Qualifying the mixing segment

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    - This adds only a little to diminico_SPMD_01_051822.pdf
  - Piergiorgio Beruto
  - Michael Paul
  - David Brandt
  - Wojciech Koczwara

If repeaters are specified, why specify mixing segments?

- If repeater delay is a limiting factor, delay will multiply with the number of repeaters
- Error probability also multiplies with each repeater
- Therefore, minimize the number of repeaters needed
- This means maximizing node count means multidrop segments between repeaters

802.3cg wasn't for plug-and-play

- 802.3cg was targeted at engineered networks – engineered mixing segments
- Specifications were margined and simplified, and excluded many configurations that would likely work
  - Smooth functions for IL and RL essentially margin in reflections
    - Reflections cause 'wiggle' (e.g., ILD) and the limit line basically gets touched by the dips, leaving margin
    - Greater loss likely works, if the intersymbol interference is small
- Some (self included) thought cabling standards would take up component specifications for constructing mixing segments
  - Linkage to the PHY models is has proved too great
- Measurement methodologies were ambiguous due to varying impedances

What do we need to do?

- Come up with a set of specifications for mixing segments that are:
  - Unambiguously measurable
  - Maximize utility
  - Enable plug and play multidrop networking
  - While assuring PHY operation
- This presentation (and our work so far) focuses on the signal transmission path
  - The noise characteristics (balance, mode conversion) are TBD

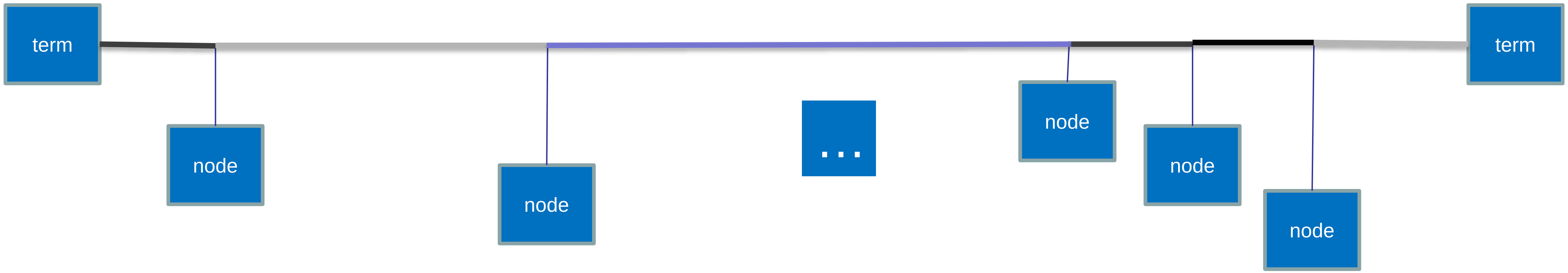
Reflection Problem in Multidrop

- The multidrop channel is dominated by ISI on the transmission path – not loss.
- Simulating the electrical parameters of a topology to get an eye diagram is neither practical, nor does a clause 147 PHY have any requirement to operate under that condition
  - Hence, an “open eye” may make you feel good about operation, may be likely to work, but is neither NECESSARY nor SUFFICIENT for operation
- 802.3da has alleviated the issue of reflections off the MDI interface of the node

Steps to a spec

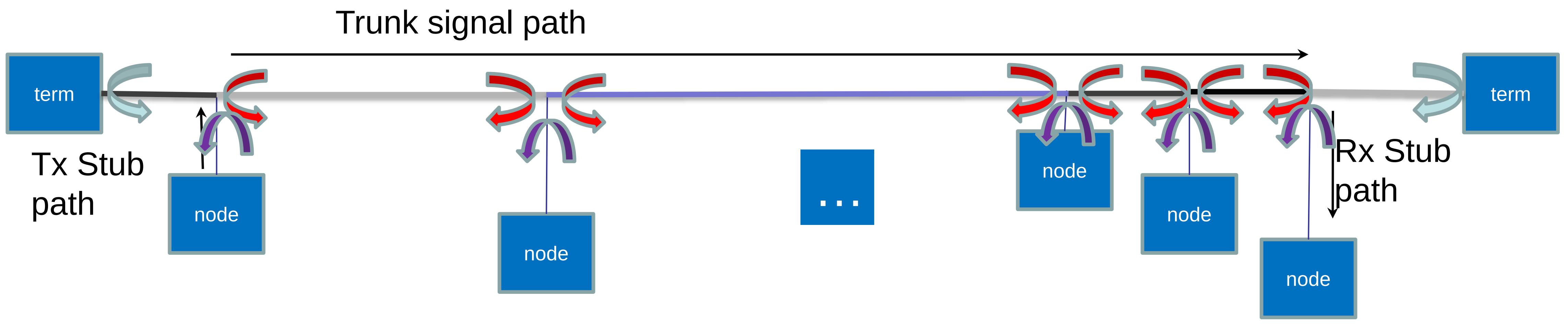
- Determine what specifications are necessary to cover the sources of ISI:
  - Transmitter specifications – PSD / pulse template
  - Which mixing Segment characteristics need to be qualified
- Consider two different mixing segment scenarios:
  - A new mixing segment (which can be decomposed by components)
  - A configured (e.g., installed) mixing segment
    - perhaps the same as the new segment, but likely simplified
- Consider a receiver model to set the limits for the transmitter and mixing segments
- This presentation focuses on the new mixing segment

Trunk-stub model / heterogeneous

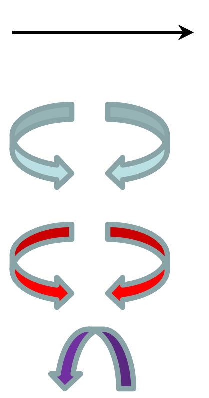


Signal paths from each node to each other node
(that's why cg specifies between all the MDI attachment points – that's N^2_{node} paths)

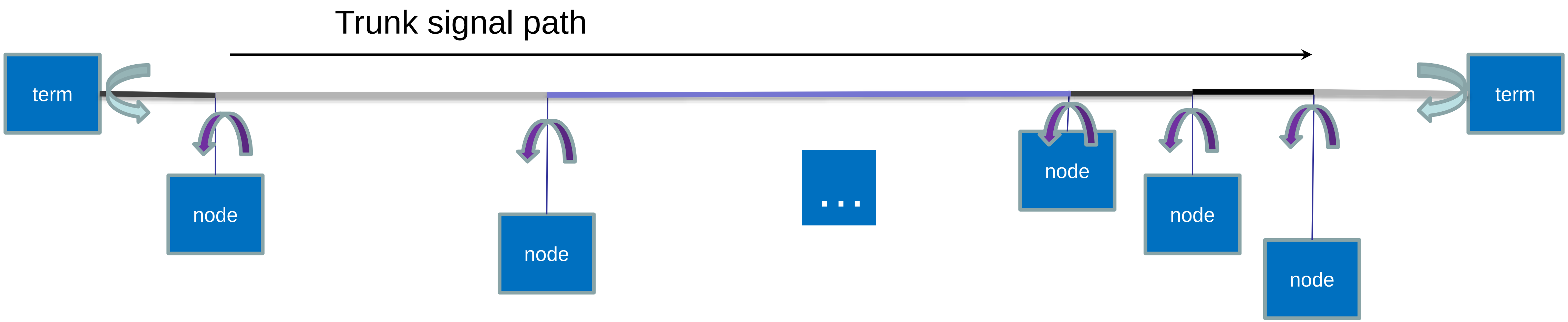
What contributes to ISI



Key: Element	Symbol
Frequency-dependent signal path insertion loss (stubs & trunk)	
Trunk termination reflections	
Stub/connection point reflections on trunk	
Stub/interface reflections on stub (reflected back by the MDI)	

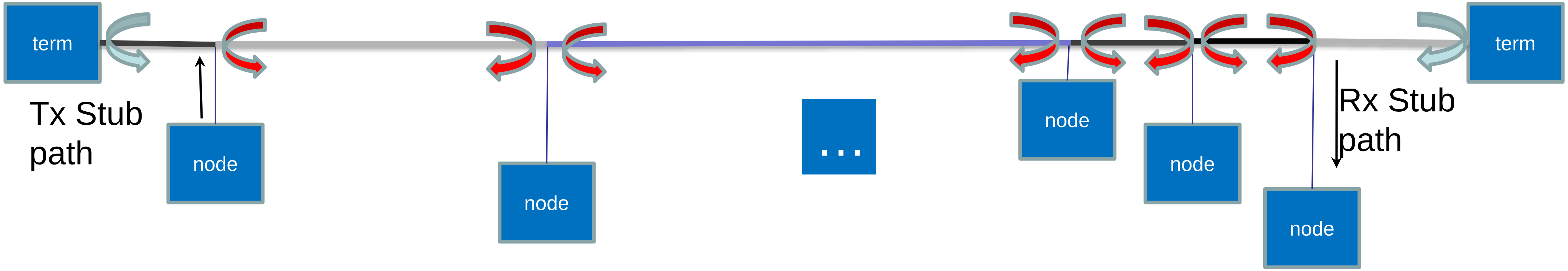


Where we were last meeting



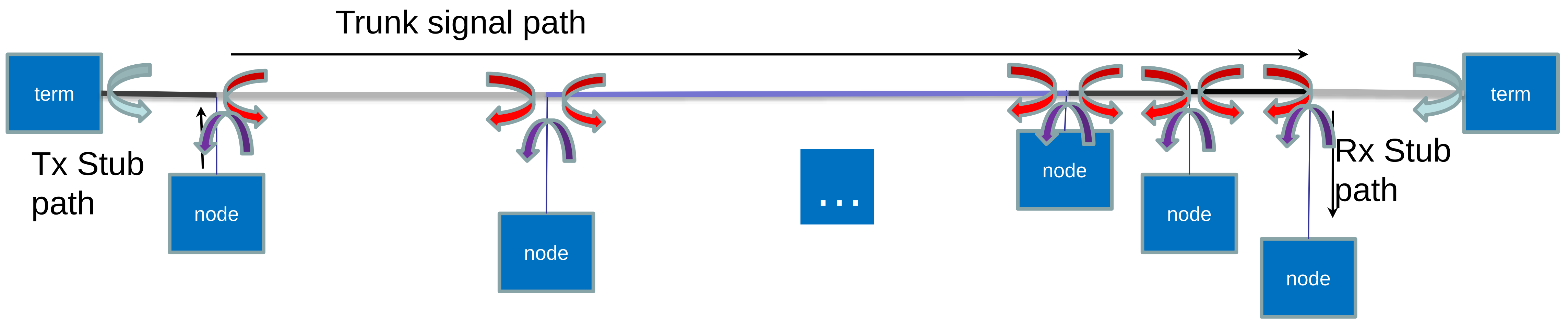
Key: Element	Symbol
Frequency-dependent signal path insertion loss (trunk only)	Trunk insertion loss
Trunk termination reflections	Trunk end return loss (100 ohm)
Stub/connection point reflections on trunk (hidden)	Hidden in trunk IL/stub RL
Stub/interface reflections on stub (reflected back by the MDI)	Stub return loss at MDI (50 ohm)

What was missing and bothering me



Key: Element	Symbol	
Frequency-dependent signal path insertion loss (stubs)	→	Stub insertion loss
Trunk termination reflections		
Stub/connection point reflections on trunk		Trunk end return loss (100 ohm)
Stub/interface reflections on stub (reflected back by the MDI)		

What measurements?



Key: Element	Symbol	Primary Measurement
Frequency-dependent signal path insertion loss (stubs & trunk)	→	Trunk and stub insertion loss
Trunk termination reflections		Trunk end return loss (100 ohm)
Stub/connection point reflections on trunk		Trunk end return loss (100 ohm)
Stub/interface reflections on stub (reflected back by the MDI)		Stub return loss at MDI (50 ohm)

Details

- Measurements can be made with a VNA
  - Note – these would require new, partitioned specs
  - Trunk IL – without MDI loading
    - Separates mixing segment from MDI measurements
  - Stub RL – (can be done in-situ)
  - Trunk delay
  - Stub delay, Stub IL
    - Probably not measurable in-situ, but specify for new builds/components
    - Constrain them to be small to maximize trunk length
- Do we constrain stub positioning (inter-stub delay?)
  - Probably would need a TDR measurement in our spec

Next steps, Consensus & Values

- Validate based on TX/RX model (TBD)
  - IL starting point? Trunk + 2 max stubs = .3cg spec?
- RL will need receiver model
  - .3da will likely set a higher receiver ISI tolerance bar than clause 147 – but experience suggests it can