Canova Tech

The Art of Silicon Sculpting

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IEEE 802.3cg

PLCA Burst mode

November 7th, 2018

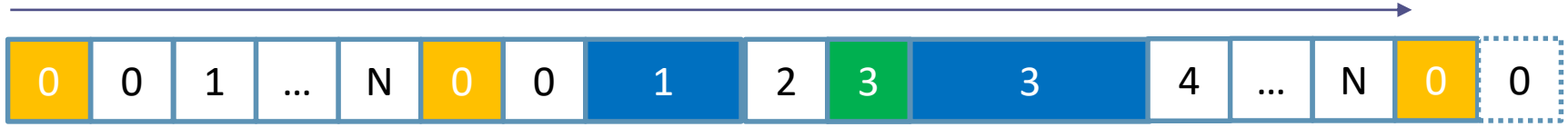
Outline

- PLCA currently provides packet-level access fairness (round-robin) across all nodes on the mixing-segment network.
- In some cases, weighing the share of the media among the nodes is desirable
  - 802.3cg D2.0 comments:
    - #371, #372 (Kirsten Matheus, BMW)
    - #503, #504, #505 (Peter Jones, Cisco)
- This is a new feature request for PLCA: burst mode

Proposed solution

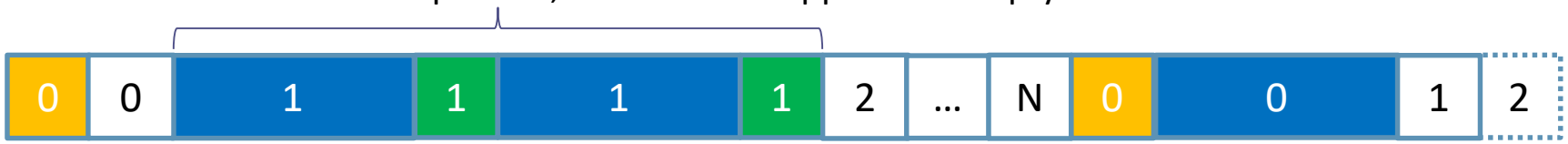
- Nodes can be individually configured for bursting from management entity by setting the max number of packets that can be sent in a single burst (max_bc)
  - max_bc = 0 → no burst, up to one packet per BEACON (default)
  - max_bc = N → up to N additional packets per BEACON
- Bursting nodes can 'keep' their transmit opportunity by filling the IPG with IDLE (i.e. COMMIT from PLCA perspective)
- Problem is, a node cannot know in advance whether the local MAC has more packets to send after a transmission with no (logical) collisions.
  - Only option is to fill the IPG with COMMIT **regardless**, after any transmission.
    - Except when the max_bc limit is met
  - This yields some negative impact on the throughput in case there are nodes awaiting their TO after a logical collision
    - In such case an additional IPG period (96 bits) is wasted at the beginning of the new transmission

Working principle



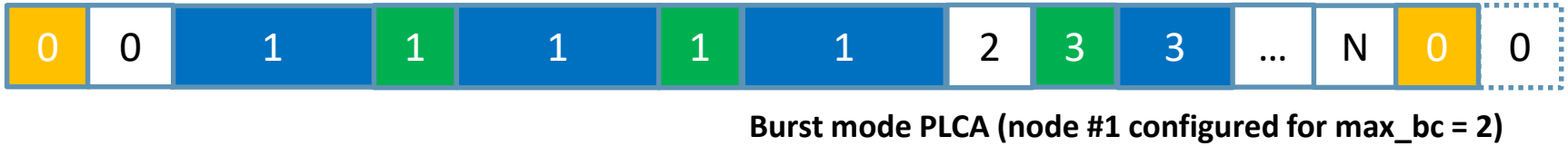
Standard PLCA operation (no bursts)

node #1 sends a burst of 2 packets, and needs to append an empty COMMIT



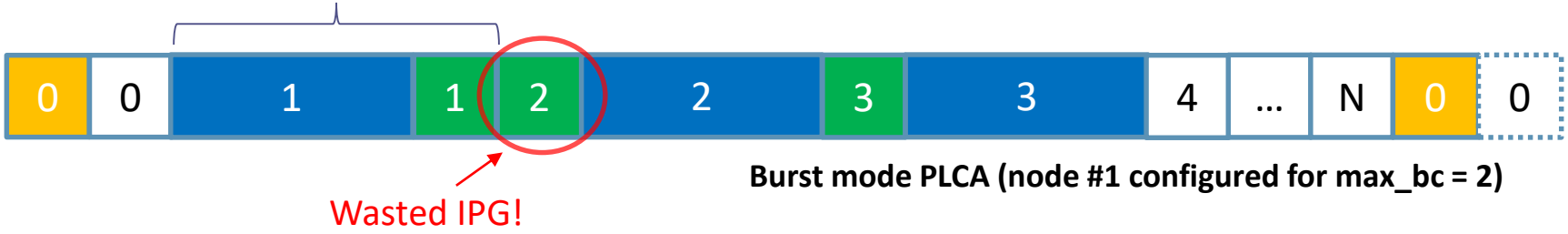
Burst mode PLCA (node #1 configured for max_bc = 2)

node #1 sends a burst of 3 packets (max) and does not append a COMMIT



Burst mode PLCA (node #1 configured for max_bc = 2)

node #1 does not burst but still needs to append an empty COMMIT

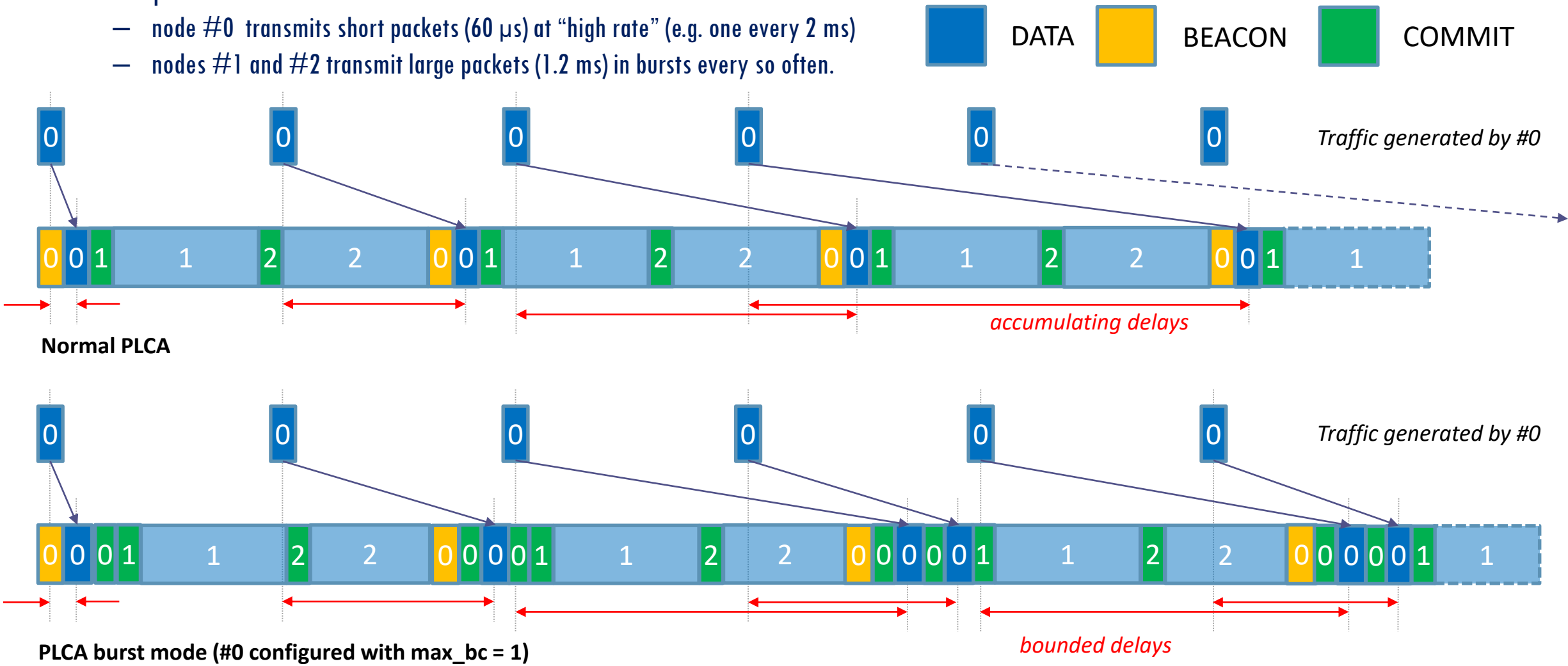


Burst mode PLCA (node #1 configured for max_bc = 2)

Bursting node keeps its TO by filling IPG with IDLE (COMMIT)

Example

- PLCA burst mode could provide a simple solution for situations where communication is inherently heterogeneous among the nodes
- Example with 3 nodes where:
  - node #0 transmits short packets (60 µs) at "high rate" (e.g. one every 2 ms)
  - nodes #1 and #2 transmit large packets (1.2 ms) in bursts every so often.



Caveats / Notes

- BURST_TIMER have to be set large enough to allow the local MAC to transmit a new packet
  - Assuming the MAC is capable of transmitting packets back-to-back, BURST_TIMER have to be at least 96 bits (one IPG at 10Mb/s operation) + some margin
  - BURST_TIMER needs not be configured equal across all nodes
  - Increasing BURST_TIMER relaxes time requirements on the MAC at the expense of throughput.
- Throughput is not significantly affected by burst mode
  - Worst case scenario is when the BUS is at max load, every node send the smallest allowed packet (72 bytes) and all are allowed to burst.
    - In this case the throughput penalty is one IPG per node.
      - That is, $1 - (72 * 8 + 96) / (72 * 8 + 96 * 2) = 12.5\ \%$

Changes to State Diagrams

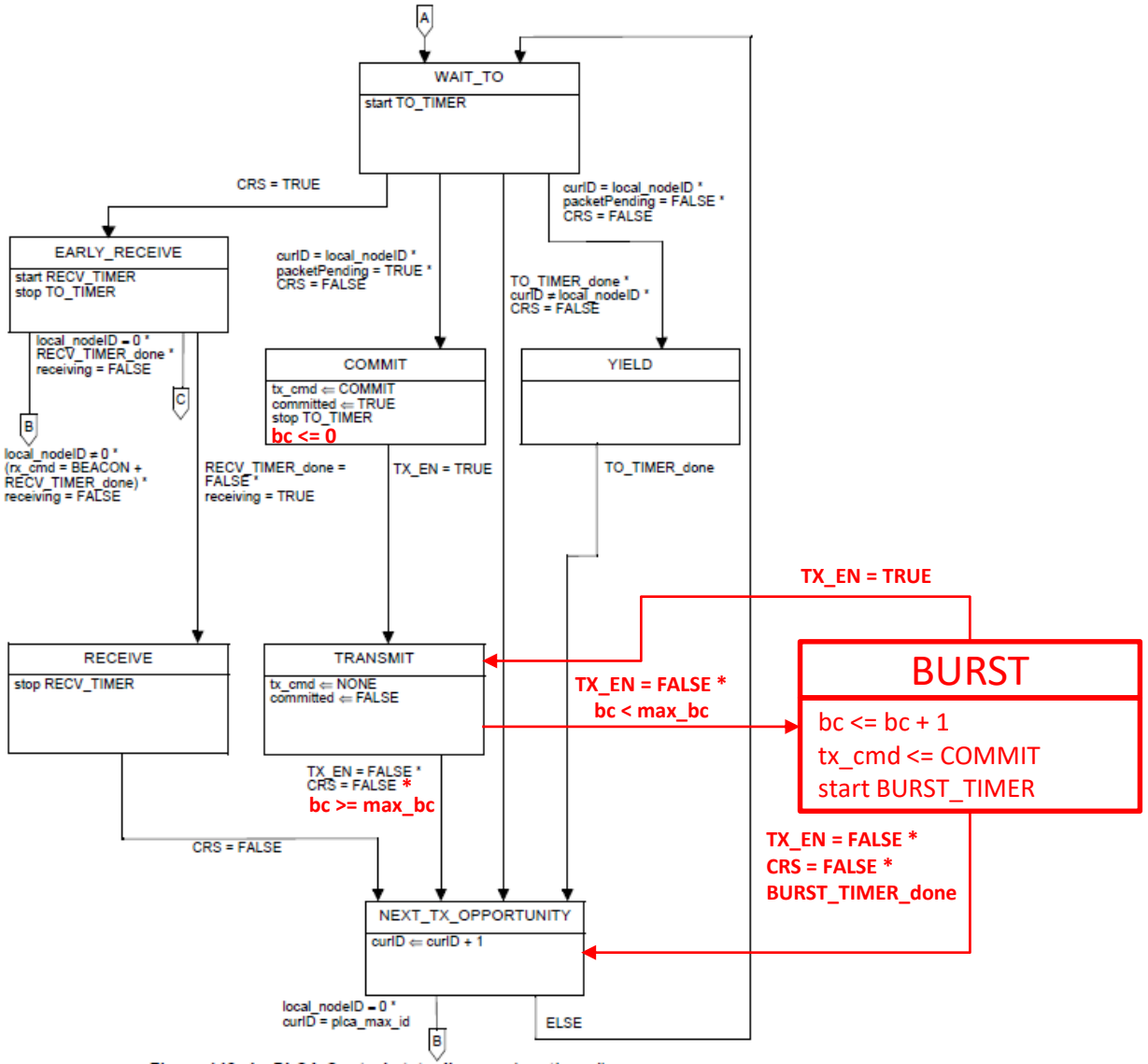


Figure 148–4—PLCA Control state diagram *(continued)*

Text Changes (C148)

Clause 148.2 → Add the following text (marked in red)

. . .

Transmit opportunities are generated in a round-robin fashion every time the PHY with node ID = 0 signals a BEACON on the medium, indicating the start of a new cycle. This happens after each node has had a transmission opportunity.

Each node is allowed to transmit a single packet during its own transmit opportunity. Individual nodes can be enabled to transmit a number of additional packets, up to the configured limit, within the same transmit opportunity.

PLCA relies on the PLS_SIGNAL. . .

Text Changes (C148)

Clause 148.4.5.1 → Apply changes marked in red

. . .

When condition (2) occurs, the PHY now gets a TO having at least one packet to be transmitted. COMMIT state is then entered to signal other PHYs to stop their TO_TIMER and wait for a packet by the means of a COMMIT request. COMMIT state is left once the data to be transmitted is available from the MAC or the PLCA delay line.

When condition (3) occurs, the PHY now gets a TO without being ready to send any packet. In this case the YIELD . . .

Text Changes (C148)

Clause 148.4.5.2 → Add the following variables description

bc

counts the number of additional packets currently sent in a burst after the first transmission.
Value: integer from 0 to 255

max_bc

maximum number of additional packets the node is allowed to transmit in a single burst. This signal maps to aPLCAMaxBurstCount attribute. When MDIO is present, max_bc is configured to the content of bits 28.3.15:8. When MDIO is not present, the functionality of bits 28.3.15:8 can be provided by equivalent means.
Value: integer from 0 to 255 add description for new variables

Text Changes (C148)

Clause 148.4.5.4 → Add the following timer description

BURST_TIMER

Counts the time to wait for the MAC to send a new packet before yielding the transmit opportunity, in bit-times. For PLCA burst mode to work properly this timer should be set greater than one IPG.

Duration: integer number between 0 and 255, expressed in bit times.

Add the following lines (marked in red) to table 30-1c under oPLCA managed object class (30.3.9) section:

	aPLCATransmitOpportunityTimer	ATTRIBUTE	GET-SET									x												
	aPLCAMaxBurstCount	ATTRIBUTE	GET-SET									X												
	aPLCABurstTimer	ATTRIBUTE	GET-SET									X												

Text Changes (C30)

Add the following subclauses in 30.3.9.2:

30.3.9.2.x aPLCAMaxBurstCount

ATTRIBUTE APPROPRIATE SYNTAX:

INTEGER VALUE in the following range (inclusive): 0 to 255

BEHAVIOUR DEFINED AS:

Maximum number of additional packets the node is allowed to transmit in a single transmit opportunity. Behavior is specified in 148.4.5.1 and 148.4.5.2. By default, this attribute is 0.;

30.3.9.2.y aPLCABurstTimer

ATTRIBUTE APPROPRIATE SYNTAX:

INTEGER VALUE in the following range (inclusive): 0 to 255

BEHAVIOUR DEFINED AS:

Counts the time to wait for the MAC to send a new packet before yielding the transmit opportunity, in bit-times. See definition in 148.4.5.1 and 148.4.5.4. By default, this attribute is 128.

Make the following changes to Table 45-351a:

28.2	PLCA TO Timer	45.2.13.3
28.3	PLCA Burst Mode	45.2.13.6
~~28.3 through~~ 28.4	Reserved	

Append the following subclause to 45.2.13

45.2.13.6 PLCA Burst Mode register (Register 28.3)

The assignment of bits in the PLCA Burst Mode register is shown in Table 45–351f

Table 45-351f - PLCA Burst Mode register bit definitions

Bit(s)	Name	Description	R/W[25]
28.3.15:8	max_bc	Maximum number of additional packets the node is allowed to transmit in a single transmit opportunity	RW
28.3.7:0	burst_timer	Counts the time to wait for the MAC to send a new packet before yielding the transmit opportunity, in bit-times	RW

45.2.13.6.1 max_bc (28.3.15:8)

Maximum number of additional packets the node is allowed to transmit in a single transmit opportunity. See definition in 148.4.5.1 and 148.4.5.2.
The default value of bits 28.3.15:8 is 0.

45.2.13.6.2 burst_timer (28.3.7:0)

Counts the time to wait for the MAC to send a new packet before yielding the transmit opportunity, in bit-times. See definition in 148.4.5.1 and 148.4.5.4.
The default value of bits 28.3.7:0 is 128.

THANK YOU!