Measurements in a 5G network

A Leading Provider of Smart, Connected and Secure Embedded Control Solutions

Simon Butcher

End User Testing of the vPRTC

- Why vPRTC was chosen

- Boundary clock drawbacks
- Optical Timing Chanel implementation

- Customer Network Measurements
- Catching Faults

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vPRTC – Chosen for 5G

- **Overcomes the flaw of traditional boundary clocks**
- **Minimise the use of GNSS in the network**
  - Reduce vulnerabilities and OPEX.
- **Remove uncertainty that occurs from “in band” PTP**
- **Share investment in ePRTC to all parts of the network**
- **Simplify engineering deployment rules for timing**

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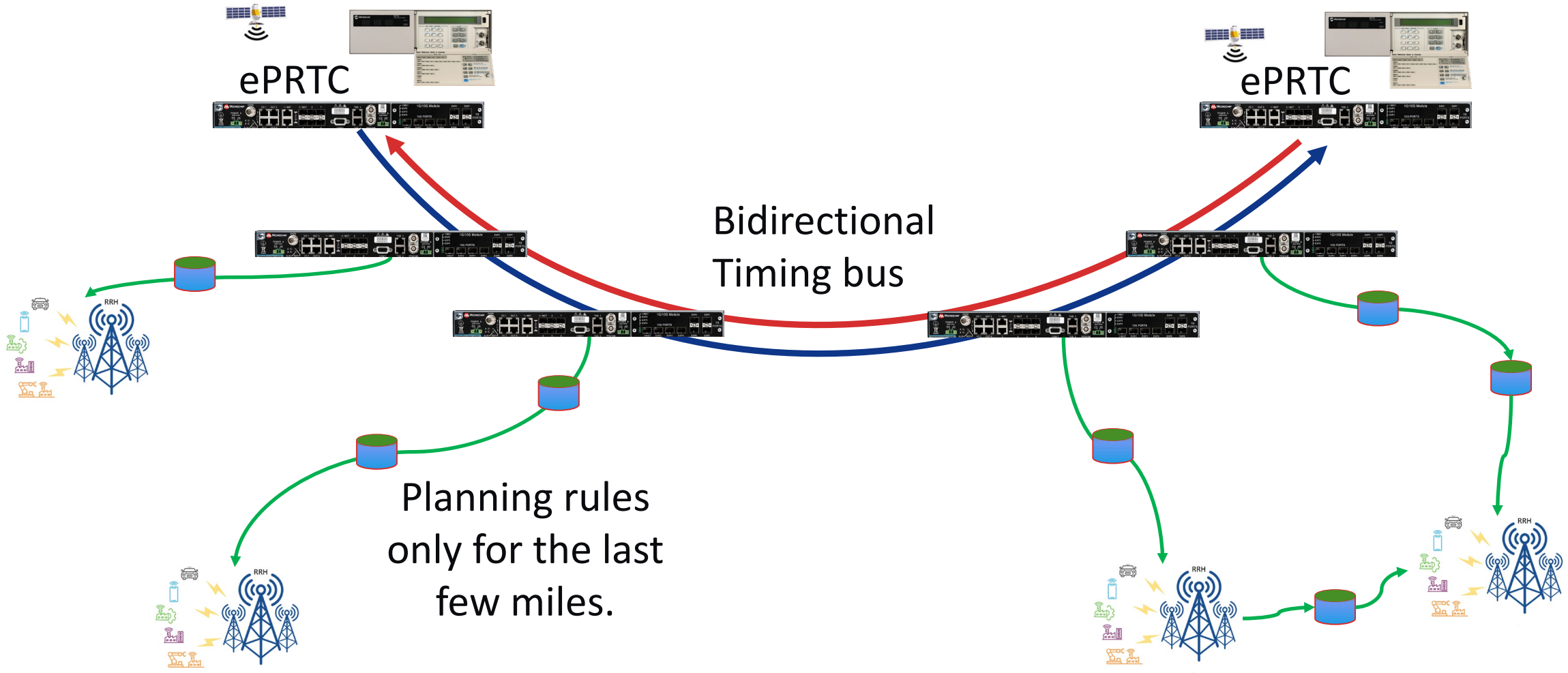
vPRTC

Every vPRTC node meets PRTC



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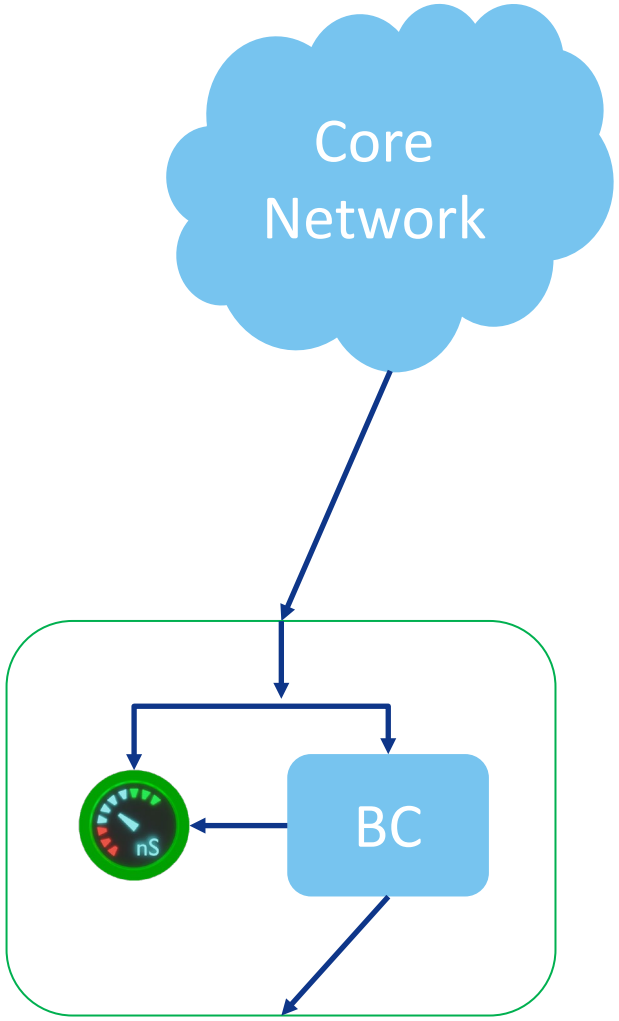
Traditional Boundary Clock

- **Embedded Boundary Clocks**
  - Single PTP Input
  - Secondary inputs are only monitored for signalling
  - Any measurements are referenced to the same input

- **Boundary Clocks usually cannot detect static asymmetry**



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The Optical Timing Channel

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Optical Timing Channel

- **A Dedicated timing path**
  - Physically separated from the voice / data in a network
  - Where possible over a single Fiber
  - PTP operates in both directions

- **Metro Level**
  - Bidi SFP – Up to ~120Km
  - Chromatic Dispersion must be accounted for

- **DWDM**
  - Often sent along the same path as the OSC.
  - Tested with Nokia, Ciena, Infinera, Cisco, Ekinops

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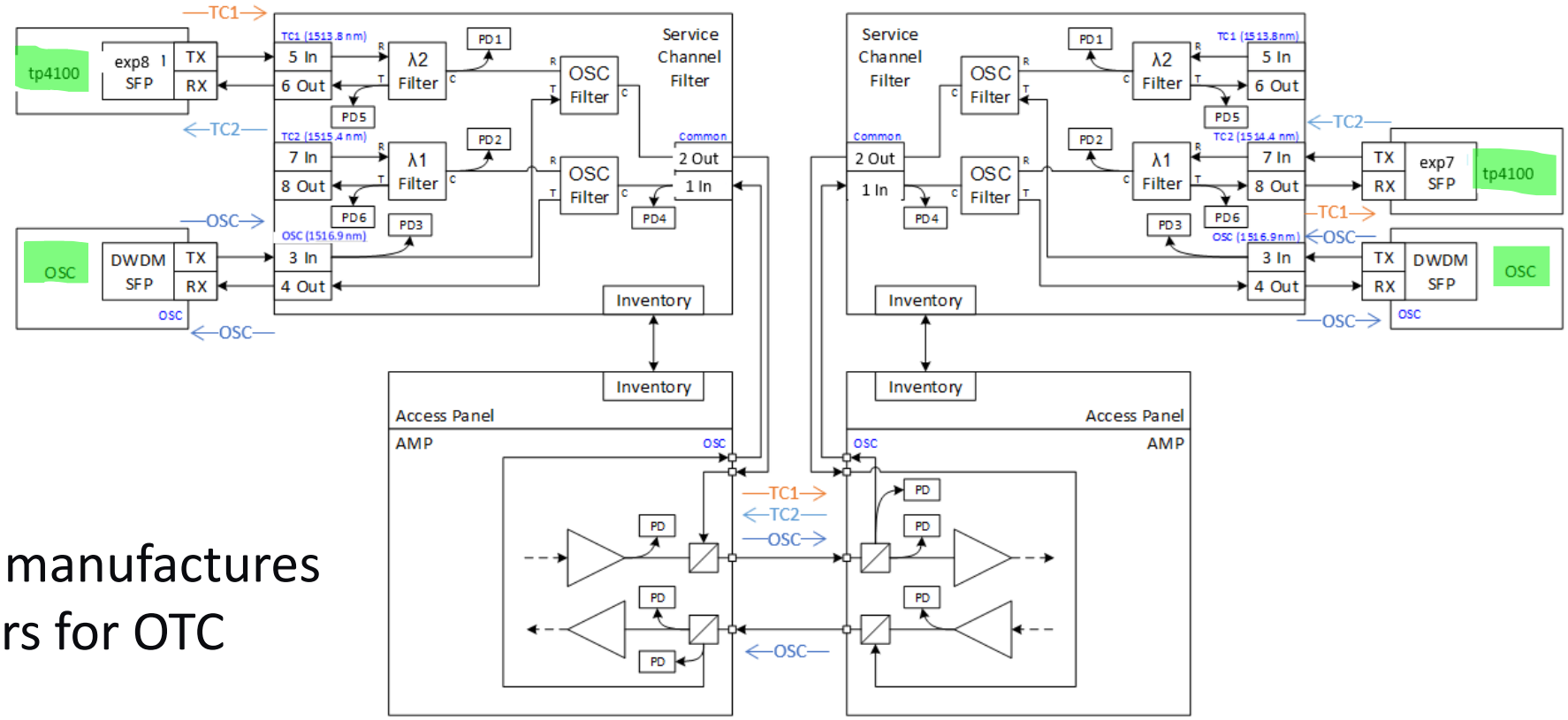
Optical Timing Channel



- Multiple DWDM manufactures use external filters for OTC
- Fast Ethernet SFP often used for distance.

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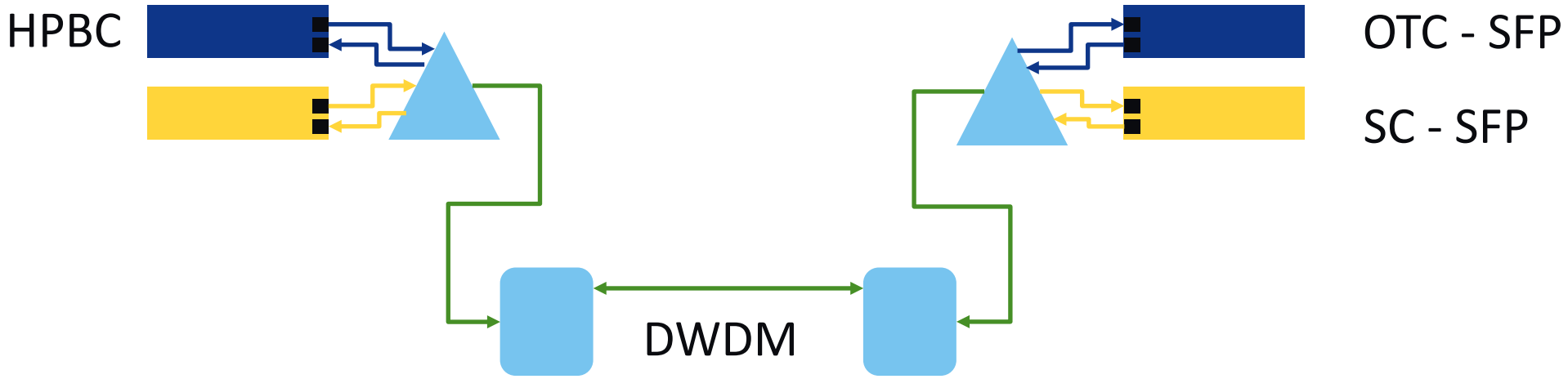
Adding the OTC



- **External filter allows OTC to be added to the OSC**
- **Uses single fibre between the DWDM nodes**
- **External Filter allows for 0.6nM difference on the OTC**
  - 2300pS over 80Km
  - Chromatic Dispersion can almost be forgotten

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Customer Example

- **200Km DWDM Loop**
  - Anticlockwise active direction
  - Nokia OTC
  - Fast Ethernet

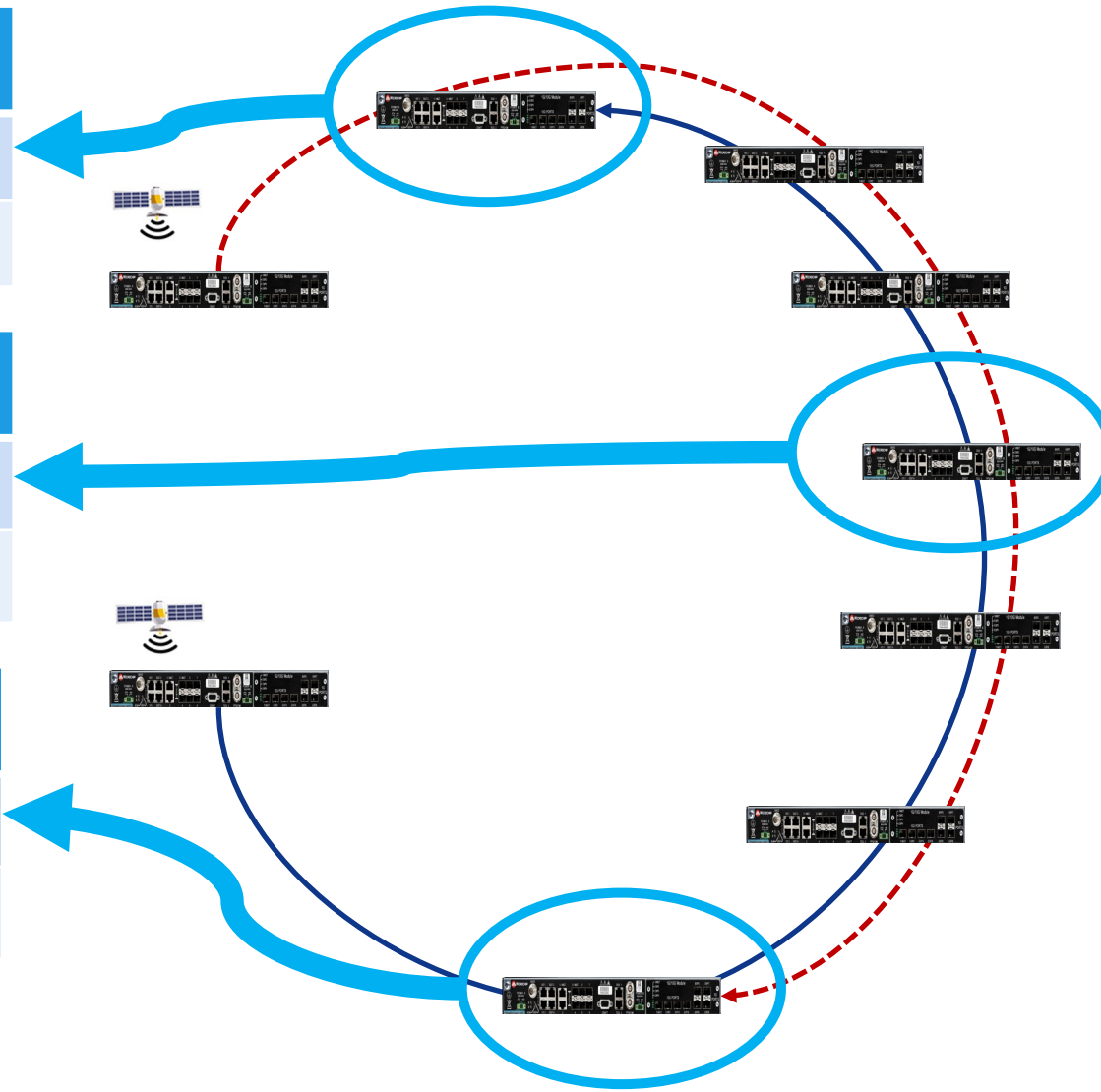
- **Paths align in both Directions**

- **Peek and Offset are “peek” measurements in 24 hours**

	Active Path	Standby Path
Offset	4	4
Noise	28	26

	Active Path	Standby Path
Offset	2	5
Noise	13	27

	Active Path	Standby Path
Offset	0.5	6
Noise	5	31



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Static Error Test

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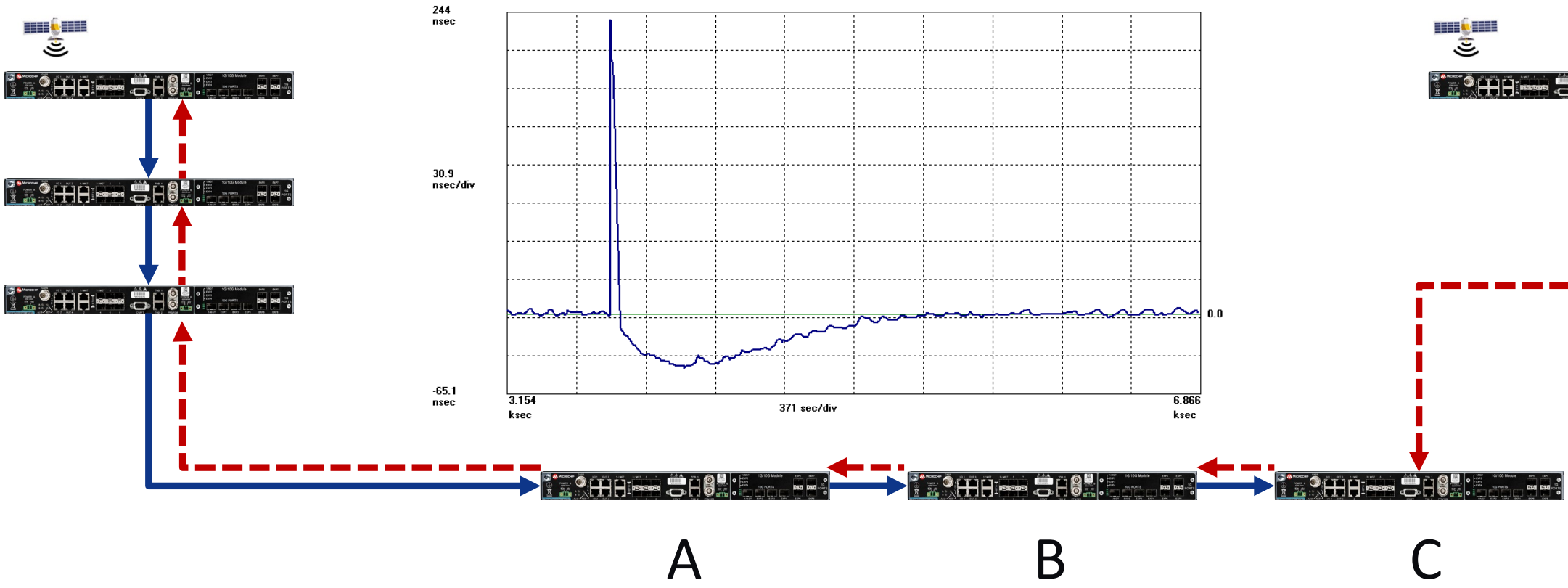
Customer Field Test Network

- Network with 2 x PRTC-B and 5 x vPRTC Boundary clocks
- A 200nS “error” was inserted between A and B
- Minutes later the error was undetectable



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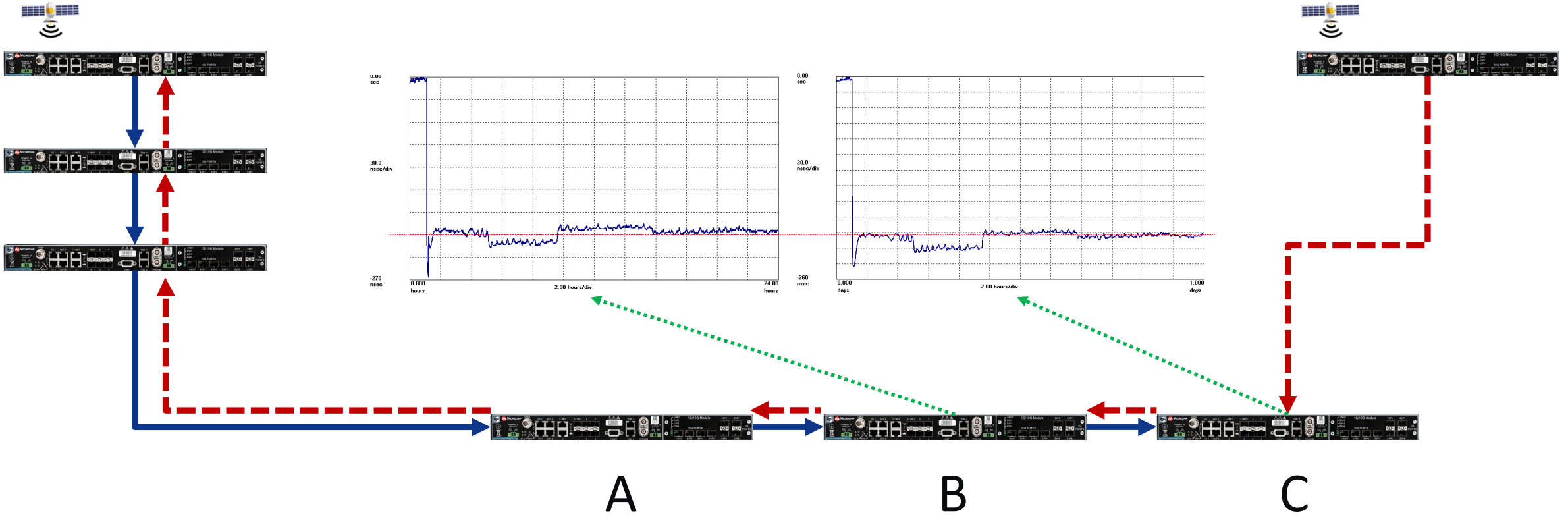
Customer Field Test Network

- The 200ns error was detected and shown with the backup path
- Single path for East and West removes many unknown factors



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