PLCA improvement for high node count

Wojciech Koczwara • | 24th Apr 2019

Rockwell Automation

PLCA improvement for high node count

Presenter: Wojciech Koczwara, Rockwell Automation

Supporter: Piergiorgio Beruto, Canova Tech

1 Background

2 PLCA with low number of nodes (no issues)

3 PLCA with high number of nodes (problem)

4 Solution candidate

5 Solution candidate concerns

Background

Collision handling at MAC vs. slotTime

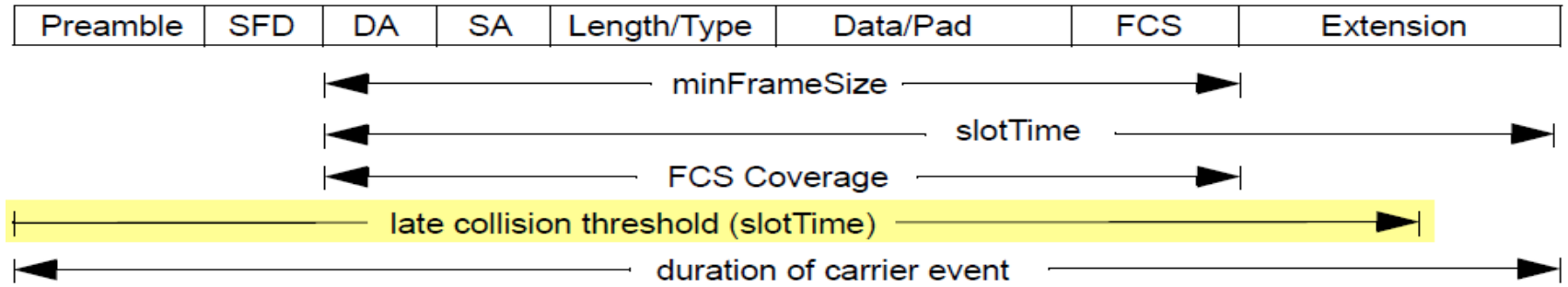


Figure 4–5—Frame with carrier extension

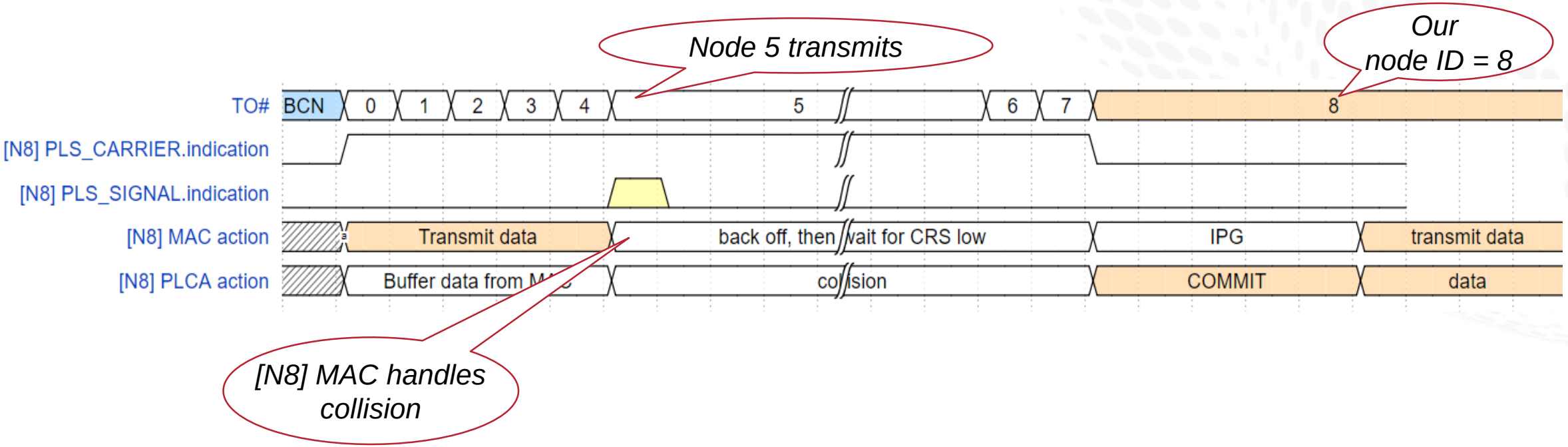
During sending, MAC reacts to COL signal, handling the collisions. This behavior is guaranteed until slotTime (512BT) has been reached during sending. After the slotTime has passed, MAC can terminate with lateCollisionErrorStatus.

- For PLCA to work reliably, we need to ensure our MAC can always handle the collisions.
  - Therefore, PLCA **shall never buffer >=512 bits, not to cross the late collision threshold** (==slotTime == 512BT default) when buffering data from MAC.

PLCA with low number of nodes – NO ISSUES

Node 8 perspective, node 5 shoots in and sends.

- When MAC of node 8 starts sending just after the Beacon, PLCA buffers the data to send it at Transmit Opportunity 8.
- node 5 starts transmitting meanwhile, so PLCA of node 8 asserts a collision to the MAC.
  - MAC will back off for 0 or 512 BT
  - PLCA uses PLS_CARRIER.indication to prevent the MAC from re-sending until TO#8
  - At TO#8, data is put on the line without buffering. IPG time is filled with COMMIT.

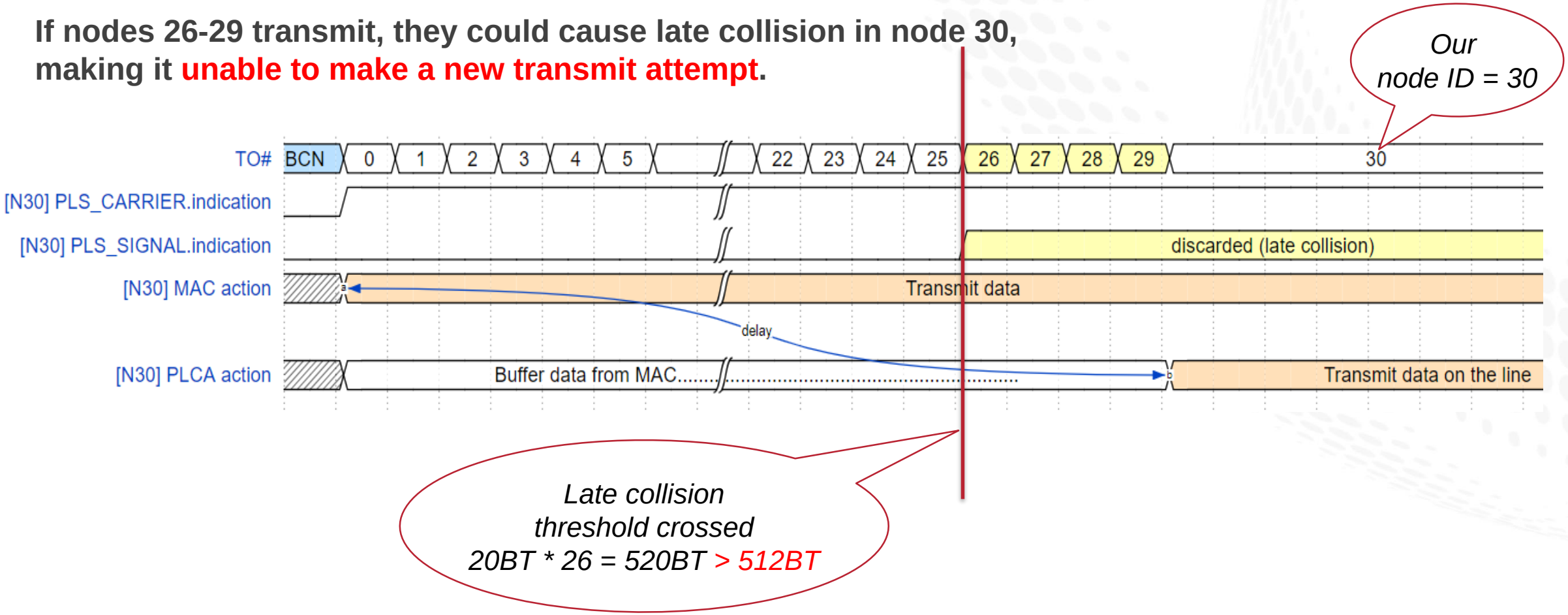


PLCA with high number of nodes - PROBLEM

Perspective of node 30, yellow fields show the potential issue

Due to excessive data buffering, late collision threshold (512BT) is reached in MAC.

If nodes 26-29 transmit, they could cause late collision in node 30, making it unable to make a new transmit attempt.



Solution candidate

PLCA should avoid buffering long portions of data. Buffering shall be definitely shorter than the slotTime (512BT).

Currently, max buffering length is c.a. aPLCANodeCount * aPLCATransmitOpportunityTimer

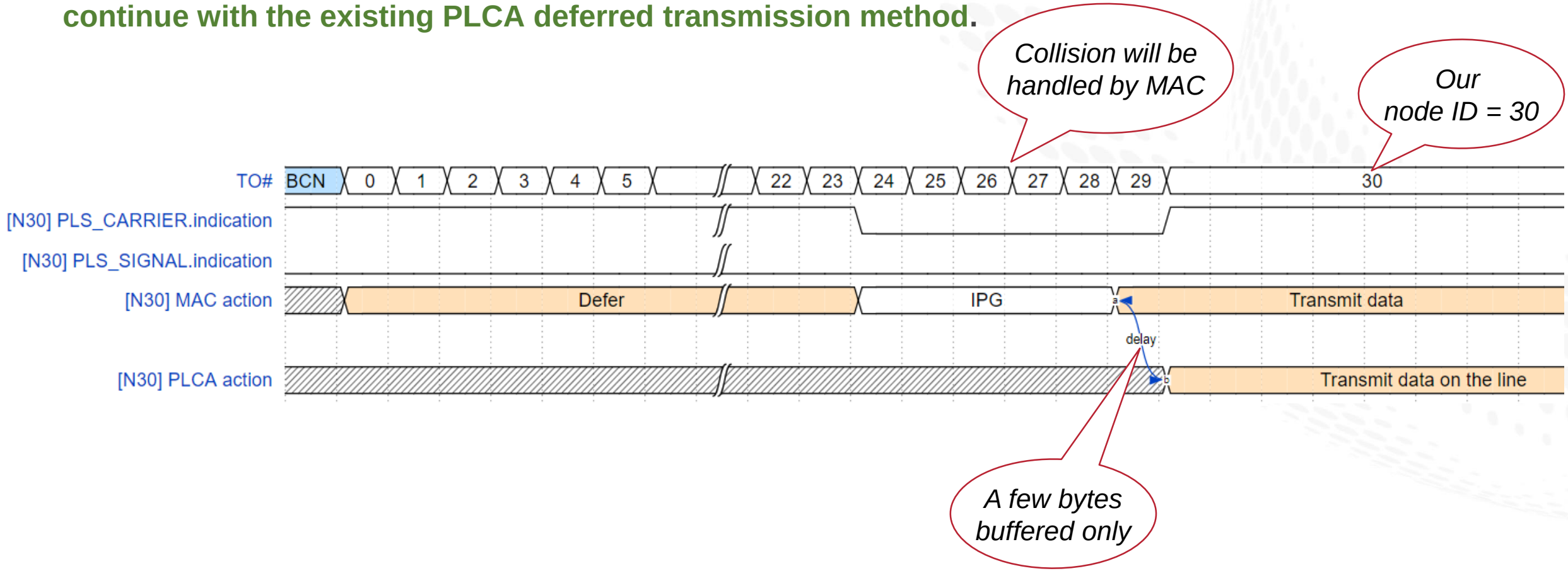
Solution candidate **under test** for high [TBD] node count :

- keep PLS_CARRIER.indication=true by default
- set PLS_CARRIER.indication=false IPG_LENGTH (96-128BT) ahead of your TO. Set PLS_CARRIER.indication=true when entering your TO slot.
- MAC data transfer is expected just before PLCA Transmit Opportunity, so data buffering is limited to a few bytes (0-4B)
- In case of MAC sending after PLS_CARRIER.indication is set back to high (race condition), issue a collision to the MAC and continue with the existing PLCA deferred transmission method

Solution candidate

Perspective of node 30

Prevent data buffering by holding PLS_CARRIER.indication=true.
If nodes 24-29 transmit, or if MAC starts sending after PLS_CARRIER.indication=true, issue a collision to the MAC and continue with the existing PLCA deferred transmission method.



Solution candidate concerns

Length of InterPacketGap varies from MAC to MAC.

- 96 BT IPG is only the minimum length
- 128BT proposed to cover MAC latencies
- IPG_LENGTH should be configurable in PLCA, to support longer configurable IPGs in MAC
- misconfigured IPG_LENGTH should still work
    - PLCA can still issue a collision if the data from MAC appears after PLS_CARRIER.indication = true, and continue with the existing PLCA deferred transmission method (i.e. hold the MAC with PLS_CARRIER.indication until the right TO comes, then fill the IPG with COMMIT)

Thank you

www.rockwellautomation.com

Rockwell Automation