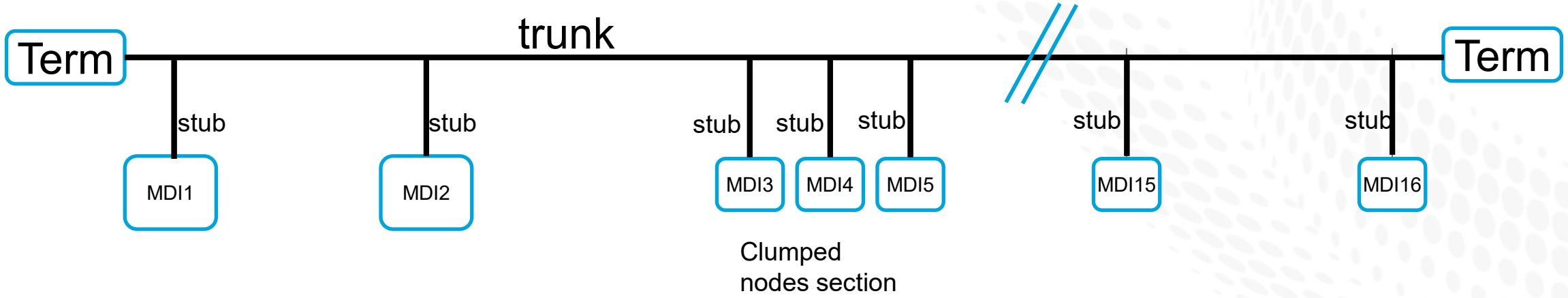
Multidrop link measurement options

Wojciech Koczwara • Multidrop link measurement options | 23rd May 2022

Rockwell Automation

Link configuration

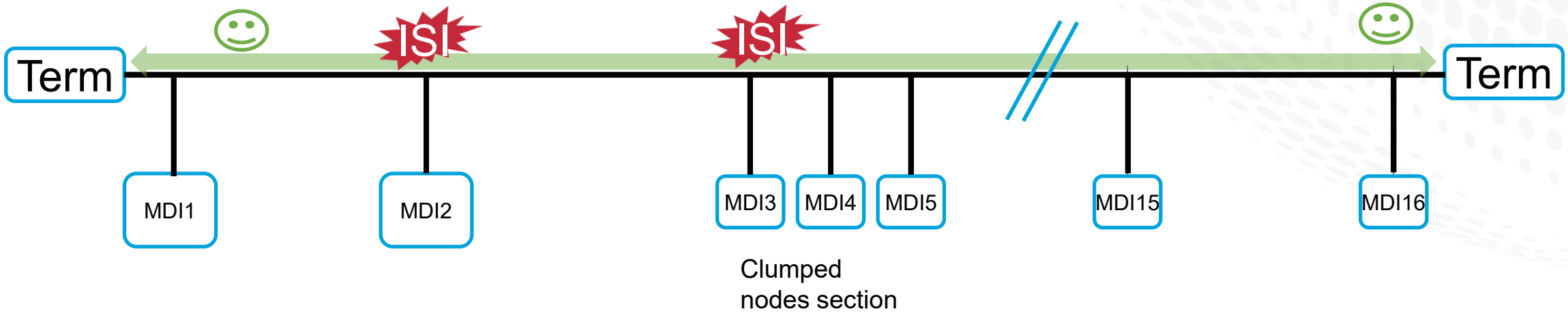


Option 1: End-to-End trunk measurement (MDIs attached)

Green line shows the 4-port VNA connection at termination points

+ Mixed mode trunk parameters (IL, RL, MC) directly measurable with 4-port VNA (connecting in place of terminators)

- **May not be enough to catch an impairment in the middle of link**
- **Stub losses may be missed**
- **Long distance between terminators**

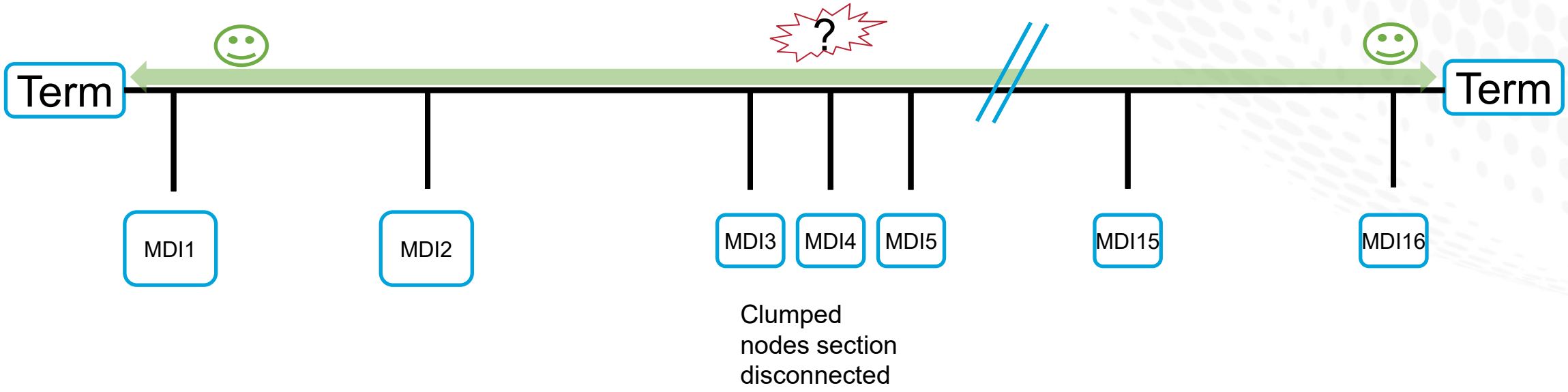


Option 2: End-to-End trunk measurement (without MDIs)

Green line shows 4-port VNA connection at termination points

+ Mixed mode parameters (IL, RL, MC) directly measurable with 4-port VNA (connecting in place of terminators)

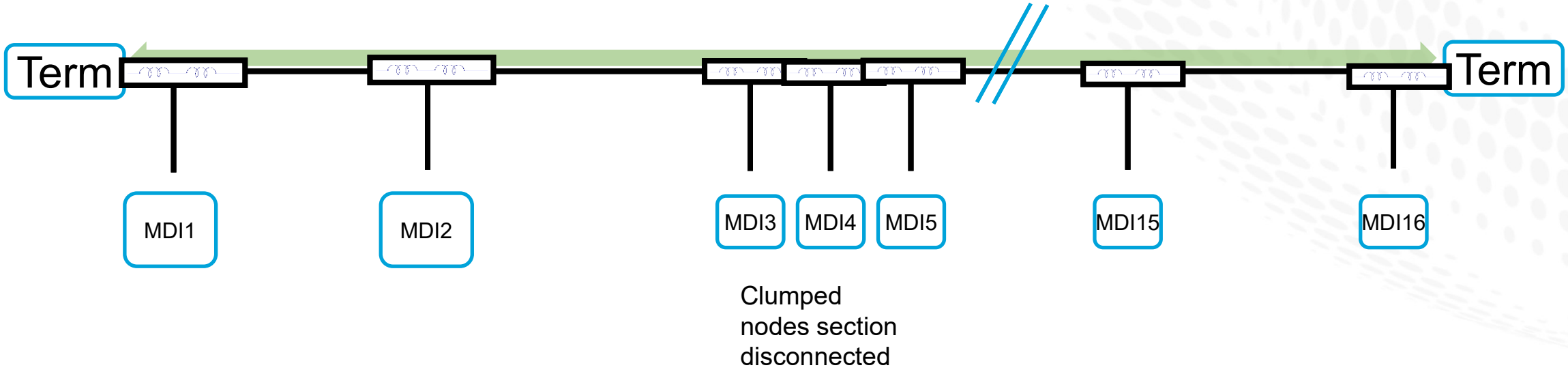
- **May not be enough to catch an impairment in the middle of link**
- **disconnecting MDIs can further mask a problem**
- **Stub losses will be missed**
- **Long distance between terminators**



Option 2 when using inline inductors

Green line shows 4-port VNA connection at termination points

Since the inductors are tuned for MDI+stub capacitance, the link parameters will degrade when MDIs are disconnected.



Option 3: Trunk Ends - to - MDIs measurement

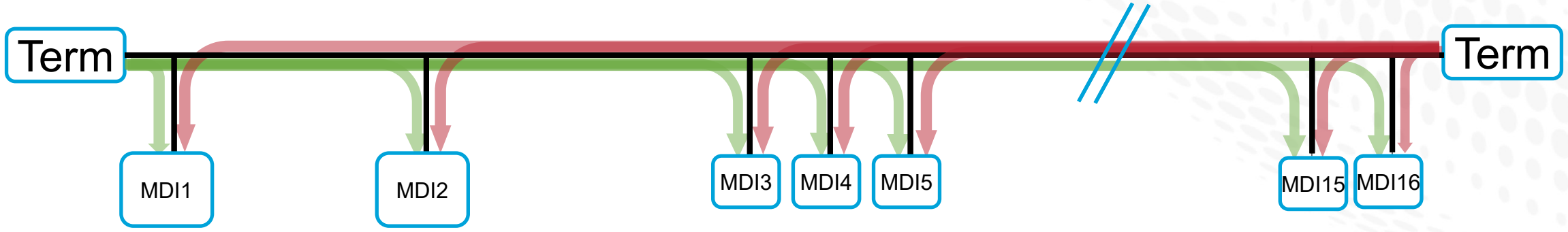
VNA connected to Termination point and each MDI

+ Direct connection to Terminators with 2x2-ports of VNA

+ Stubs characterized

+ All signal paths covered, can post-process results to extract

- **Connection to MDI requires a balun or impedance transformation (for balanced 50 Ohm or 10kOhm)**
- **Distance from terminators to MDIs can be long**



Option 4: MDI – to adjacent MDI measurement

VNA connected with two ports to MDIx and two ports to MDI(x+1)

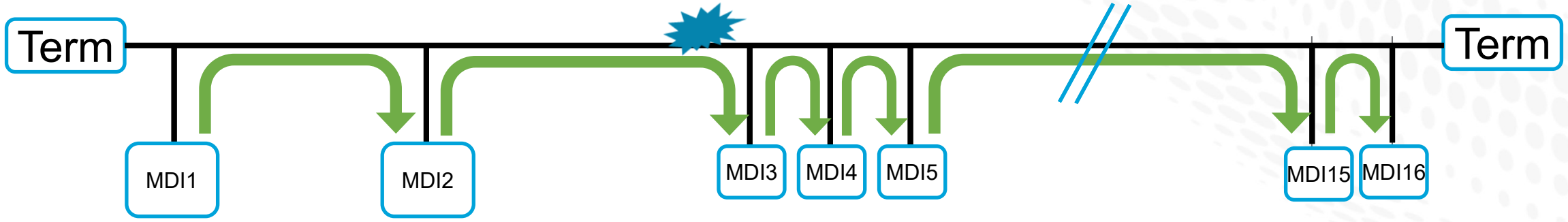
+ Direct picture of each link segment between adjacent MDIs

+ Avoiding N^2 measurements

+ Likely shorter distance from MDI to its neighbor

- Requires impedance transformation on both ends (to 50R Tx and 10k Rx)

- Risk of missing a cumulative effect over few MDIs



Recommendation

Option 3 (testing from termination points to each MDI), connected with Option 1 (End-to-End trunk measurement) seem to cover all the signal paths. The results can be post-processed to calculate the desired parameters.

- Option 4 may be worth pursuing as the potential VTF replacement and direct indication for corresponding link segments

Thank you