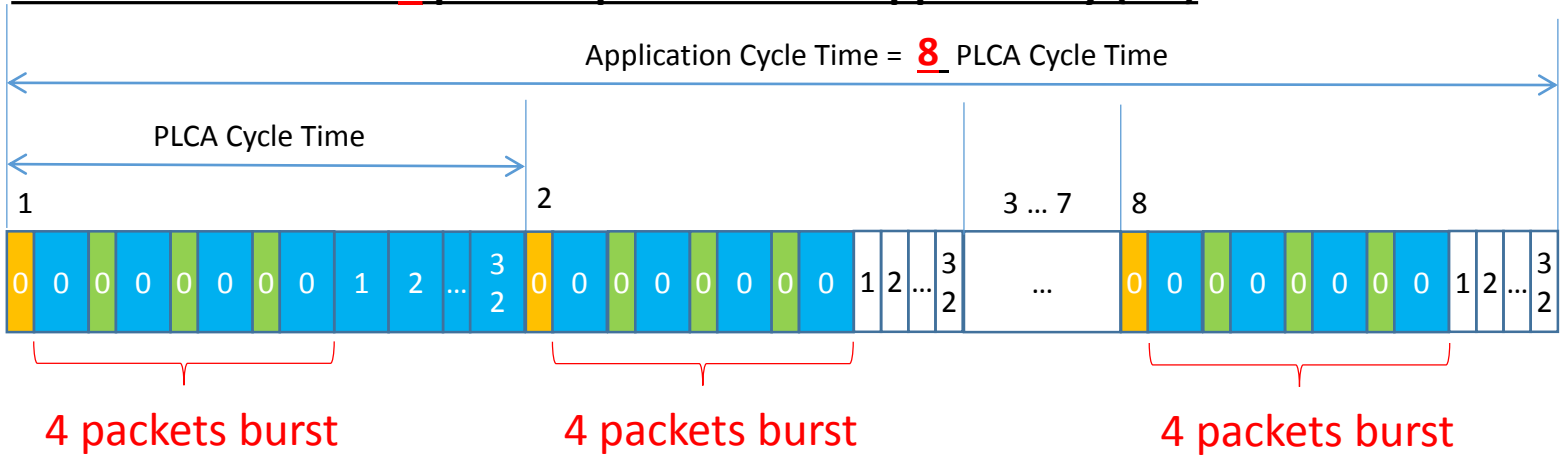
Balanced pair

Burst vs Non-burst

Node 0 does not burst



Node 0 bursts with 4 packets per Transmit Opportunity (TO)



BEACON

DATA

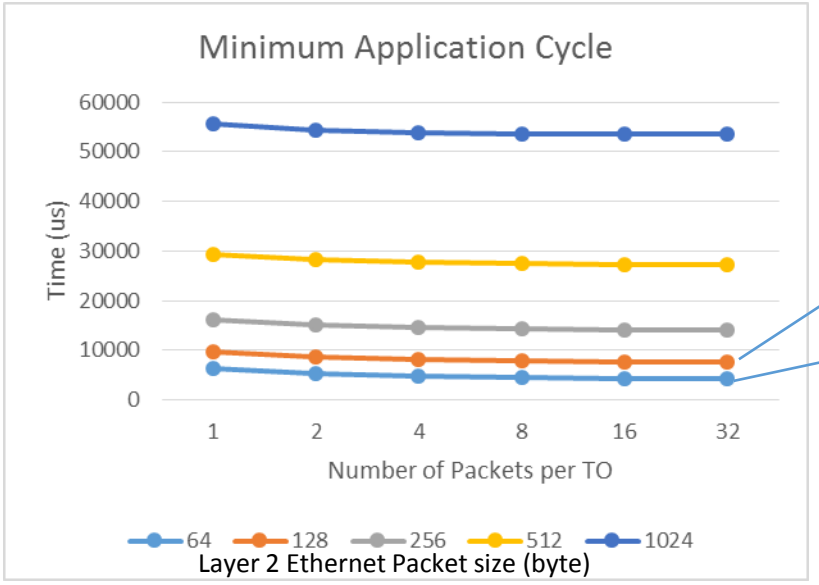
COMMIT

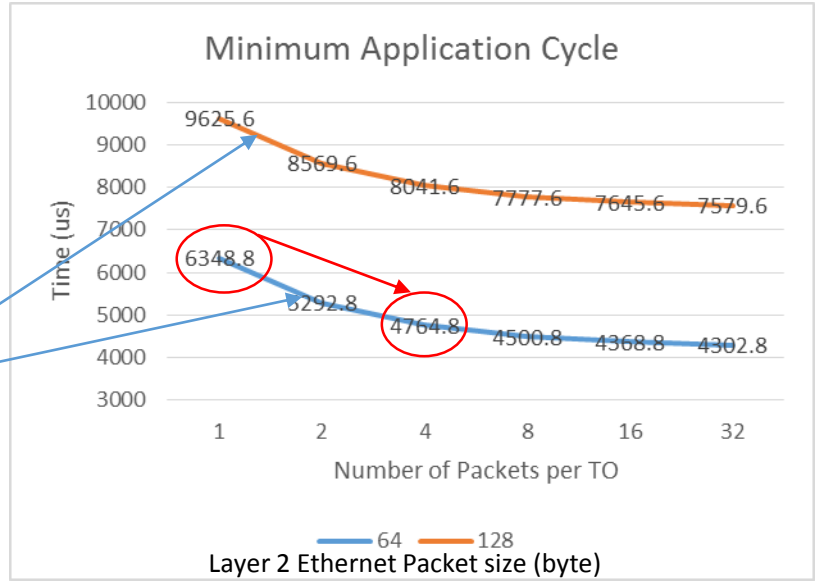
SILENCE

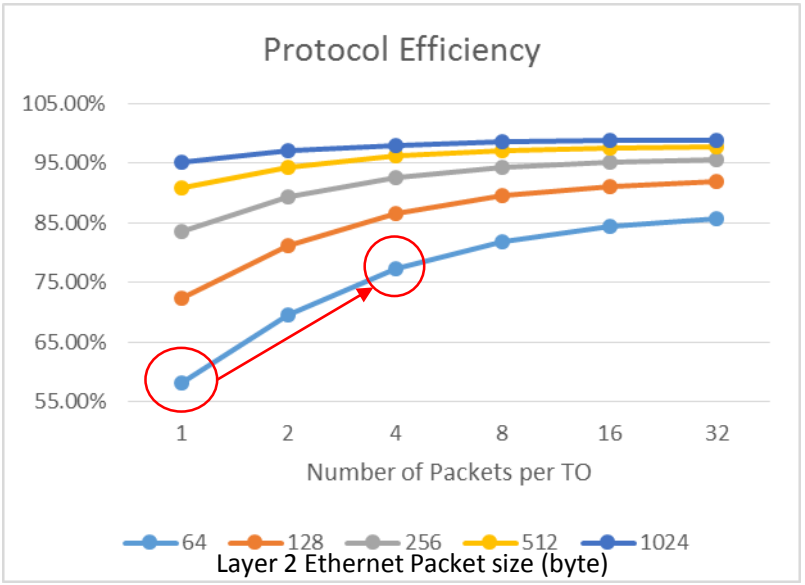
PLCA Burst Mode reduces application cycle time and improves protocol efficiency by reducing number of SILENCE slots

Performance and Efficiency

- Performance (Minimum Application Cycle): Minimum time to complete transmitting one round of all downstream and upstream Ethernet packets
  - 64 bytes @ 4 packets per TO: **1586us or 25% faster**
- Efficiency: Percentage of bandwidth used for transmitting the layer 1 Ethernet packets
  - 64 bytes @ 4 packets per TO: **19.31% higher**







PLCA Burst Mode improves performance and efficiency significantly for small control packets, 2-4 packets in a burst makes most sense

Conclusion

- PLCA Burst Mode reduces application cycle time and improves the protocol efficiency for small control packets for a Master/Slave system
  - 2-4 packets in a burst makes most sense

- PLCA Burst Mode introduces little change to current specification according to the presentation
  - http://www.ieee802.org/3/cg/public/Nov2018/beruto_3cg_PLCA_burst_mode_revB%20.pdf

- So recommend PLCA Burst Mode to be adopted to allow more broad usage of 10BASE-T1S

Question and Answer

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How to Calculate App. Cycle Time and PLCA Efficiency

- System configuration parameters
  - Layer 1 Ethernet packet size: PKT bits
  - # of packets per TO: M
  - Number of slaves: N = 32
  - Beacon Time: BT=20 bits
  - TO Time: TO=20 bits
  - Inter Packet Gap: IPG=96 bits
- Equation to calculate application cycle time and efficiency
  - Overhead: N/**M** * **BT** + (N/**M** - 1)*TO*N + N*IPG*2
  - Data: N*PKT*2
  - **Efficiency** = Data / (Data + Overhead) *100%
  - **App. Cycle Time** = (Data + Overhead)*0.1 (us)

Assumption: 10BASE-T1S Multidrop network is at full load

Ethernet Packet

- Physical Layer (Layer 1) Ethernet Packet size: 7 bytes preamble + 1 byte SFD + N bytes data + 12 bytes IPG (Interpacket Gap)

802.3 Ethernet packet and frame structure

Layer	Preamble	Start of frame delimiter	MAC destination	MAC source	802.1Q tag (optional)	Ethertype (Ethernet II) or length (IEEE 802.3)	Payload	Frame check sequence (32-bit CRC)	Interpacket gap
	7 octets	1 octet	6 octets	6 octets	(4 octets)	2 octets	46-1500 octets	4 octets	12 octets
Layer 2 Ethernet frame			← 64–1522 octets →						
Layer 1 Ethernet packet & IPG	← 72–1530 octets →								← 12 octets →

Src: Wiki