



**Gian Marco Bo**  
**Piergorgio Beruto**

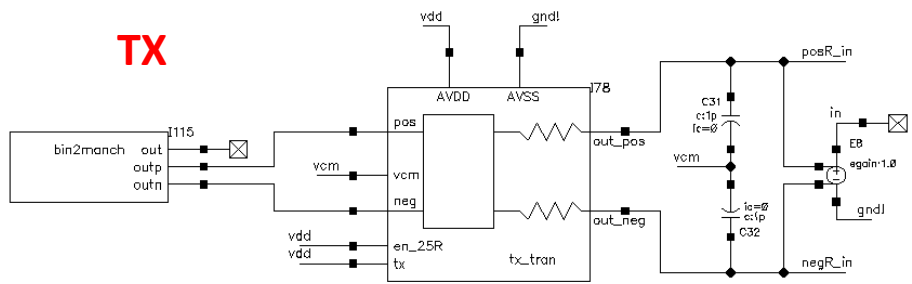
**Comment 478 - MDI electrical specification**  
*IEEE802.3cg TF*

- Follow-up in detail for mixing segment node loading
  - [http://www.ieee802.org/3/cg/public/Mar2018/brandt\\_cg\\_01a\\_0318.pdf](http://www.ieee802.org/3/cg/public/Mar2018/brandt_cg_01a_0318.pdf)
  - Comment #478
    - [http://www.ieee802.org/3/cg/comments/802.3cg\\_draft1p2\\_Received\\_Comment%20ID.pdf](http://www.ieee802.org/3/cg/comments/802.3cg_draft1p2_Received_Comment%20ID.pdf)
- Investigate the loading effect for different node count
- Propose a max total capacitance load across all nodes and a max node capacitance load

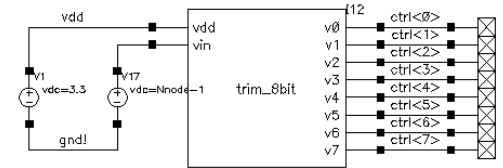
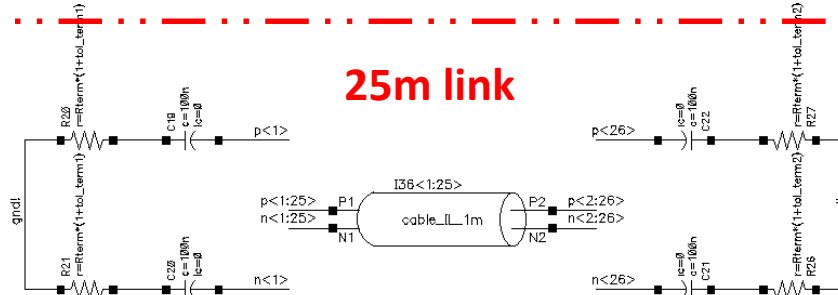
- 25m length link considered
- 8 to 40 nodes considered
- Lumped configuration considered since it represents worst case (in particular for the differential node capacitance value)
- Eye opening have been investigated versus differential node resistance, inductance and capacitance values.
- RLC from [http://www.ieee802.org/3/cg/public/Mar2018/brandt\\_cg\\_01a\\_0318.pdf](http://www.ieee802.org/3/cg/public/Mar2018/brandt_cg_01a_0318.pdf) and comment #478
  - $R > 5K\Omega$
  - $440\mu H < L < 1mH$
  - $C < 4.5pF$
- Node capacitance has been determined considering a large node count (40)
- It is expected that a smaller node count allow to tolerate larger capacitance value

# Modeling

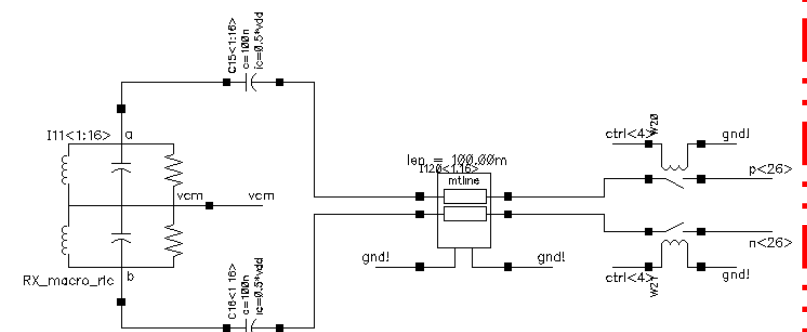
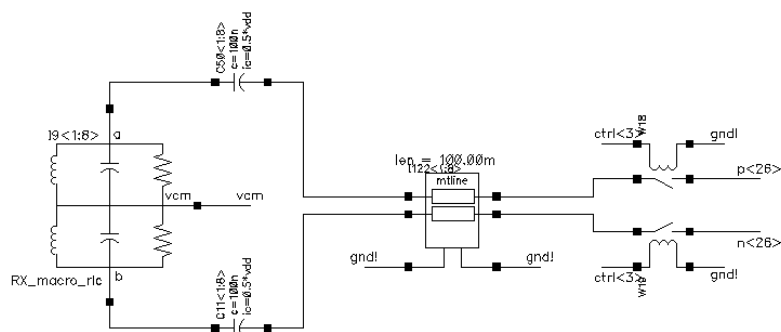
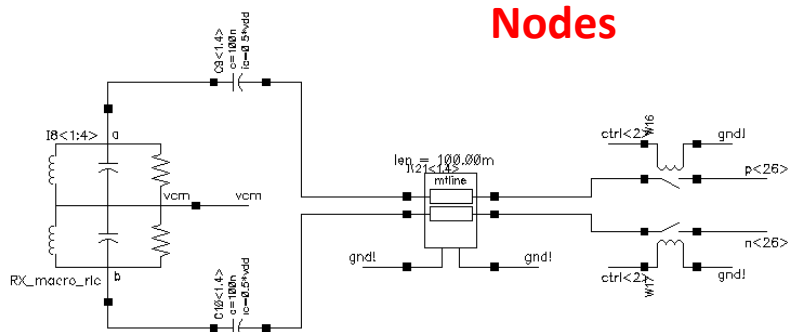
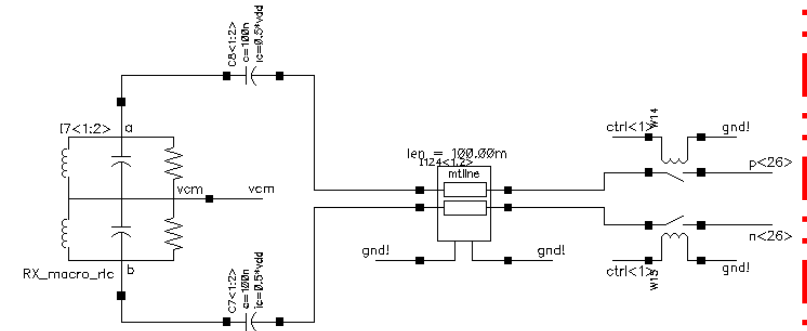
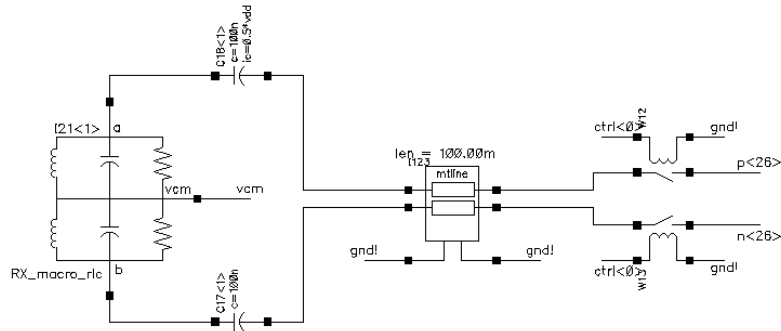
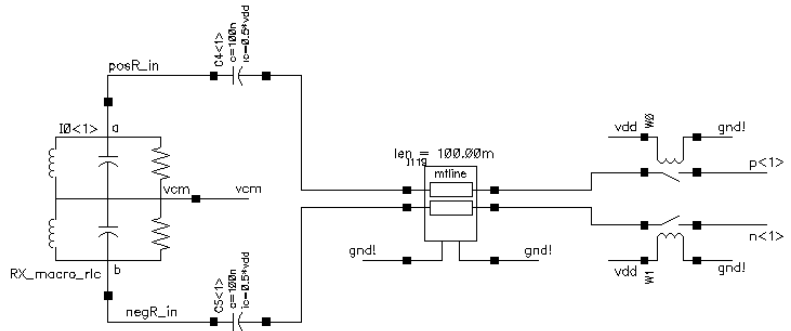
TX



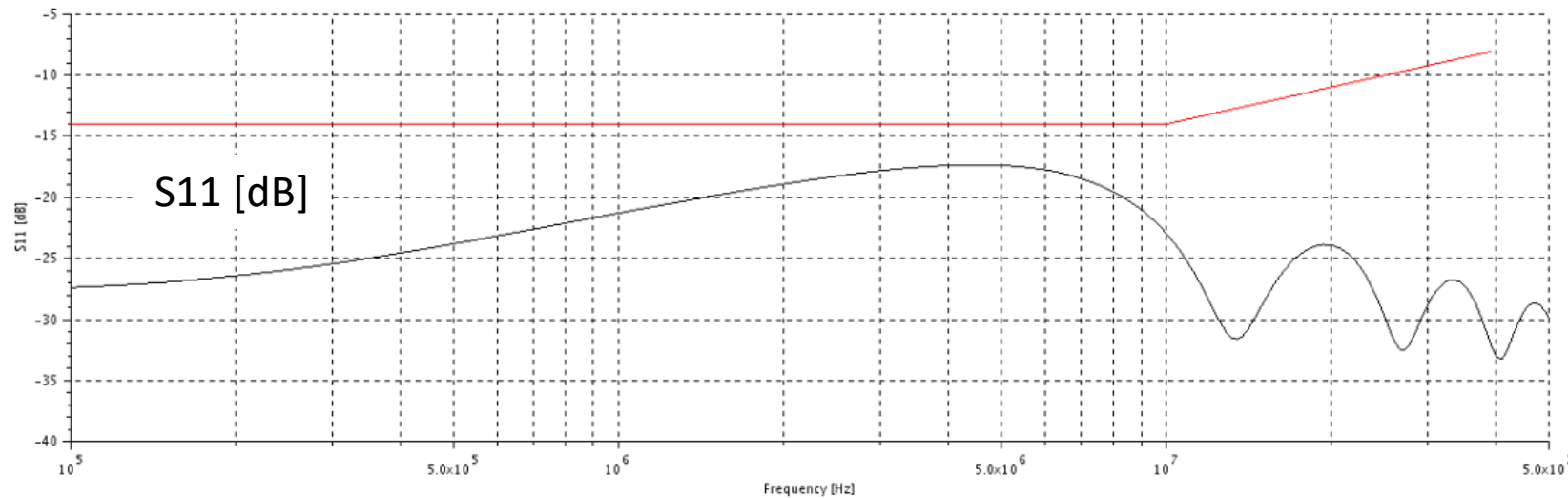
25m link



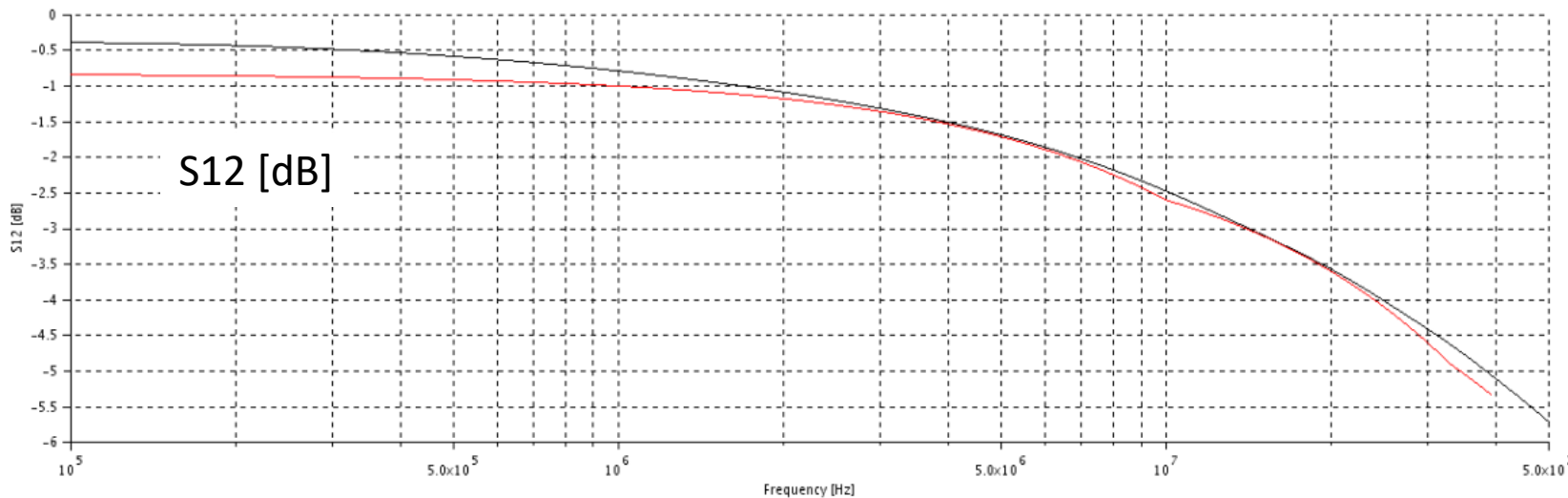
Nodes



# Modeling: 25m Link S11 and S12

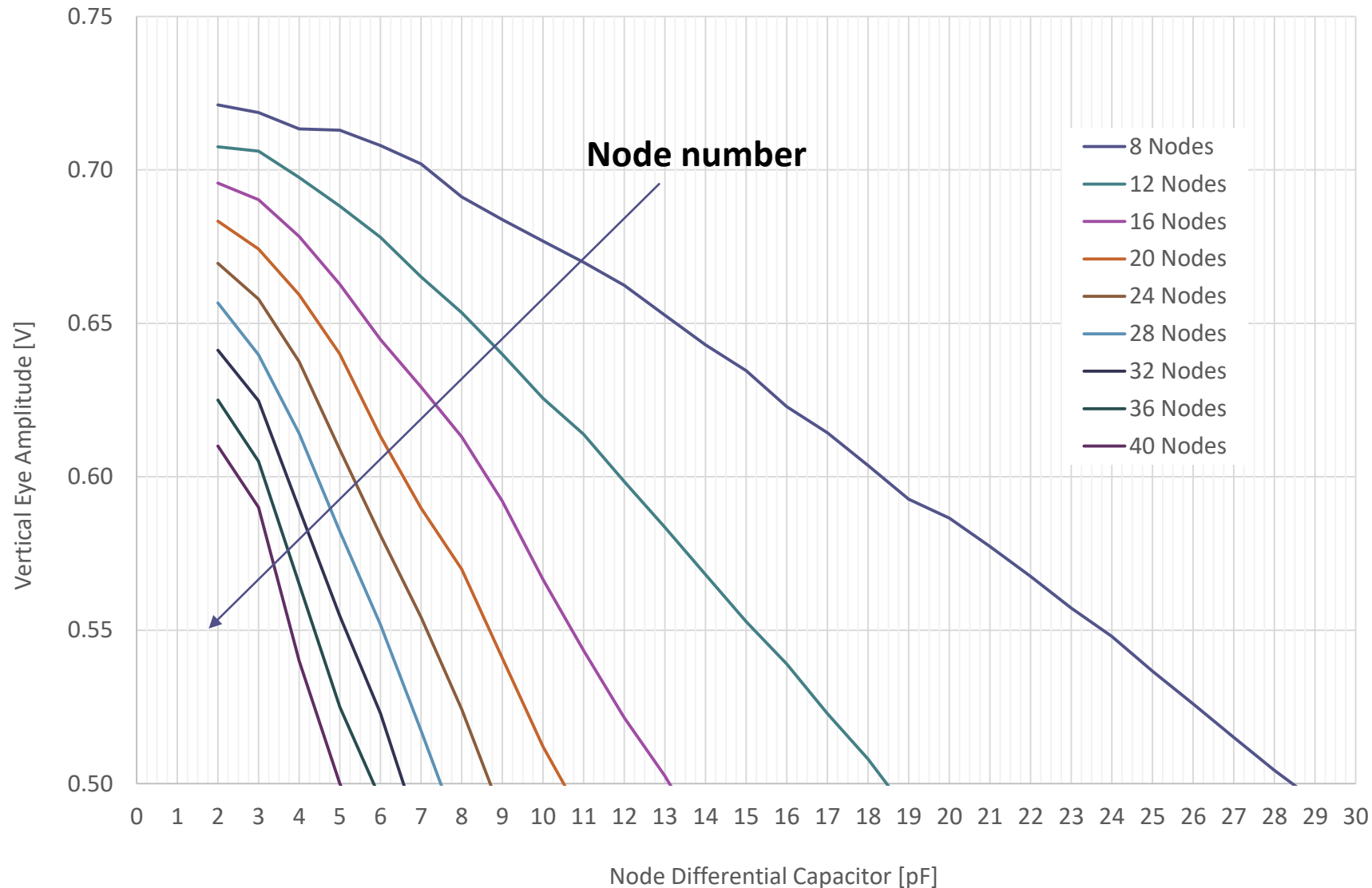


- Red: limit
- Black: model



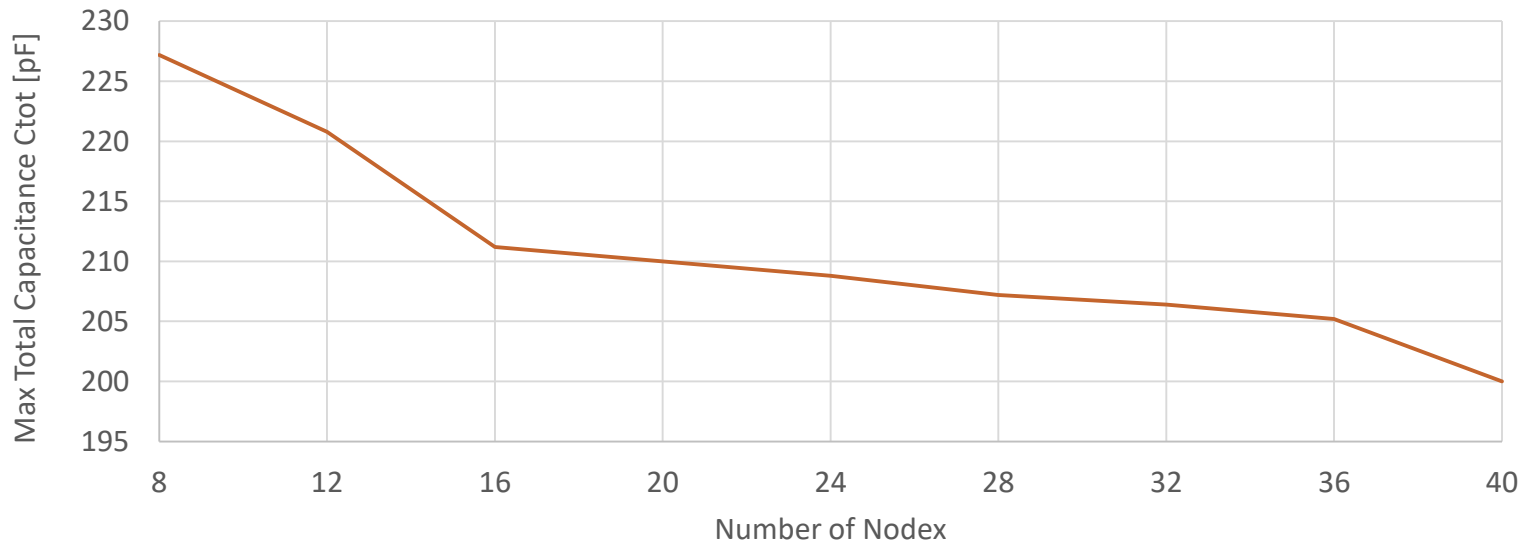
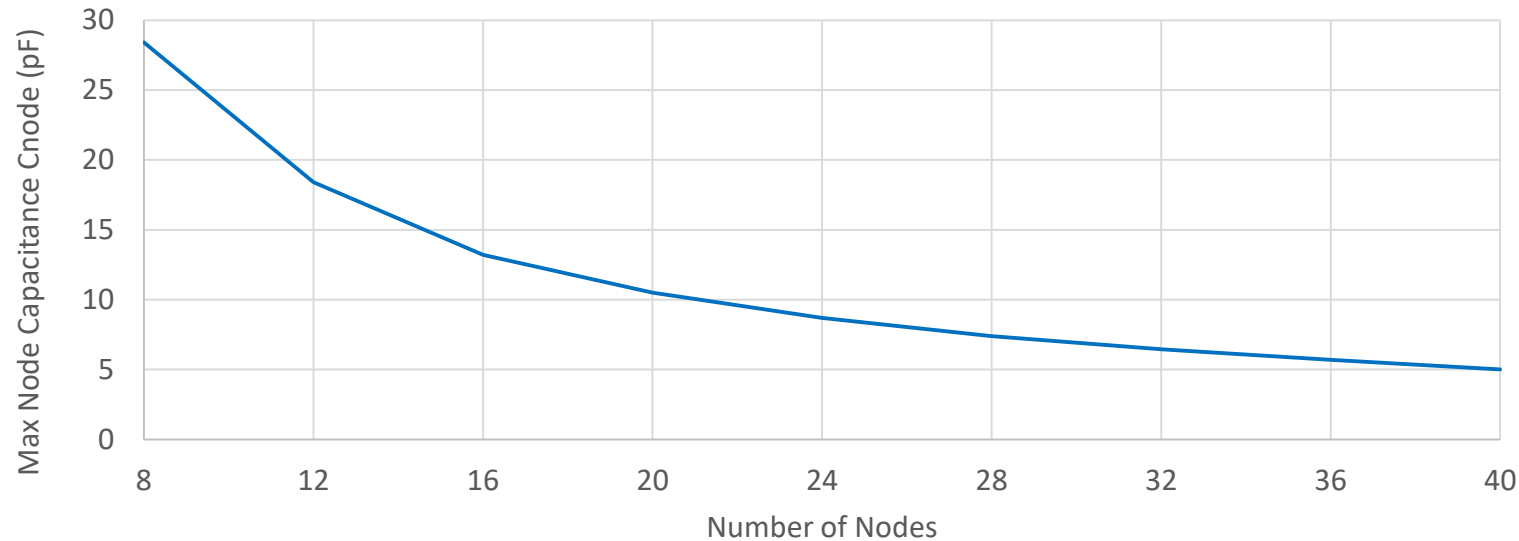
- Preliminary results show a less dependence of differential node resistance and inductance versus the number of nodes while changing the number of nodes the amount of tolerable differential capacitance change a lot.
- Several runs have been then performed with the following configuration.
  - Differential node resistance set to  $5K\Omega$
  - Differential node inductance set to  $440\mu H$
  - Differential node capacitance varied between 2pF to 30pF
  - Node number varied between 8 and 40
  - Eye opening versus node number and differential node capacitance investigated

# RX Eye Amplitude vs. Node Differential Capacitor and Node Number



- From such data the maximum capacitance for each node  $C_{\text{node}}$  and the total capacitance across all nodes  $C_{\text{tot}}$  the maximum can be extrapolated (sum of all  $C_{\text{node}}$ )
- 500mV RX eye target opening considered

# Node and Total Capacitance vs Number of Nodes



- 180pF limit for the total capacitance can be considered (some margin have been taken into account)
- 40 nodes gives 4.5pF
- 8 nodes gives 22.5pF
- 15pF limit for the single node capacitor can be also considered to limit anyway the single node loading



- Changing the node number, the amount of tolerable differential capacitance values change.
- Maximum total capacitance across all nodes  $C_{tot}$  and the maximum capacitance for each node  $C_{node}$  can be defined.
- MDI minimum parallel impedance can be expressed as follow.
  - $Z = 1/\sqrt{(1/R)^2 + (1/(2*\pi*f*L) - 2*\pi*f*C_{node})^2}$
  - $R > 5 \text{ k}\Omega$
  - $440\mu\text{H} < L < 1 \text{ mH}$
  - $C_{tot} < 180 \text{ pF}$
  - $C_{node} < 15 \text{ pF}$
  - $0.3 \text{ MHz} < f < 40 \text{ MHz}$