D-PLCA Comment #46 Accommodation for Static Node IDs greater than Seven

A Leading Provider of Smart, Connected and Secure Embedded Control Solutions

Tim Baggett

IEEE 802.3da Interim May 2025

Introduction

- **PLCA – Physical Layer Collision Avoidance**
  - Defined in IEEE 802.3-2022 Clause 148
  - Intended for engineered networks or with configuration managed through higher network layers
  - Node IDs statically assigned corresponding to their assigned Transmit Opportunity (TO)

- **D-PLCA – Dynamic Physical Layer Collision Avoidance**
  - Optional extension to Clause 148, defined in IEEE 802.3da
  - Allows for plug-and-play networking
  - Backward compatible to PLCA nodes not using D-PLCA

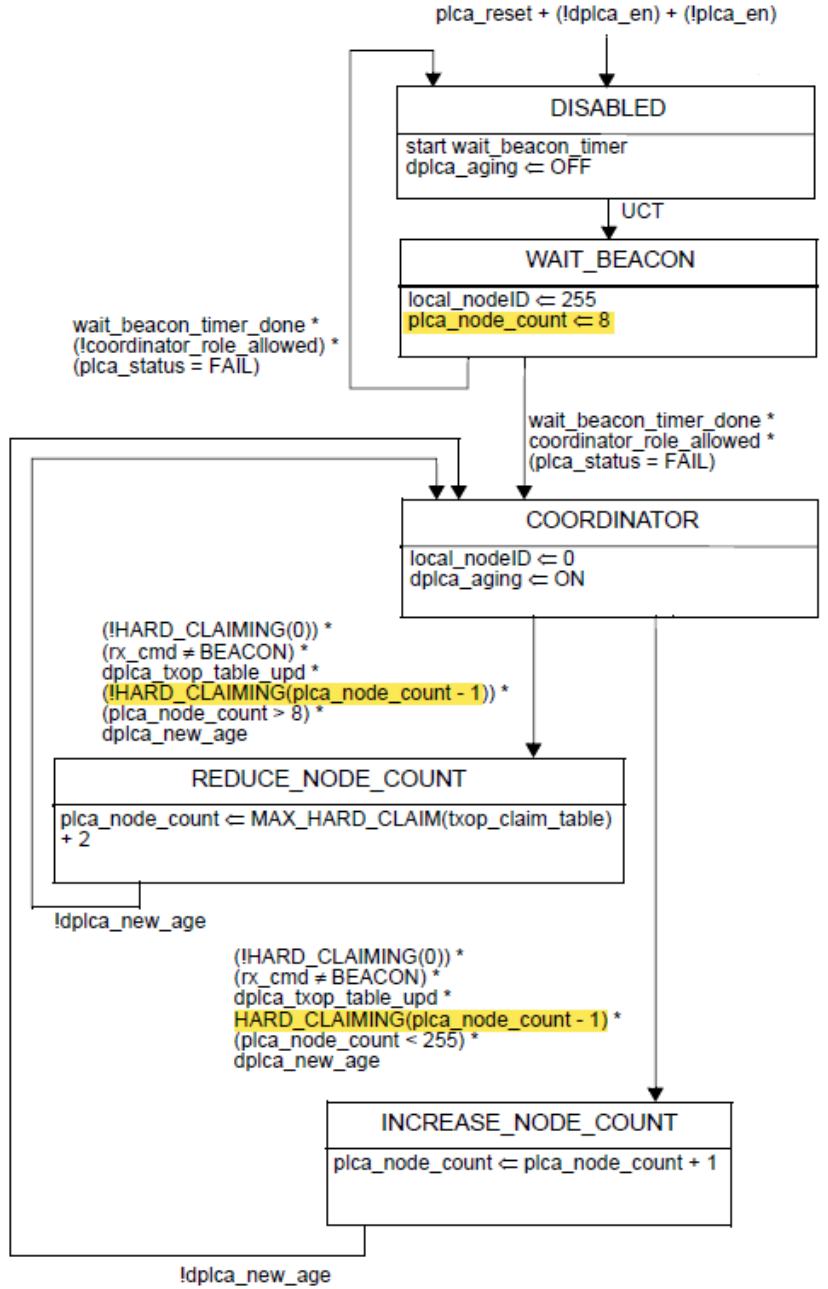
D-PLCA Overview

- **D-PLCA nodes monitor which TO are in use and move as needed**
  - Select an unused TO – one that has not heard another node transmit
  - If a D-PLCA node hears another node transmit using the same TO it has selected, it then switches to using a new unused TO
  - The system eventually converges with each node settling on its own TO

- **PLCA nodes without D-PLCA simply use their configured / assigned Transmit Opportunity**

D-PLCA Coordinator Overview

- **Coordinator self-promotes if no BEACONs are heard within the wait_beacon_timer**
- **Begin with an initial plca_node_count of 8**
  - Allows for eight transmit opportunities, 0-7
- **Monitors followers claiming the last TO (plca_node_count-1) and expands/contracts plca_node_count accordingly**
  - The last TO in the cycle is to always be unclaimed.
  - If a follower claims the last TO, the coordinator increases plca_node_count by one.
  - Otherwise, the coordinator reassigns plca_node_count to two greater than the highest TO in use.



(Only portions of the D-PLCA Control State Diagram (Figure 148-8) relating to the coordinator is shown)

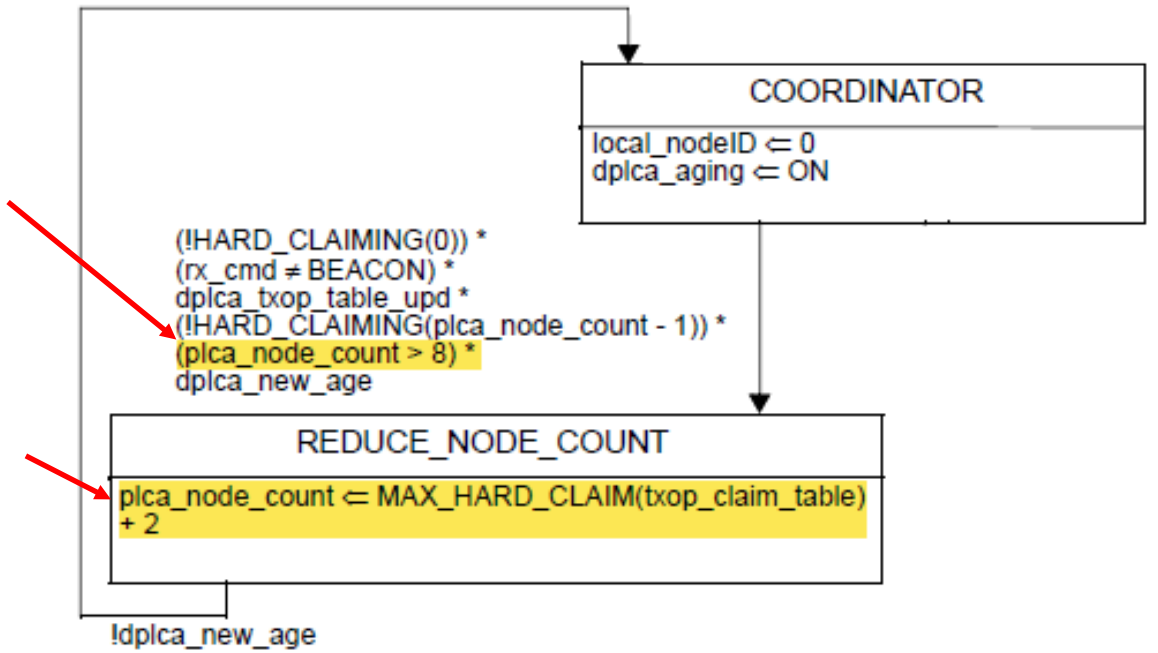
MICROCHIP

Comment #46 Problem

- **What happens to nodes that are statically assigned localNodeID > 7?**
  - Coordinator may *never* expand plca_node_count large enough to include the node.
    - Only if a D-PLCA node claims TOs up to the statically assigned node IDs
  - Static nodes may therefore *never* receive a TO on which to commit
- **Existing PLCA systems may contain many more statically assigned nodes**
  - Some up to 40 nodes!

Comment #46 Corner Case

- **If multiple nodes drop off the network at the same time, it is possible to assign plca_node_count to a value less than the desired minimum**
  - plca_node_count must be greater than the minimum to enter REDUCE_NODE_COUNT
  - But highest claimed TO returned could result in plca_node_count being reduced too much
  - Need to test the highest claimed TO prior to assignment to plca_node_count
    - Also allows elimination of plca_node_count as condition of entry to REDUCE_NODE_COUNT



(Only the relevant portion of the D-PLCA Control State Diagram (Figure 148-8) shown)

MICROCHIP

Proposed Solution

- **Specify a *minimum* plca_node_count that the D-PLCA coordinator begins with**
  - The D-PLCA coordinator will expand plca_node_count to accommodate D-PLCA followers as needed
  - Removal of D-PLCA followers will cause coordinator to shrink plca_node_count, but never below never below the minimum
  - The minimum plca_node_count *must* be greater than the largest statically assigned PLCA node ID
- **Each D-PLCA device that is permitted to become a coordinator (dPLCACoordinatorRoleAllowed = TRUE) must be configured to accommodate the largest statically assigned node ID**

Proposed Solution

- **New D-PLCA variable**

  dplca_min_node_count

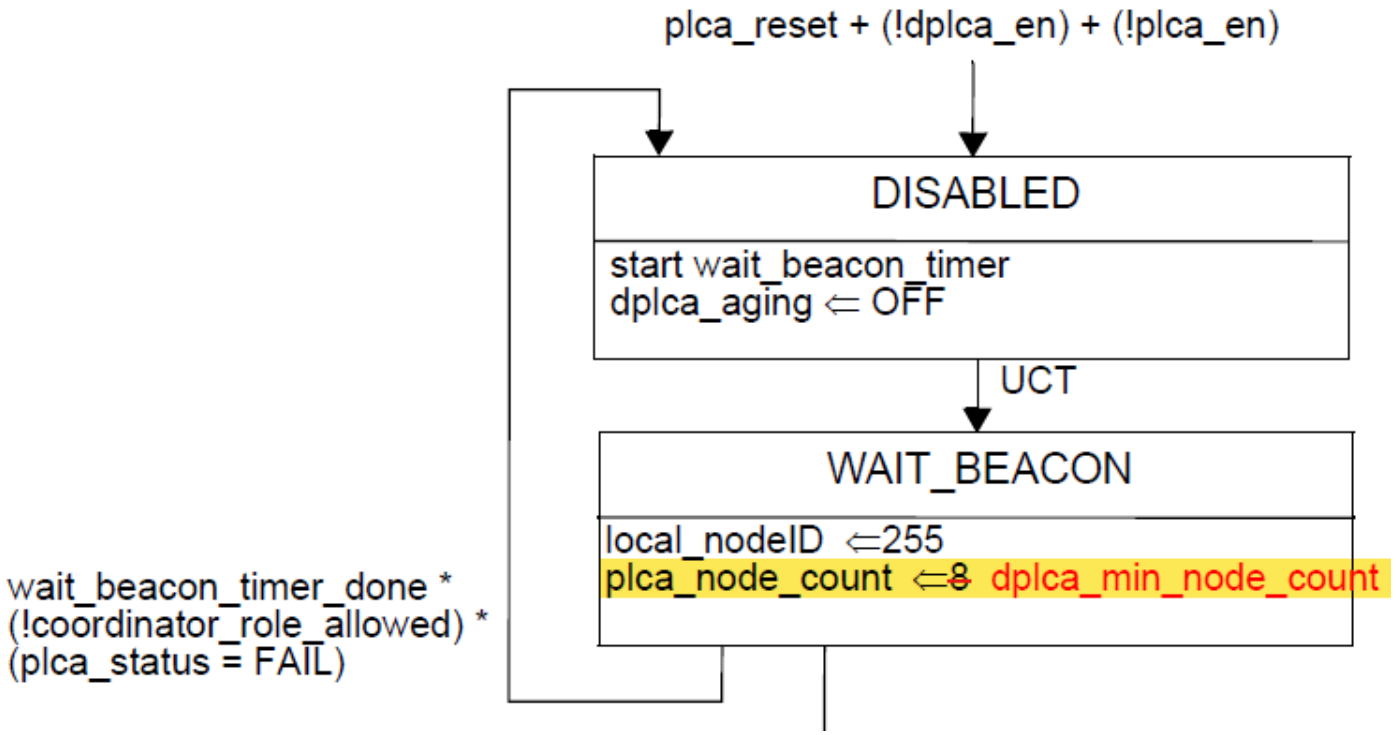
  Minimum number of PLCA nodes on the mixing segment receiving transmit opportunities before D-PLCA coordinator generates a new BEACON. The D-PLCA coordinator will reduce the number of transmit opportunities below this value. All PLCA nodes operating without D-PLCA enabled should have a statically assigned PLCA local_nodeID below this value. Nodes without D-PLCA enabled and set with a local_nodeID greater than dplca_min_node_count-1 may never get a transmit opportunity allocated.

  Values: integer number from 1 to 255

  Default: 8

Proposed Solution

- **Change initialization of plca_node_count in WAIT_BEACON**



(Only the relevant portion of the D-PLCA Control State Diagram (Figure 148-8) shown)

Proposed Solution

- **Update action in REDUCE_NODE_COUNT state**
  - Test highest claimed TO and limit reduction of plca_node_count to the desired minimum node count
  - Prevents corner case of assigning plca_node_count below the minimum

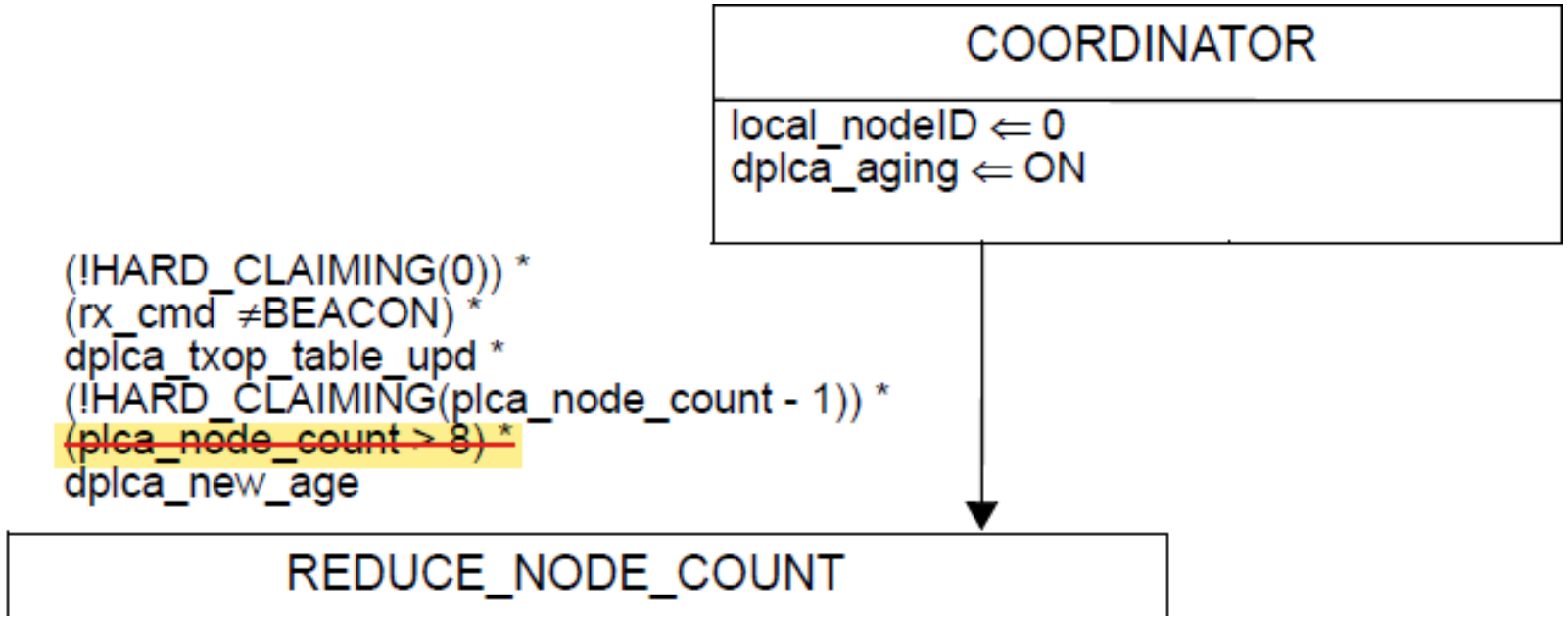
REDUCE_NODE_COUNT

IF (MAX_HARD_CLAIM(txop_claim_table) + 2) < dplca_min_node_count) THEN
  plca_node_count ⇐ dplca_min_node_count
ELSE
  plca_node_count ⇐ MAX_HARD_CLAIM(txop_claim_table) + 2
END

(Only the relevant portion of the D-PLCA Control State Diagram (Figure 148-8) shown)

Proposed Solution

- **Change condition from COORDINATOR to REDUCE_NODE_COUNT**
  - Eliminate test for plca_node_count due to fix in REDUCE_NODE_COUNT action



(Only the relevant portion of the D-PLCA Control State Diagram (Figure 148-8) shown)

Thank You

(Editing instructions follow)

Editing Instructions - 1

- **Insert new D-PLCA variable in 148.4.7.2 (P76 L26)**

  dplca_min_node_count

  Minimum number of nodes on the mixing segment receiving transmit opportunities before D-PLCA coordinator generates a new BEACON. The D-PLCA coordinator will expand the number of transmit opportunities beyond this value, as needed. All PLCA nodes operating with D-PLCA disabled must have a statically assigned PLCA local_nodeID below this value. When Clause 30 management is implemented, this variable maps to the aDPLCAMinNodeCount attribute defined in 30.16.1.1.14.

  Values: integer number from 1 to 255

- **Insert new aDPLCAMinNodeCount attribute (P33 L22)**

  30.16.1.1.14 aDPLCAMinNodeCount

  ATTRIBUTE

  APPROPRIATE SYNTAX:

  INTEGER

  BEHAVIOUR DEFINED AS:

  This value is assigned to define the minimum number of nodes getting a transmit opportunity before a new BEACON is generated by a D-PLCA coordinator. Valid range is 1 to 255, inclusive. The default value is 8.;

Editing Instructions - 2

- **Update Figure 148-8 (P79) as follows:**

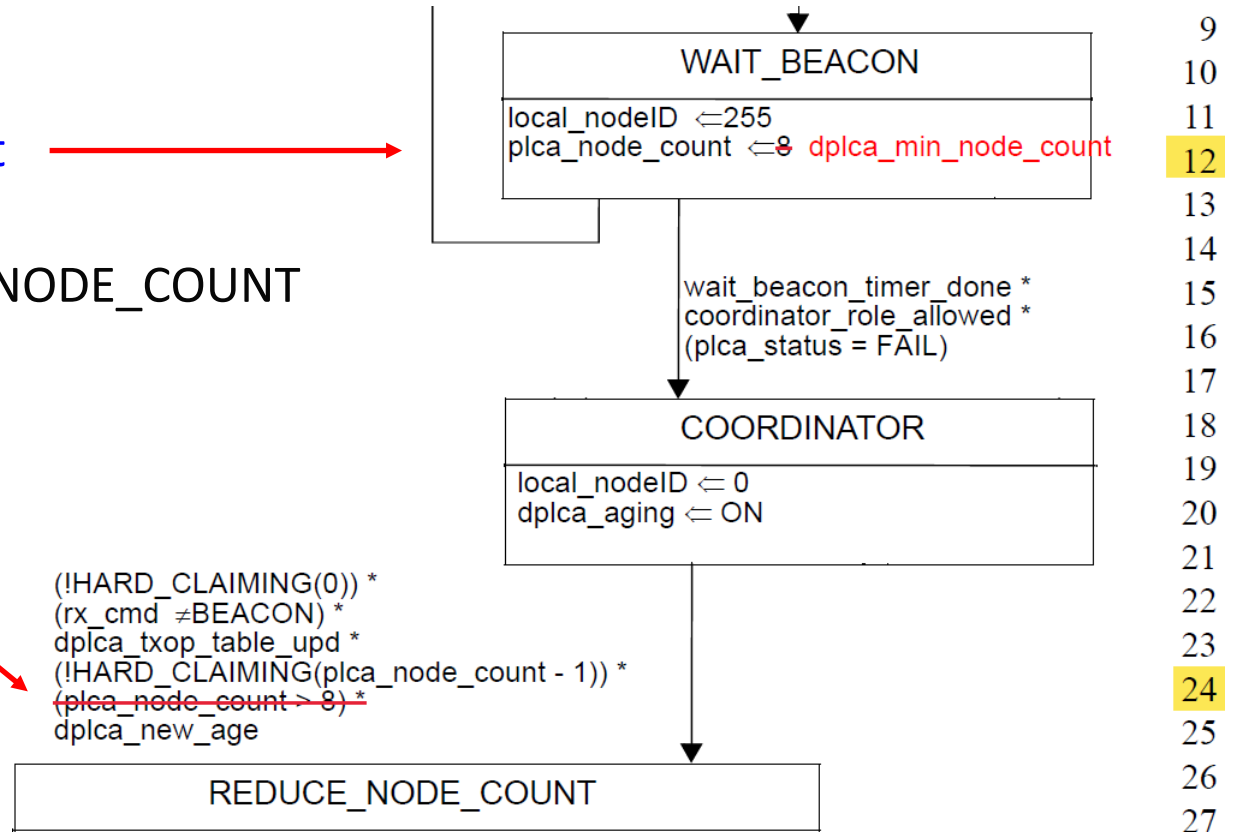
L12: In state WAIT_BEACON

Change: plca_node_count ⇐ ~~8~~

To: plca_node_count ⇐ dplca_min_node_count

L24: In transition from COORDINATOR to REDUCE_NODE_COUNT

Delete: ~~(plca_node_count > 8) *~~



Editing Instructions - 3

- **Update Figure 148-8 (P79) as follows:**

L27: Change actions in REDUCE_NODE_COUNT

Change:

plca_node_count ⇐ MAX_HARD_CLAIM(txop_claim_table) + 2

To:

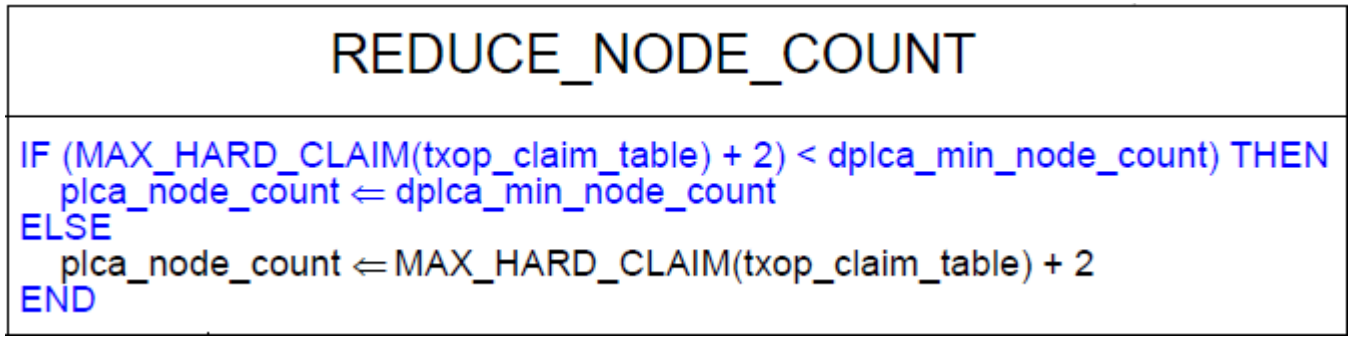
IF (MAX_HARD_CLAIM(txop_claim_table) + 2) < dplca_min_node_count) THEN

plca_node_count ⇐ dplca_min_node_count

ELSE

plca_node_count ⇐ MAX_HARD_CLAIM(txop_claim_table) + 2

END



Editing Instructions - 4

- **Update third sentence in second paragraph of 148.4.7.1 (P75 L14) as follows:**

  When using D-PLCA with statically assigned IDs, values in the range of ~~0 to 7 should~~ 1 to dplca_min_node_count plus one must be assigned first as the D-PLCA coordinator will never adjust plca_node_count below the value set by dplca_min_node_count.

- **Update last sentence in sixth paragraph of 148.4.7.1 (P75 L43) as follows:**

  In this state, the coordinator will reduce plca_node_count to the highest hard claimed transmit opportunity plus one to maintain an unused transmit opportunity at the end of the PLCA cycle, or to dplca_min_node_count, whichever is greater.