IEEE 802.3 SPMD 10SPE Multidrop Enhancements Study Group

Objectives for the Lighting, Automotive and Elevator/Escalator Segments
Follow-up on Topology Discovery (Ranging)
Reflectometry over a mixing segment

11 March 2020
Ah-hoc
v11

Presenter

- Gergely Huszak (Kone)

Supporters

- Piergiorgio Beruto (Canovatech)
- Scott Wade (WadeLux/DiiA)
- Kirsten Matheus (BMW AG)
- Cornelia Eitel (Hirschmann Automation and Control)
- Wojciech Koczwara (Rockwell Automation)

Previous presentation: Topology Discovery (Ranging)

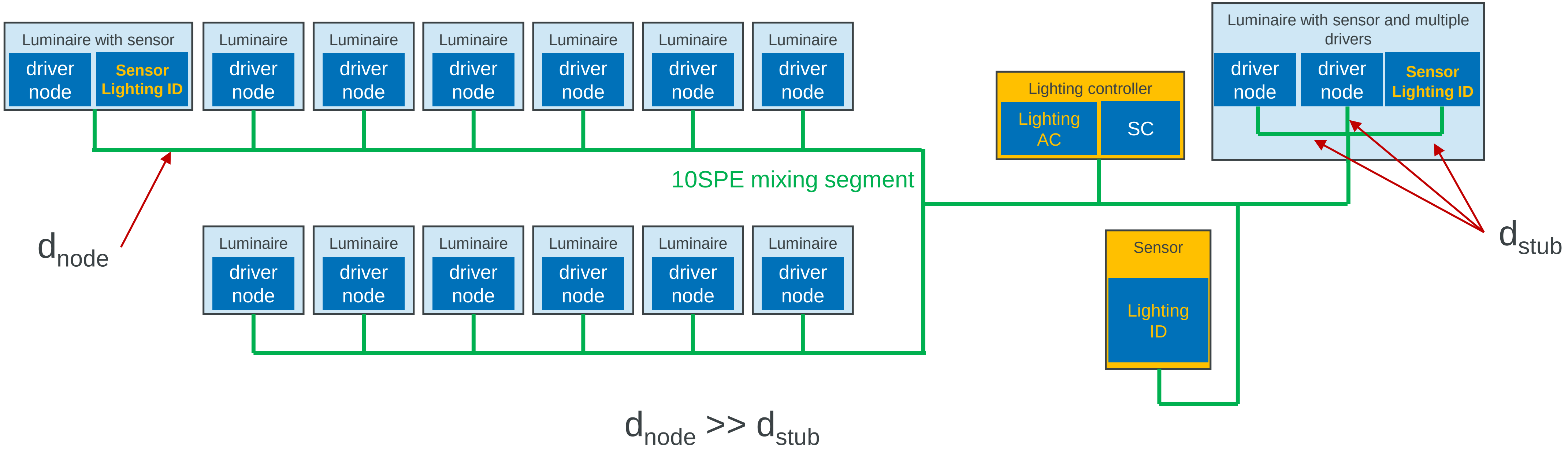
http://www.ieee802.org/3/SPMD/public/jan20/Huszak_01_SPMD_0120.pdf

The feature

- Use reflectometry over mixing segment to **measure** absolute or relative **distance** (**order**) of devices (PHYs) and/or phenomena (shorts, branches, discontinuities etc.) over a mixing segment, to achieve any of the following:
  - Automatic location- or order-dependent configuration of devices (PHYs and/or host application)
  - Topology discovery
  - Fault finding

  Note: When wave propagation properties of the cable is known (measured or made available by the cable provider), exact distance can be measured
- Works the best with **linear** network **topology** and when the **measurer** is **at the end** of the segment, **but** can also be used in any scenario, when a one-to-one mapping (bijection) can be made between distance and node
- May be run **in conjunction with PLCA** in a coordinated matter, to avoid collisions and/or unexpected degradation of network performance

Use case: lighting*



Lighting commissioning: The location or proximity of devices helps make it easier to assign them to groups that operate together. Each room or area may have lighting devices in 1 or more groups. Without knowledge of the topology, each luminaire/device must be identified (flashed) in turn.

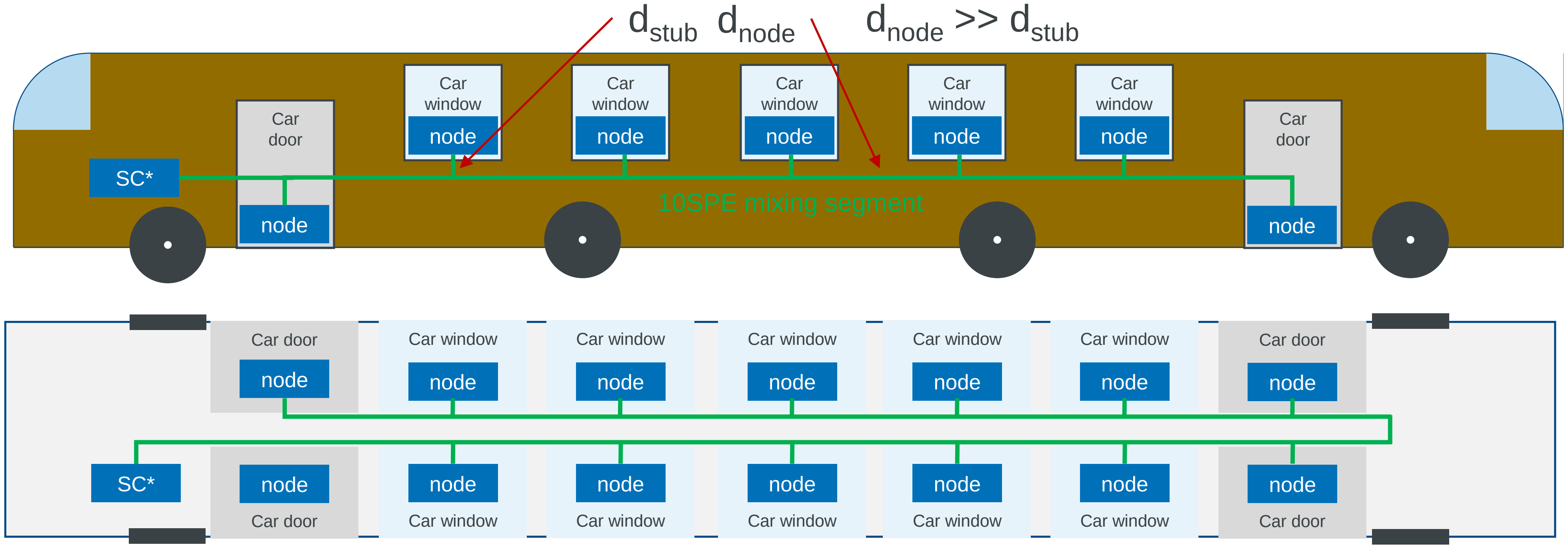
Lighting AC = Lighting application controller (at least one per lighting system)
Lighting ID = Input device: provides information to the system, such as sensor data, button presses, etc.
SC = Segment coordinator. Often in the same product as the lighting application controller

* Scott Wade (WadeLux/DiiA)

Use case: trains and buses

Side and top views

$t_{reflection}$: $node_{closest} < node_{middle} < node_{farthest}$



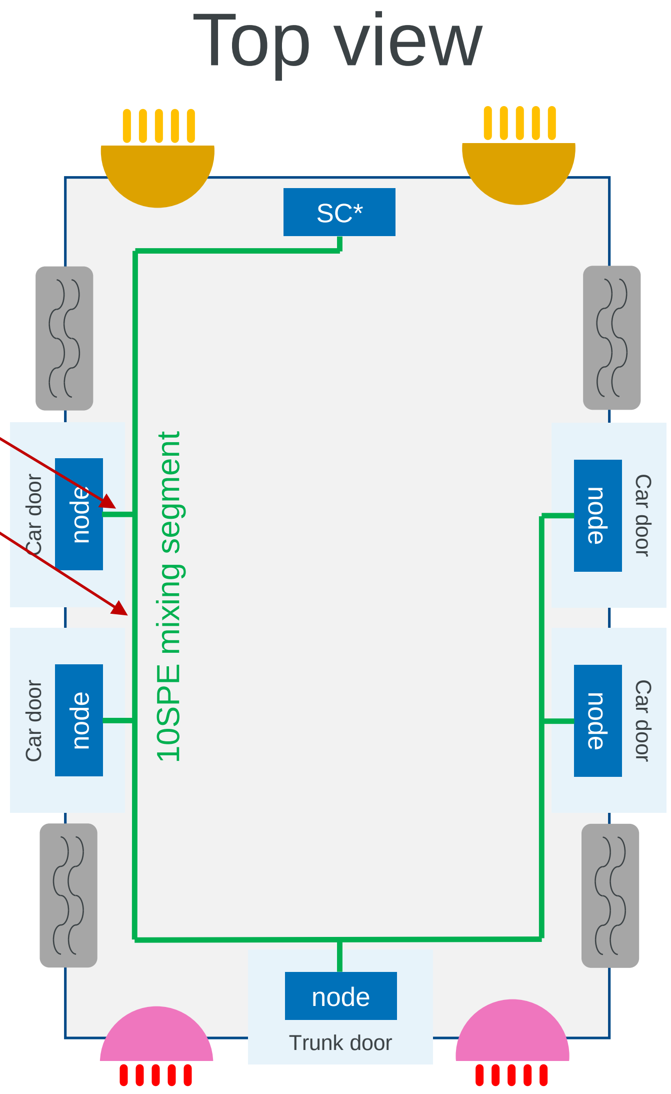
Result: each physical node can be assigned location-specific function (configuration) as SC can detect each node's physical location through ranging. For example – due to wiring rules – the top-left node in the train car can receive its function-specific configuration at first boot, without need for additional hardware element/processes

Use case: cars

d_{stub}

d_{node}

$d_{node} >> d_{stub}$



$t_{reflection}$: $node_{closest} < node_{middle} < node_{farthest}$

* Assumption

Parameters

- Some of the parameters to be discussed include:
  - Precision: based on the feedback of supporters, this could be ≤0.1m (≈0.5ns)
    - This permits **order detection** and is driven by minimum node separation
  - Accuracy: ≤0.2m (≈1ns)
    - Allows informative **user feedback**, such as “cable fault detected xx meters away from head node”
  - Allowed topologies, and their properties, such as:
    - Node separation
    - Stub length
    - Stub separation
    - Location of the measurer
    - T-pieces

Example standard text

- **Measured device**: “when commanded through .., PHY shall present an impedance of at most .. at its MDI for a time duration of ..”
- **For the measurer**: “when commanded through .., PHY shall issue a pulse and measure the time it takes for some reflection to arrive back, with an accuracy of at least .. and precision of at least ..”

Why in the standard?

- Until now, feature of similar kind were handled outside of the standard (e.g. through MSA)
- Stakeholders expressed interest in:
  - being capable of having **multi-vendor networks**, where PHYs from different providers are inter-connected over a mixing segment
  - having a **vendor-independent interface** (e.g. registers) to the feature: this is to cover backward compatibility concerns
- **Interoperability between** components from **all vendors** this level cannot be handled by MSAs

Challenges and remaining work

- Defining the smallest set of features that would need to be defined in the standard to maintain **interoperability**
- **Low-complexity** technical **solution** may exists, but more work is needed on mustering precise data of technical feasibility (preferably without DSPs, PLLs and high-speed ADCs)
- Defining the **conditions** under which this feature can be used, e.g.:
  - Topologies
  - T-pieces
  - Measurer in the middle of the segment
- Optionally, define the feature so that, that it would also permit **channel** (cable, connector) **diagnostics**, through detection of changes in impedance, its distribution or abnormal values of those

Industry's interest

- Based on feedback so far, an estimated volume of ≈300 million devices per year is seeking a solution to these problems, as follows:
  - Lighting: 250M/y
  - Automotive: 20M/y
  - Elevator/escalator: 20M/y
  - Industrial/control: 1+M/y

Presenters' request

- Provide **feedback** on the presentation
- Express **interest** in and contribute to picking correct feature set and parameters
- Support a motion to list a **new objective** (#12) that reads as follows:
  "**Support detection and discovery of physical node locations on the mixing segment**"

Thank you for your kind attention
Any questions?