Summary of Progress on Mixing Segment Specifications in 802.3da

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Updated to remove “MDI” language and clarify it is the PMA attached
Draft 0.7 Content

FROM JUNE 2022, DIMINICO CONTRIBUTIONS
Background

Background in diminico_SPMD_01_06152022

Adjustment resulted from online and offline discussions

Adopted in June 2022 (6/29/2022) from diminico_SPMD_02_06292022

Limited clarity on trunk connections & compensation
Draft 0.7 - topology

Trunk – stub

- Other configurations allowed
  - Meaning stars, Y’s, etc. ARE allowed
  - Must meet other requirements in 168.7
- Defines stubs with TC (trunk connection), MDI attachment points
  - TC is a single point, only defined on the stub
  - Defines ‘edge terminations’ on trunk
  - Figure is an example

Source: IEEE P802.3da D0.7
Draft 0.7 – Insertion Loss

IL of trunk specified between edge terminations without MDIs or loads attached

○ Are unterminated stubs attached?, If there is compensation at the TC, is that attached?

IL and delay of (separated) stub from TC to MDI attachment point specified

The mixing segment insertion loss is specified by independently meeting the requirements specified in this section for trunks and stubs. The stub time delay is specified to limit reflective resonances.

Source: IEEE P802.3da D0.7
Draft 0.7 – Return Loss

RL at MDI attachment point without MDI or other loads attached is specified

◦ If compensation is used, is that attached?

The mixing segment at any MDI attachment point, without the MDI or other loads attached, shall meet the return loss values determined using Equation (168–6). The reference impedance is 50 Ω.

Source: IEEE P802.3da D0.7

RL at Edge terminations is specified without any MDIs or loads

◦ Are unterminated stubs attached?, If there is compensation at the TC, is that attached?

The mixing segment edge terminations, without the MDI or other loads attached, shall meet the return loss values determined using Equation (168–7). The reference impedance is 100 Ω.

Source: IEEE P802.3da D0.7
RX Model
RX Model – July 2022 & after

Correlator receiver model, introduced in beruto_3da_20220711_rx_model

Added to consensus model, w/programmable TX filter paul_02_da_09142022

Follow-on presentations:
- diminico_SPMD_01_1122
- Paul_da_20221207
- diminico_SPMD_01_0123
- diminico_SPMD_01_0223

*The simulation purpose is to evaluate how well the proposed metric follows the noise environment compared to the receiver model performance*
Presentation summary

Diminico 11/22 – showed compensated/uncompensated 30 node, 75m topologies working – no proposed specifications

Paul 12/22 – looked for worst-case location to attach a node, found worse than Diminico 11/22, conclusion:
- We are going to need rules about how much a node can reflect
  - Either compensate nodes that have high parasitic capacitance
  - Or design nodes that have low parasitic capacitance (<5pF?)
- Zimmerman 12/22 – showed 10BASE-2 approach to specifying reflections – need more test points

Diminico 1/23
- Confirms Paul sensitivity to node position and reflection
- Considers return loss on equally spaced nodes due to varying impedance segments
  - Measured: No MDI’s and No compensation ; Compensation + MDI’s attached ; or Compensation + dummy-MDI load attached
  - NOT: MDI without compensation

Diminico 2/23
- Eliminate stubs – specify ‘in and out’
- Compensation, when used, in the device MDI connector...
So, where are we?

Latest presentations have no stubs – this suggests
- Delete stub measurement from draft
- Keep trunk IL, RL measurements without MDI’s attached and without compensation to measure trunk as a unit
  - This needs to include margin for TC connectors, PHY loading

Need to specify a trunk connection interface
- Connects left & right sides of trunk
- Connects to PMA/PMD of PHY
- Key question: is the TC connector part of the mixing segment, or is it part of the PHY/DTE?

- When PMA/PMD is not attached, acts like an inline connector (prescribed IL, prescribed RL)
  - IL & RL without PMA/PMD should be included in mixing segment
  - Left, right to mixing segment – third port goes to the PMA
  - w/o PMA attached - Left <-> Right path is included in trunk edge-termination IL, RL specifications without MDI attached
    - Insertion loss needs to be minimal
    - Return loss needs to be high
    - Left

Question - does RL measurement sufficiently specify reflections from ‘left’ and ‘right’ of TC?
- (we should be able to use the consensus model to do this, no?)
  - Consider a mismatched TC near the far-end of the mixing segment –should that set the overall return loss limit?
So, where are we?

Latest presentations have no stubs – this suggests
  ◦ Delete stub measurement from draft
  ◦ Keep trunk IL, RL measurements without MDI’s attached and without compensation to measure trunk as a unit
    ◦ This needs to include margin for TC connectors, PHY loading

Need to specify a trunk connection interface (TCI)
  ◦ Connects left & right sides of trunk
  ◦ Connects to PMA/PMD of PHY
  ◦ Key question: is the TC connector part of the mixing segment, or is it part of the PHY/DTE?

TCI has characteristics of both
  ◦ When PMA/PMD is not attached, acts like an inline connector (prescribed IL, prescribed RL)
    ◦ IL & RL without PMA/PMD should be included in mixing segment - this likely means no compensation engaged
  ◦ When PMA/PMD is attached (or dummy MDI loading), PHY loading increases IL, decreases RL
    ◦ Need an IL budget for this extra loading that allows 30 nodes
    ◦ Need to specify left & right RL to minimize reflections

*TCI is the new MDI.... But with 2 media ports and an interface to the PMA....*
Inspiration – Clause 10 (10BASE2)

Specification is both on cabling without PMAs and on reflections WITH PMA attached

Meat of signal integrity comes from reflection specs in 10.4.1.1

These equate to return loss at the ports that connect to the mixing segment

Connection between trunk and MAU is specified separately

Source: IEEE Std 802.3-2022
Inspiration –
Trunk to MAU

States a possible T connector, but defines connection characteristics

Limits stub length via shunt capacitance

Limits reflection (10.4.1.1 specifies reflection)

Uses qualitative specifications that likely need tightening up ("shall present a low shunt capacitance...", "shall not disturb transmission line characteristics significantly...")

Provides some safety, grounding, and physical specifications that are likely not relevant

Source: IEEE Std 802.3-2022
TCI/MDI specification

TCI connects to left and right trunk pairs and presents both sides as a 4 pin interface to the PMA (MDI plane)

The TCI meets different RL & IL specs depending on whether PMA/loading is or is not attached

When no PMA attached, the TCI maintains continuity between the left and right sides of the mixing segment as part of mixing segment (like an inliner)

When a PMA is attached, the TCI routes continuity of through 4 signal interface (p_left, n_left, p_right, r_right) to the PMA, PMA completes the path from left to right

Normal RL specs associated with the MDI are met at both the left and right side of the TCI – not at a single MDI interface plane

TCI specification contains the left to right side insertion loss when the PMA is attached

Specify IL from left side to right side (and reverse)

Specify RL to mixing segment impedance

TCI (Connector if external to DTE)

“TC1” interface plane

“TC2” interface plane

PMA or dummy load

interface plane to PMA

Compensation & dummy loading are dependent on PMA design

Updated to remove “MDI” language and clarify it is the PMA attached
Summary approach

Specify trunk independent of stubs and PMA loading/compensation
  ◦ PMA loading & compensation belong in the device, because they depend on the device
  ◦ Include margin for trunk connectors as ‘inline’ connectors (unloaded, uncompensated)

TCI replaces MDI – it’s different in that it has 2 media ports, so it deserves its own name

Will need specification of end-to-end trunk insertion loss with maximum load TCI & PMAs in place
  ◦ Not specified in clause 147
  ◦ Need contribution on what the appropriate insertion loss curve is
  ◦ Need work on budget for reflection magnitude – Consensus model w/RX

Specify TCI & PMA connection (what we normally think of as MDI) as a unit
  ◦ Specify left-to-right insertion loss and left, right side return loss with PMA (or compensated loading) in place
  ◦ PMA electricals tested with TCI fixture in place, at left and right TCI ports
  ◦ Implementers can include compensation can be included here, or can be uncompensated – just needs to meet specs
    ◦ Should probably add descriptive text, but leaves room for development innovation
  ◦ Implementers can incorporate wiring and service loops (“stubs”) into device provided that TCI specs are met
  ◦ Delete mention of stubs and stub length – this is part of the TCI specification
168.7.2a Trunk Connection Interface

The Trunk Connection Interface (TCI) connects the left and right sides of the mixing segment together (trunk port CP1 and trunk port CP2) and has a third port to attach the PMA at the MDI attachment point (see 168.7). The TCI is part of the mixing segment, and the requirements of 169.7 are met with TCIs in place with or without attached MDIs as specified for the particular specification.

A TCI may be a “T” type connector to provide a mean of connecting the segments of balanced conductors and attaching a PMA to the trunk. The connection is specified so as not to disturb the transmission line characteristics of the trunk conductor significantly, except for the increased insertion loss when loaded with a PMA. TCI’s with compensation are expected to be matched to a particular PMA.

Without a PMA or PMA loading present, the differential insertion loss of the TCI between the trunk ports shall be less than TBD dB (small number) from 0.3 to 40 MHz, in each direction, measured into 100 ohms.

With the specified PMA or PMA present, the differential insertion loss of the TCI between the trunk ports shall be less than TBD dB (allows for compensation and phy loading – may be an equation) from 0.3 to 40 MHz, in each direction, measured into 100 ohms.

Without a PMA or PMA load present at the TCI attachment, the return loss of the TCI at port CP1 and CP2 shall be greater than Equation 169-X with the other trunk port terminated in 100 ohms. (NOTE – this is to allow meeting the unloaded trunk RL spec)

With a PMA or PMA load present at the TCI attachment, the return loss of the TCI at port CP1 and CP2 shall be greater than Equation 169-Y with the other trunk port terminated in 100 ohms. NOTE - this specification replaces the MDI return loss and is measured at the TCI.

The TC adaptor and the PMA attachment may be located within a single assembly, presenting negligible stub length when the PMA attachment is open circuit, and may include compensation engaged when a PMA or PMA load is attached. (NOTE – should we specify the length of a stub, and if so, how – in cm? In ns delay? – alternatively, as TBD shunt capacitance based on the various studies?)
Discussion? - Thank you