IEEE P802.3cg 10SPE AD HOC MEETING

Two proposals for priority based PLCA

November 7th, 2018

Presenter : Sungkwon Park

Hanyang University, Seoul, Republic of Korea

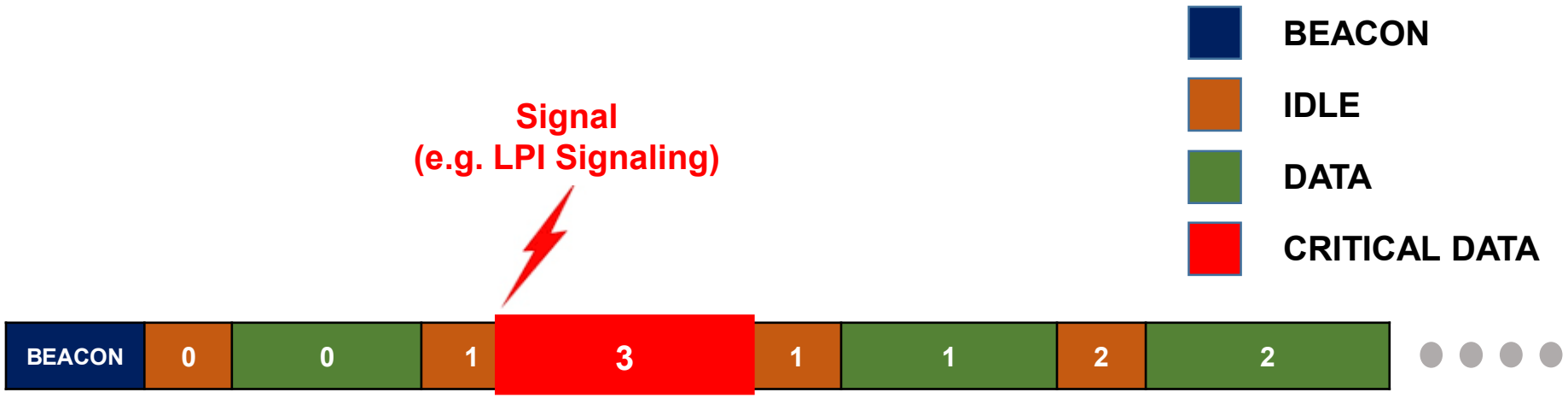
sp2996@hanyang.ac.kr

Co-authors : Byungjoo Kim / Hanyang University

Inyong Jung, Jinhwa Yun, Dongok Kim / Hyndai Motor Company

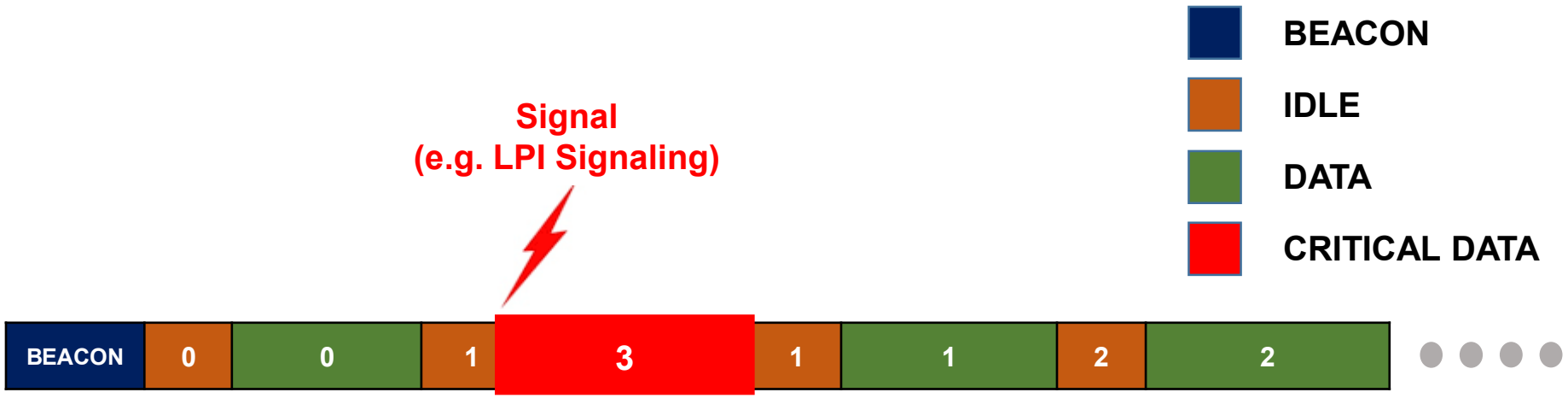
HYUNDAI MOTOR GROUP 한양대학교 HANYANG UNIVERSITY

1. Priority issues have been discussed for comment #573, but it deals with OSI layer 2
2. However, IEEE P802.3cg 10SPE should only deal with the OSI layer 1, not the upper layers
3. Our two proposals try to apply the priority method to the OSI layer 1 :
    1) Single node priority method
    2) Multiple nodes priority method
4. Using the above two methods, we can have frequent transmission opportunities for higher priority nodes in the OSI layer 1
5. Those two methods can be optional functions as a supplement of priority mechanism for PLCA



1. Assumption

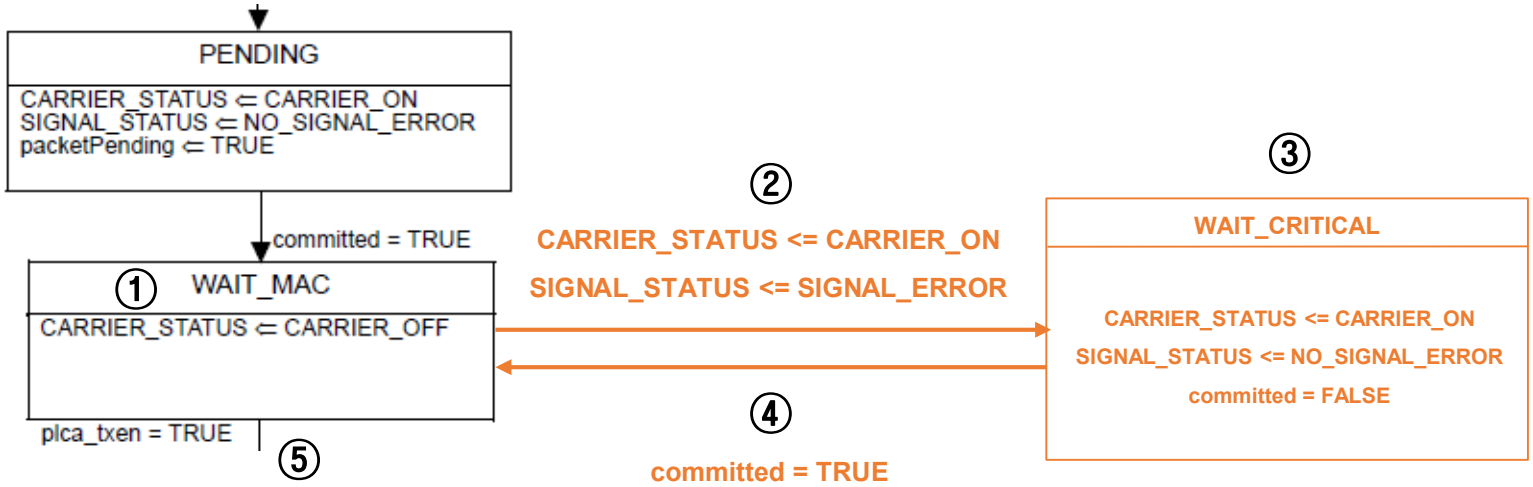
1) Only one node has high priority and the others have equally low priority.
2) All nodes should have a certain time of IDLE if they are given a transmission opportunity.
3) Any electrical signal should be used to detect the transmission request of the high priority node (e.g. LPI signaling used for Energy-Efficient-Ethernet).
4) If the node having the transmission opportunity detects the priority signal (electrical signal), the node waits for a certain time (until the transmission of the high priority node is completed) and resumes transmission.



2. Proposal

1) Each node is given sequential transmission opoortunities like the operation of the existing PLCA.
2) Node 3 is the only node with the high priority in this scenario.
3) As shown in the figure above, node 1 has an IDLE time before transmission, but CRITICAL DATA transmission request of node 3 occurs at the corresponding IDLE time.
4) Node 3 receives the transmission opportunity and transmits CRITICAL DATA preferentially.
5) Node 1 waits until the transmission of CRITICAL DATA is completed, and then starts transmission with a certain time of IDLE.
6) If there is no CRITICAL DATA transmission request, the PLCA transmission scheme is maintained.

Figure 148-5 PLCA DATA state Diagram



3. Need to be added

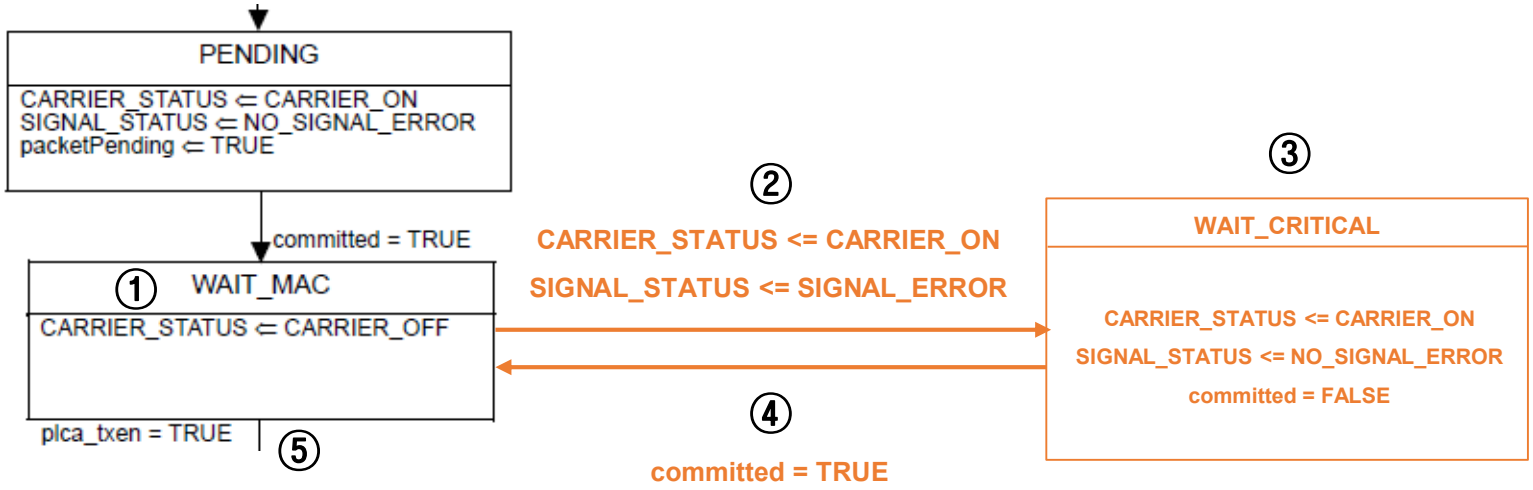
- Figure 148-5 shows the state diagram of the operation of the node with the transmission opportunity.
- For **single node priority method**, the node having the existing transmission opportunity is deprived of the transmission opportunity at the idle time, waits for the completion of the transmission of the CRITICAL DATA, and then starts transmission.

① WAIT_MAC = IDLE time

② When an electrical signal is received, the CARRIER_STATUS is in the CARRIER_ON state to transmit CRITICAL DATA and the signal status forces the SIGNAL_ERROR state to enter WAIT_CRITICAL.

CARRIER_ON && SIGNAL_ERROR == CRITICAL DATA transmission

Figure 148-5 PLCA DATA state Diagram



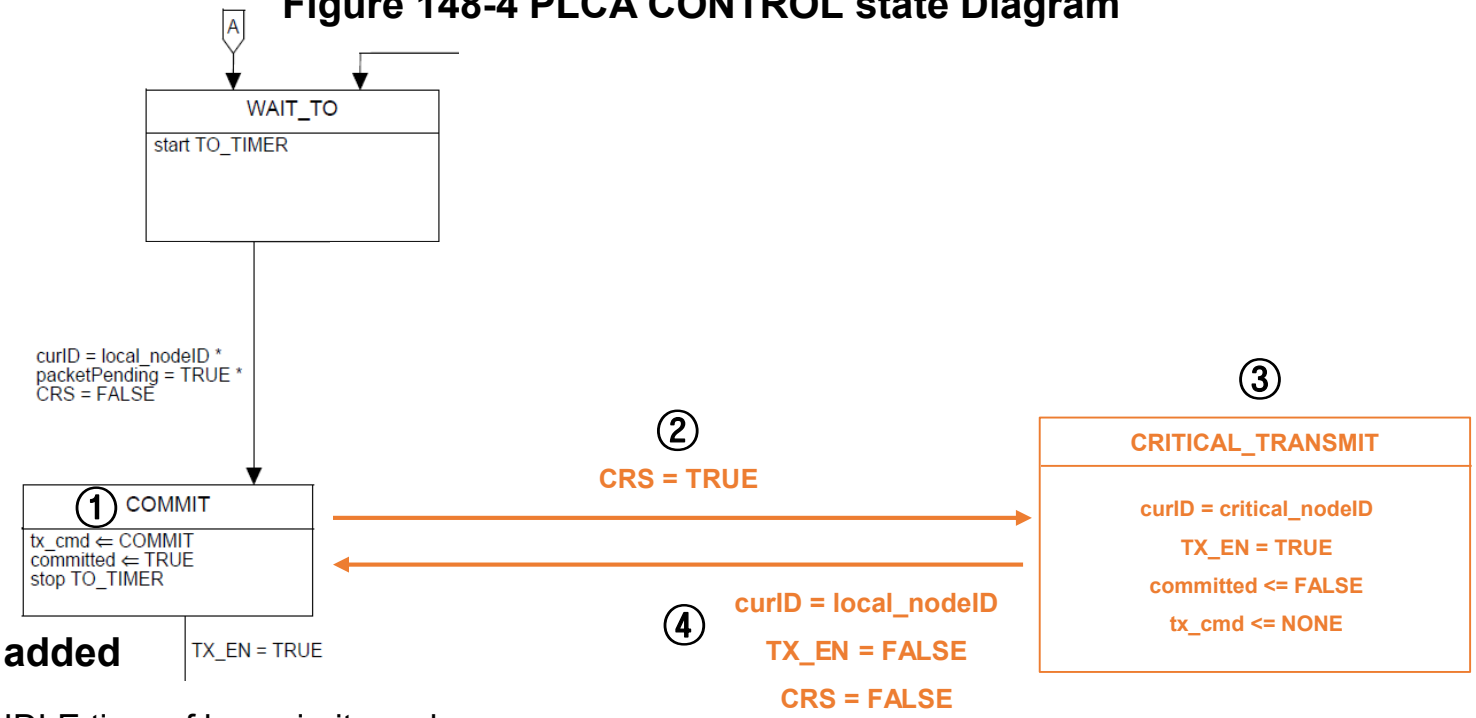
3. Need to be added

③ After entering the WAIT_CRITICAL state (CRITICAL DATA transmission), the state of the node having the transmission opportunity recognizes the transmission of the CRITICAL DATA through CARRIER_STATUS <= CARRIER_ON and waits (committed = FALSE).

④ After CRITICAL DATA transmission is completed, the waiting node acquires the transmission opportunity again (committed = TRUE).

⑤ The waiting node have an IDLE time and start to transmit DATA.

Figure 148-4 PLCA CONTROL state Diagram



3. Need to be added

① It is IDLE time of low priority nodes.

② An electrical signal has been detected (CRS = TRUE).

③ The transmission opportunity is passed to the node that generated the electrical signal (curID = critical_nodeID**).** The node with the previous transmission opportunity stores the transmission sequence number via the local_nodeID variable.

④ When the transmission of the critical data is finished, the transmission opportunity is returned to the original node (curID = local_nodeID) and the PLCA transmission cycle is continued.

1. **Assumption**
   1) Assign more transmission opportunities to specific 2 nodes which is called Multiple Nodes Priority (in our scenario, node #0 and node #1 are relatively high priorities in vehicles. Those nodes are kinds of ECU such as brake, airbag, engine,.etc).
   2) The nodes with a lower number, the nodes with higher priority (e.g. priority of node #0 > #1 > #2…).

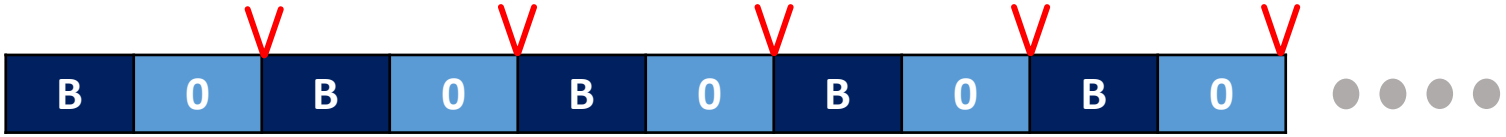
2. **Proposal**
   1) The number of nodes is N.
   2) Node #0 and node #1 are Multiple Nodes Priority.
   3) There are two kinds of cycle.
      - Main-Cycle consists of N * (N - 1) slots.
      - Sub-Cycle consists of N slots
        - The transmission opportunities of the nodes (Multiple Nodes Priority) gradually increase as the subcycle proceeds.
      - (ex) N = 3, { (012) (010) }
      - (ex) N = 4, { (0123) (0120) (0101) }
      - (ex) N = 5, { (01234) (01230) (01201) (01010) }

If N < 3, use existing PLCA

Number of nodes = N

N = 1

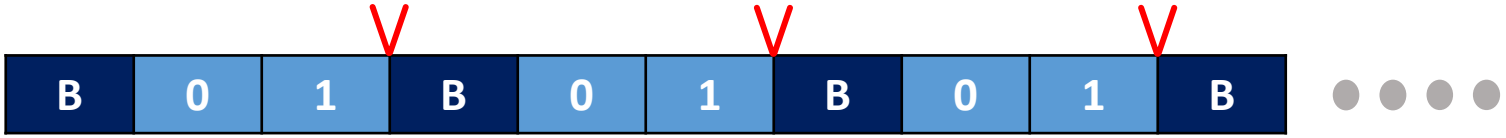
V : The point at which one cycle ends



Number of nodes = N

N = 2

V : The point at which one cycle ends



- **B means BEACON, the numbers mean the node ID.**
- **In case of N < 3, it can be said that only one node has a transmission opportunity or a maximum of two nodes alternate, so that a sufficient transmission opportunity is guaranteed.**

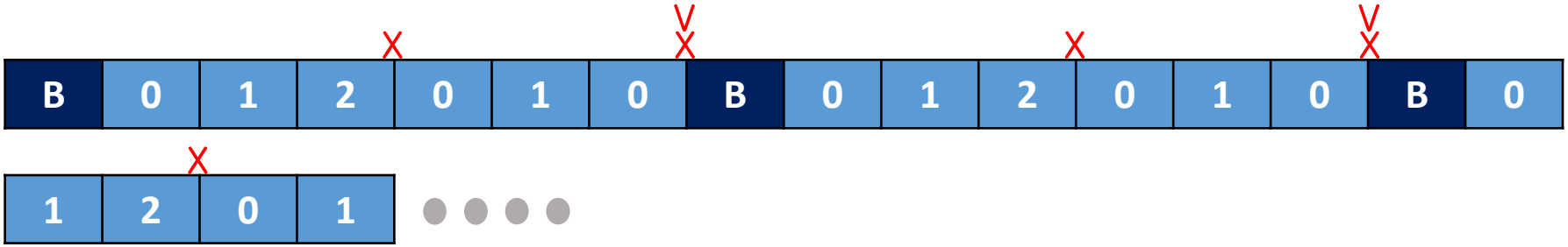
If N ≥ 3, use Multiple nodes priority method

Number of nodes = N

N = 3

V : The point at which one Main-Cycle ends

X : The point at which one Sub-Cycle ends



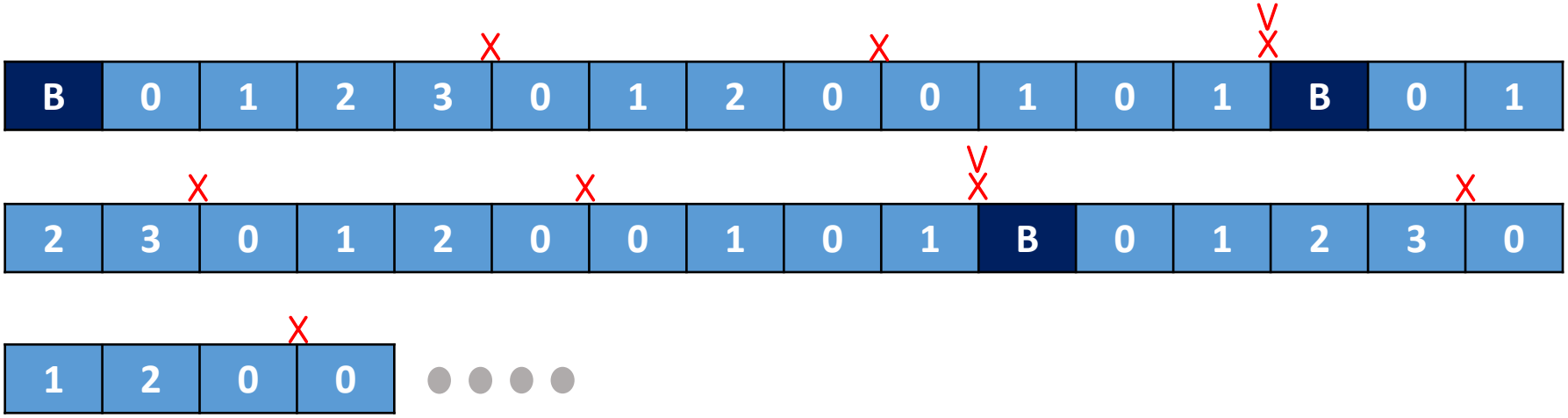
- **First, BEACON is transmitted and N * (N – 1) time slot cycles are started.**
- **One such cycle is called Main-Cycle.**
- **After one Sub-Cycle, the next Sub-Cycle proceeds.**
- **Since the node #2 is considered to be the lowest priority, there is no transmission opportunity time slot assigned to the node #2 in the next Sub-Cycle.**
- **In the last Sub-Cycle, only the node #0 and node #1 have been granted the transmission opportunity, so the Main-Cycle is ended and the BEACON is transmitted again to restart the Main-Cycle.**

Number of nodes = N

N = 4

V : The point at which one MAIN-CYCLE ends

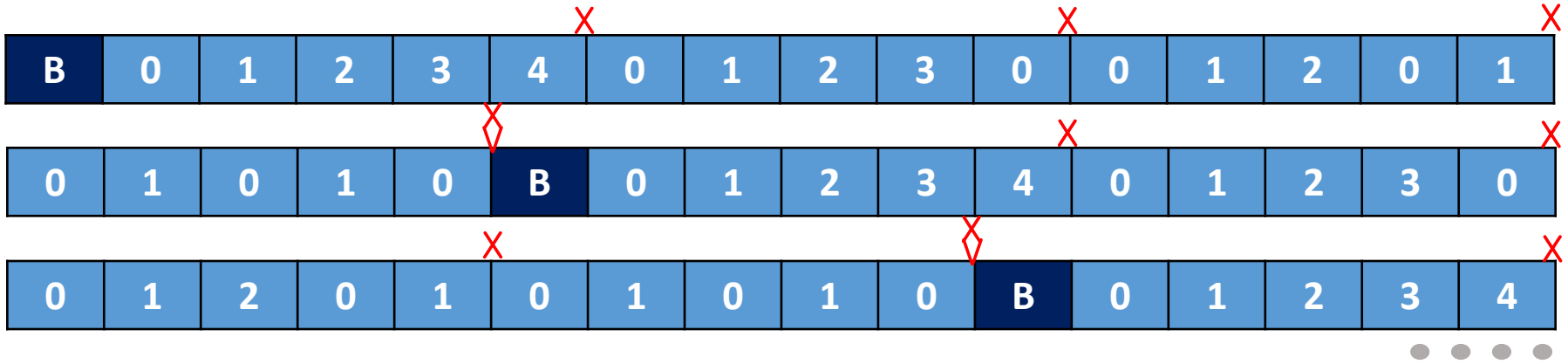
X : The point at which one SUB-CYCLE ends



- As described above, the Main-Cycle is made up of a total [4 * (4 - 1) = 12] time slots, and each Sub-Cycle consists of 4 time slots.

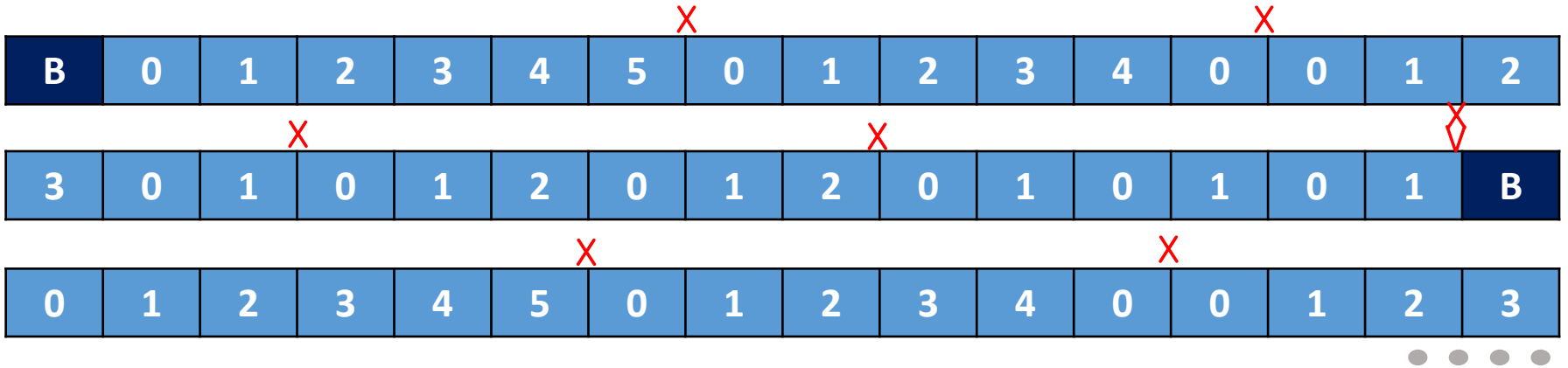
Number of nodes = N

N = 5



Number of nodes = N

N = 6



Comparison of Efficiency

- S = The sum of transmission opportunities of node #0 and node #1 in one cycle of the existing PLCA
  - ✓ If N > 2, S = 2 * (N – 1) slots

- S = The sum of transmission opportunities of node #0 and node #1 in the Main-Cycle of the proposal
  - ✓ If N = 3, S = 5 * N – 11 (+ 1) = 5 * N – 10 = 5 slots
  - ✓ If N > 3, S = [(5 * N) – 11] slots
  - ✓ S = 5 slots for N = 3, and S = [5 * N – 11] slots for N > 3

- lim n -> ∞ {(5 * N – 11) / [2 * (N – 1)]} = 2.5
  - ✓ Node #0 and Node #1 have transmission opportunities of about 2.5 times as much as those of the existing method

THANK YOU !