Application scenarios of enhanced Ethernet Equipment Clocks

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- Equipment clocks and reference chains
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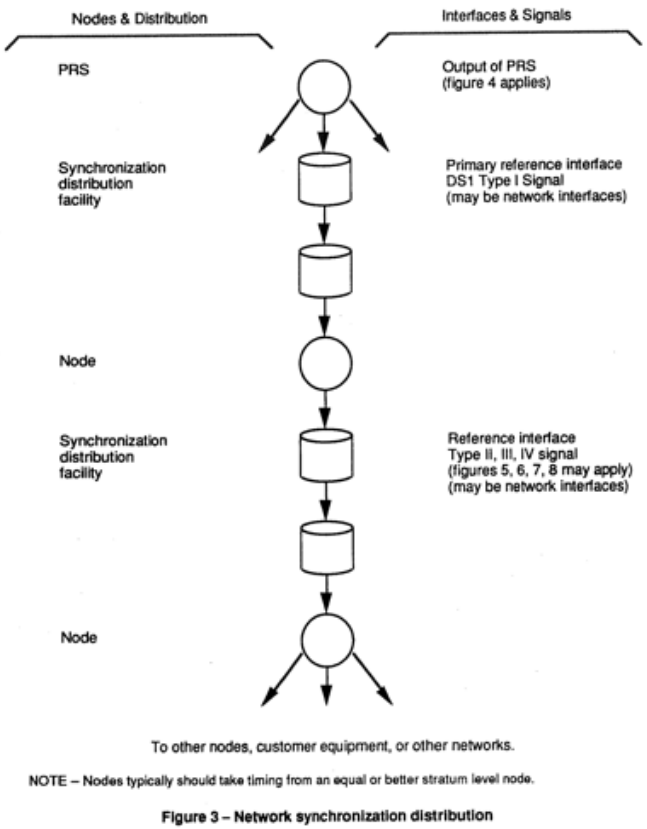
Synchronization Reference Chains



NOTE – Nodes typically should take timing from an equal or better stratum level node.

Figure 3 – Network synchronization distribution

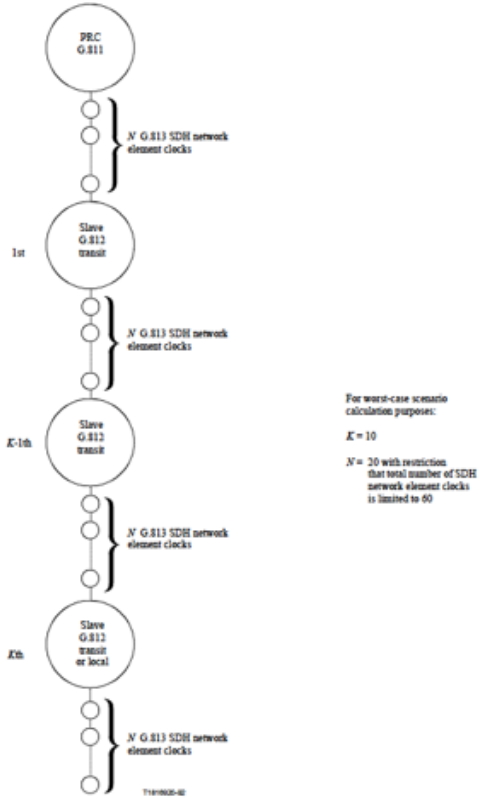
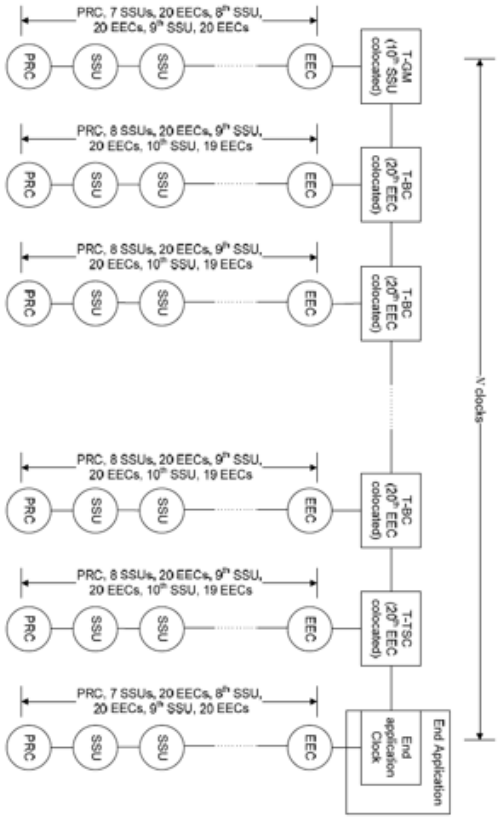


Figure 8-5/G.803 – Synchronization network reference chain



Evolution of Equipment Clocks

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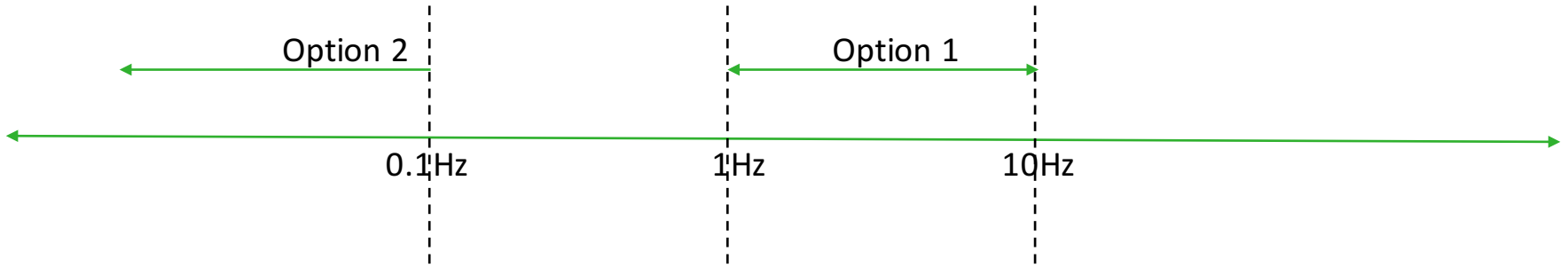
- **SEC** → (Option 1 / Option 2) → **EEC** → (Option 1 / Option 2) → **eEEC** → ?

- **Mutually exclusive Loop Bandwidths**



PEC – F **T – BC** **T – TSC** **T - BC – P/A** **T – TSC – P/A** **T-TC**

Objectives for Improving EECs

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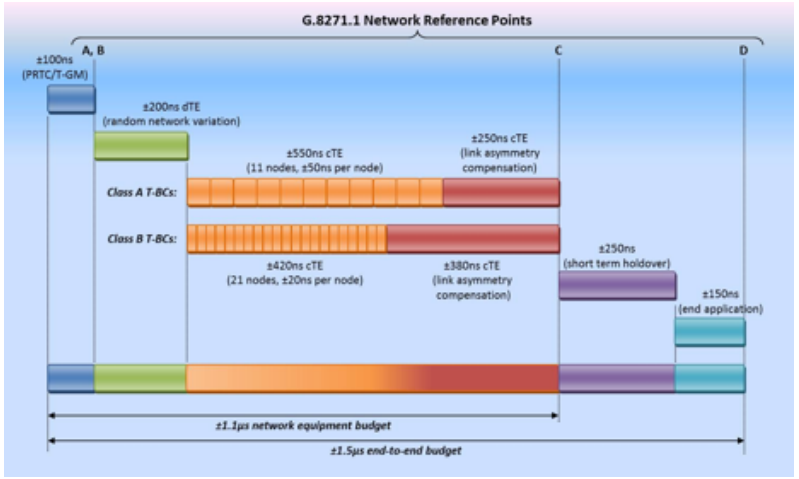
- **To support the performance improvement of Packet Clocks**
- **Reduce**
  - The impact of SyncE Re-arrangements
  - The Wander Generation effects
  - Challenges?
- **Backward Compatibility**
  - Insertion into existing chains
  - Extend the Chains
  - Support other for packet clocks



Courtesy: Calnex Solutions Ltd

Transients & Wander Generation

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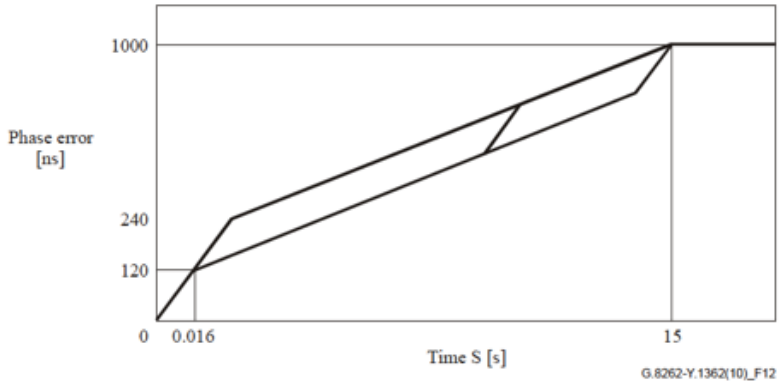
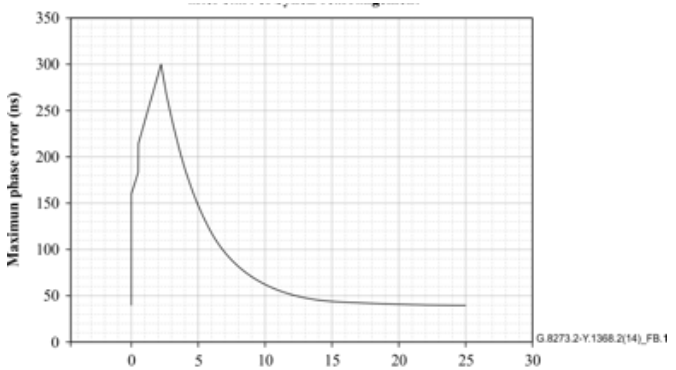
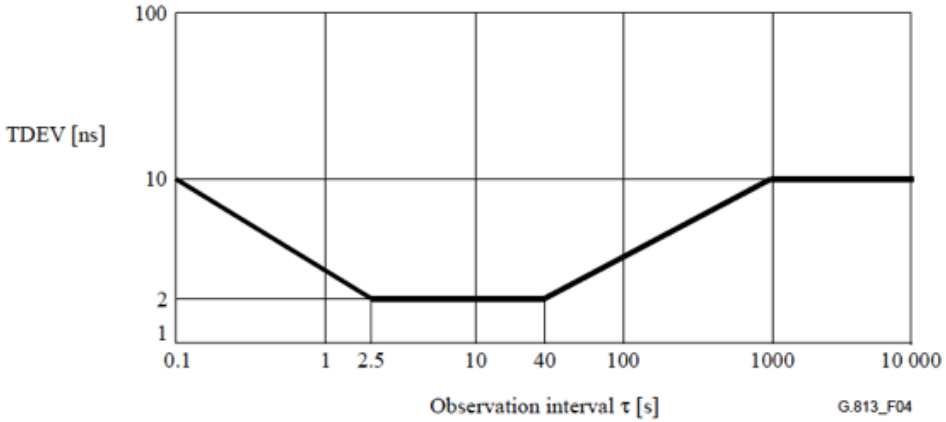
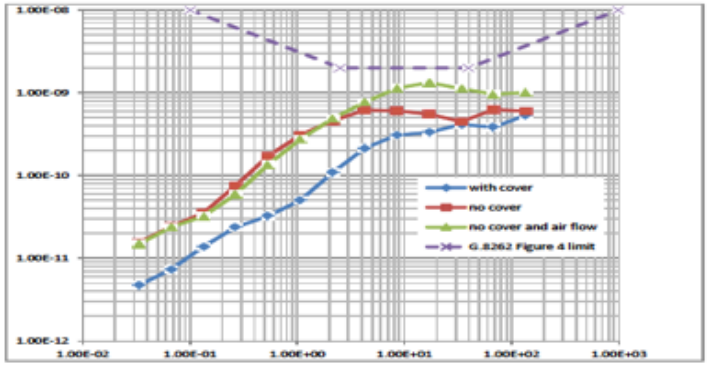
G.8262 transient and impact on G.8273.2





Wander Generation performance





Backward Compatibility

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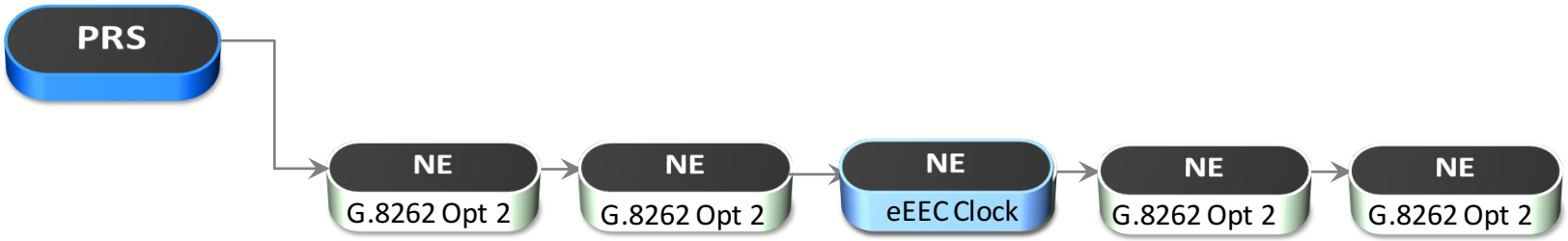
- Inserting new clocks on extending networks



Backward compatibility

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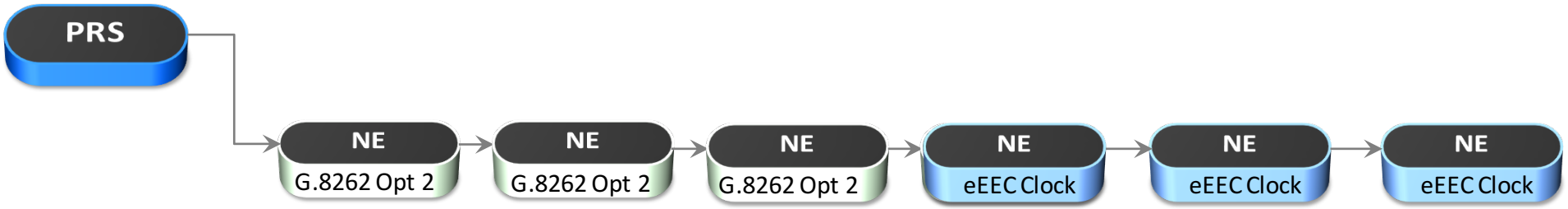
Extending existing chains



Backward Compatibility

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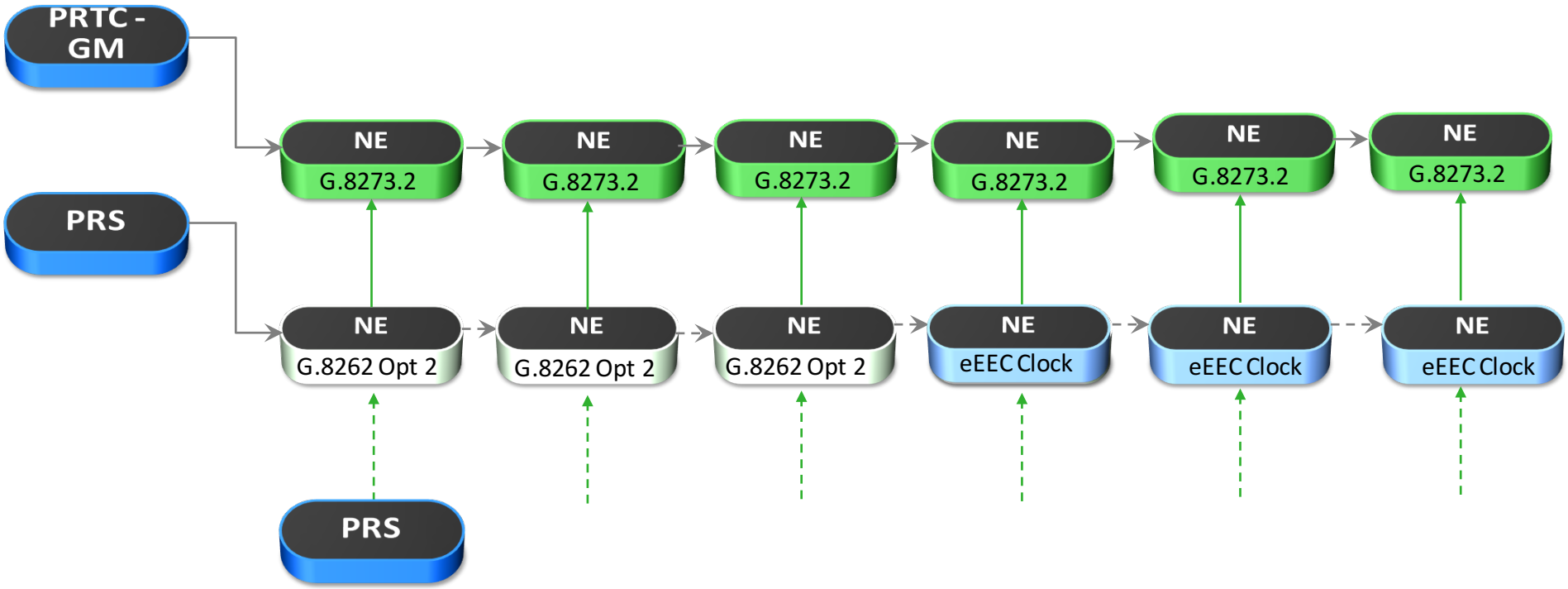
Inter-operation with existing packet clock solutions



Applications of Telecom Slave Clocks

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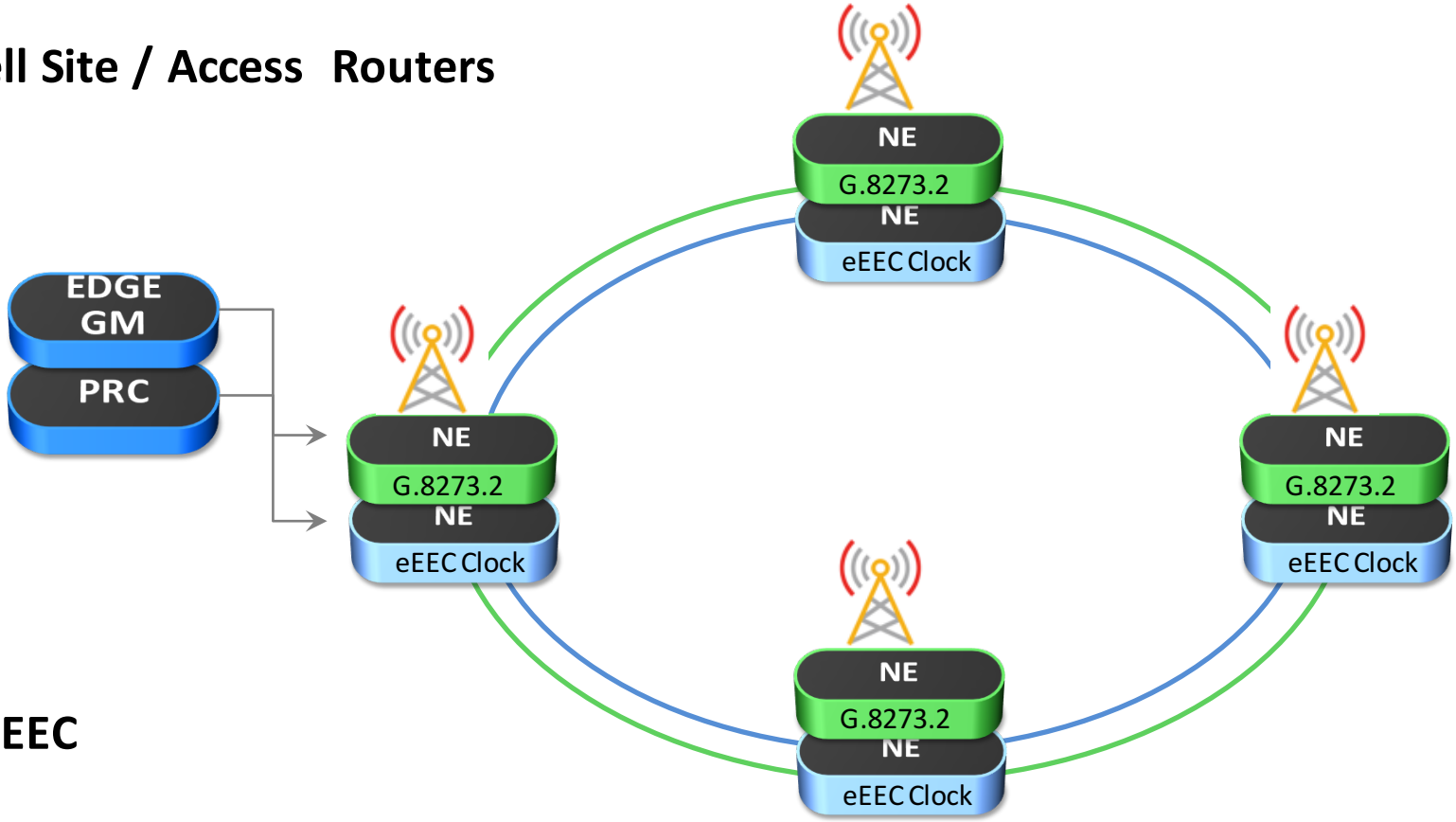
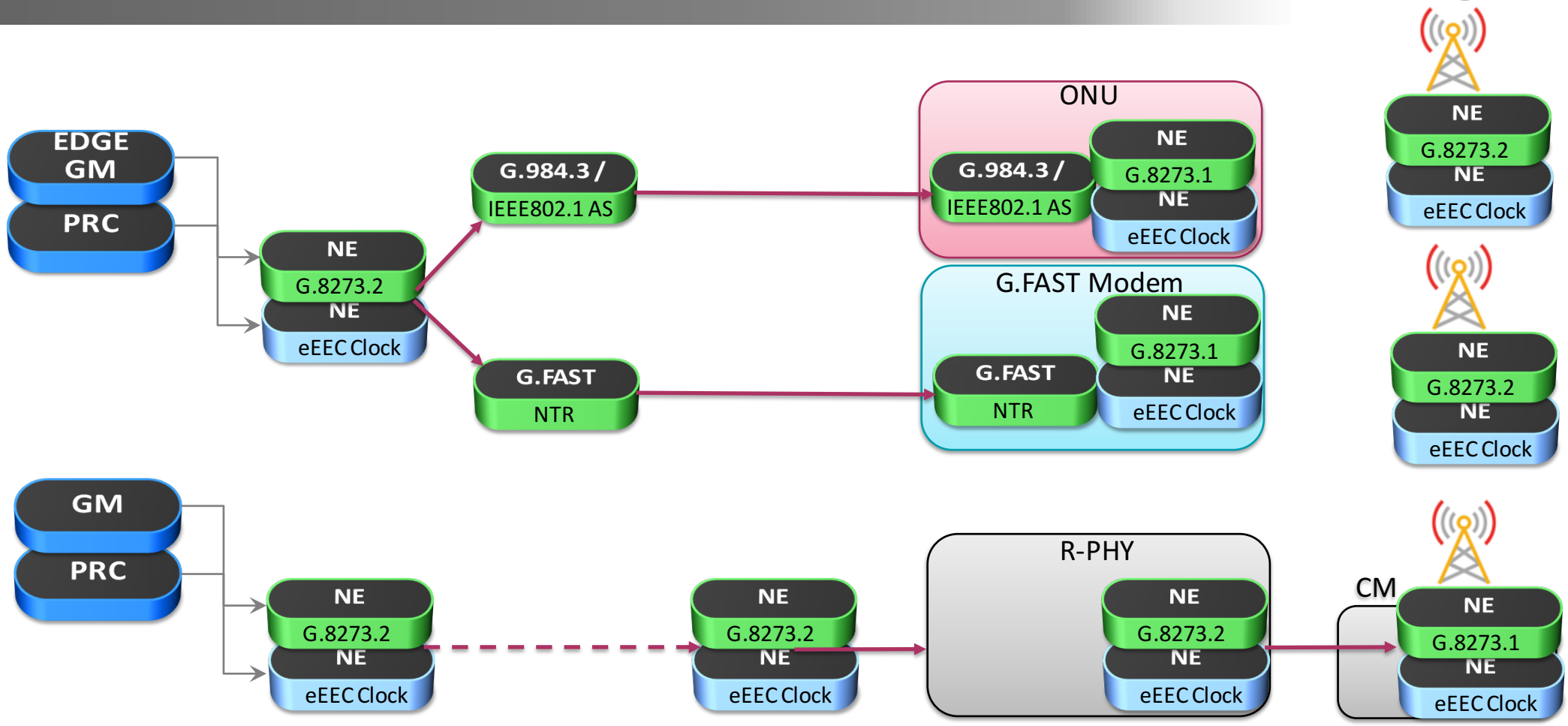
- Backhaul / Cell Site / Access Routers



- Holdover of eEEC

Access Technologies as Back haul



Edge/Mini Grand Masters

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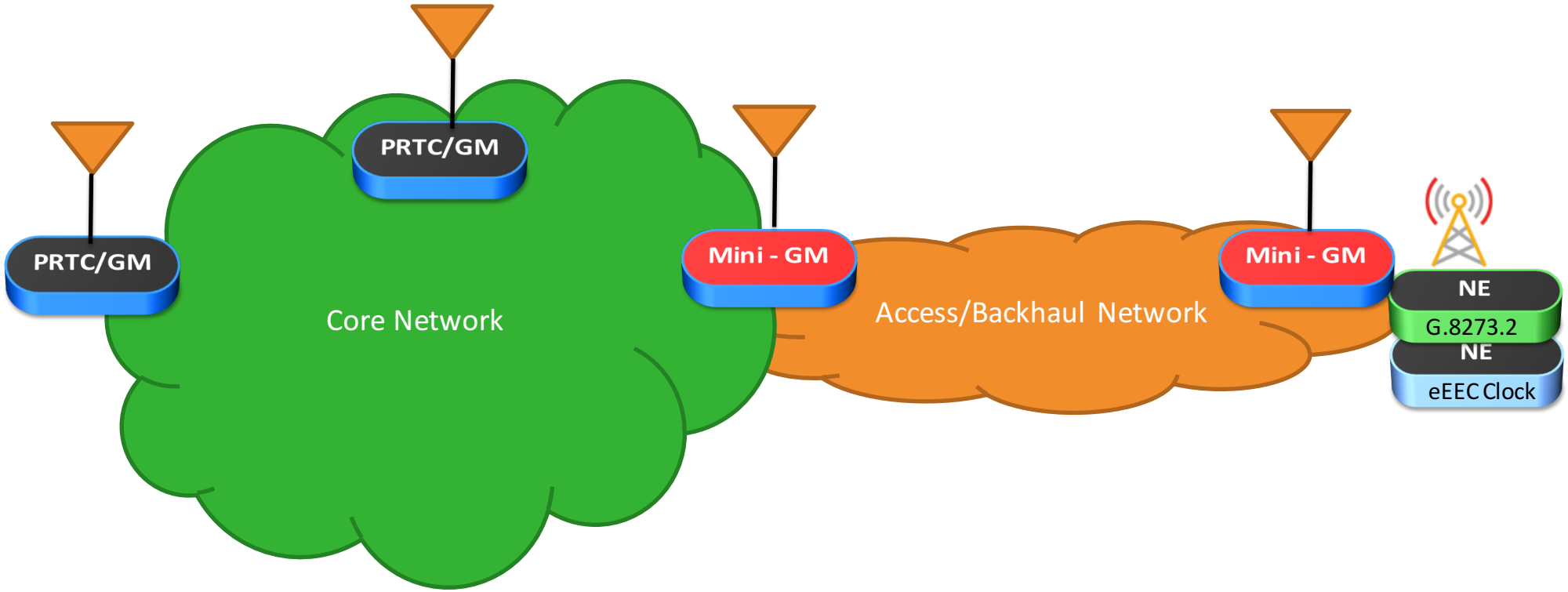
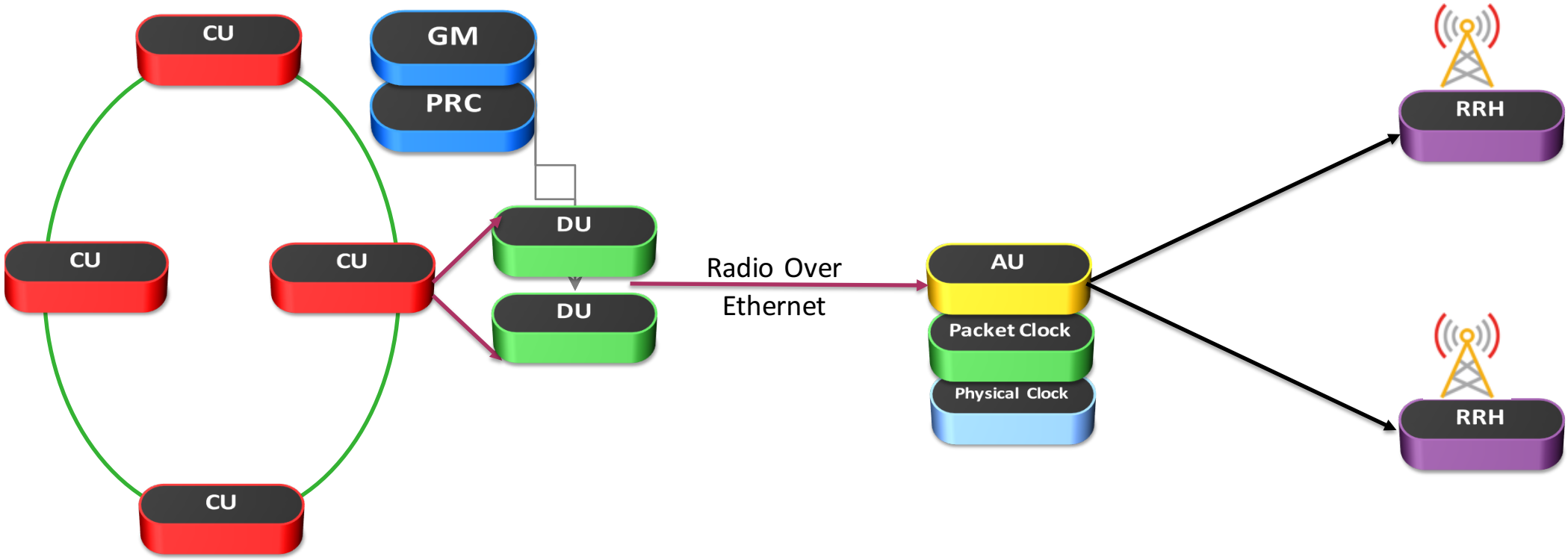
Flattening of Synchronisation Hierarchy



Next Generation Front – Haul applications



CU – Cloud Unit, DU – Distribution Unit, AU – Access Unit

13 However there are other network scenarios

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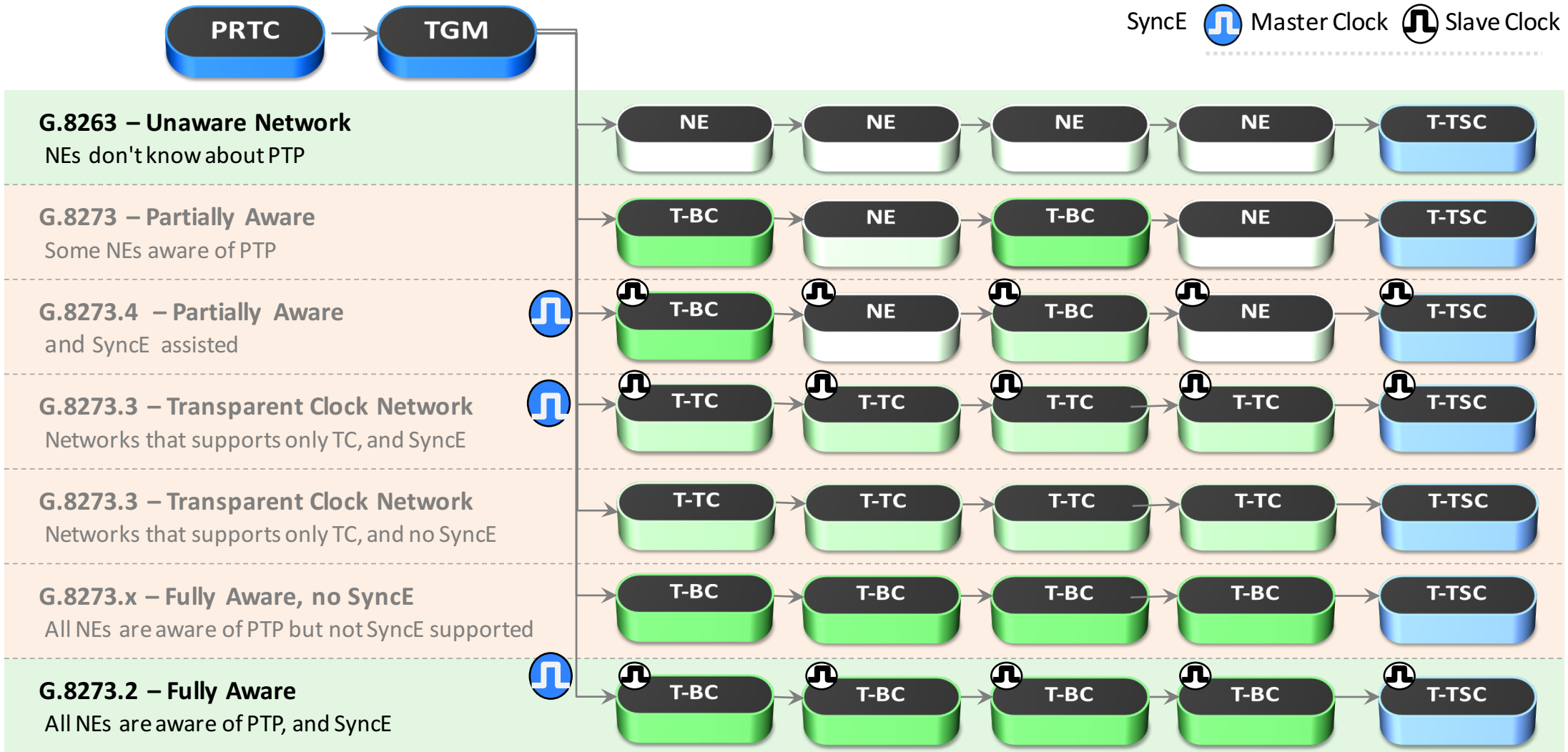

eEEC and Oscillators

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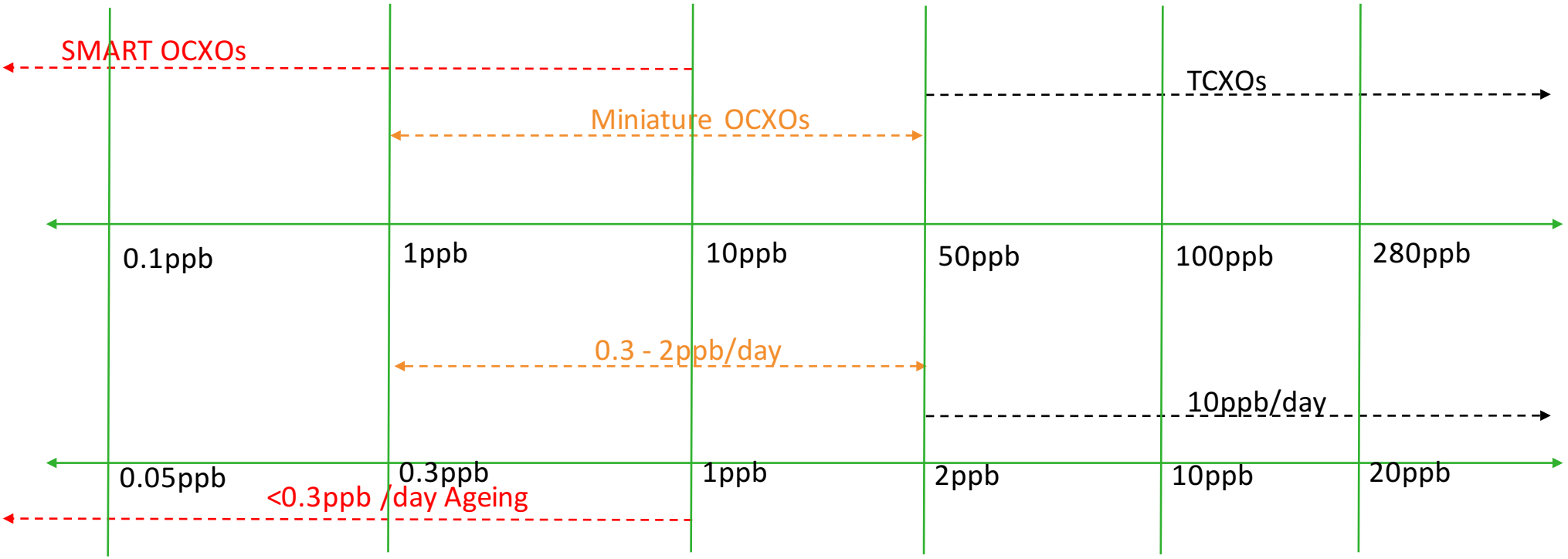
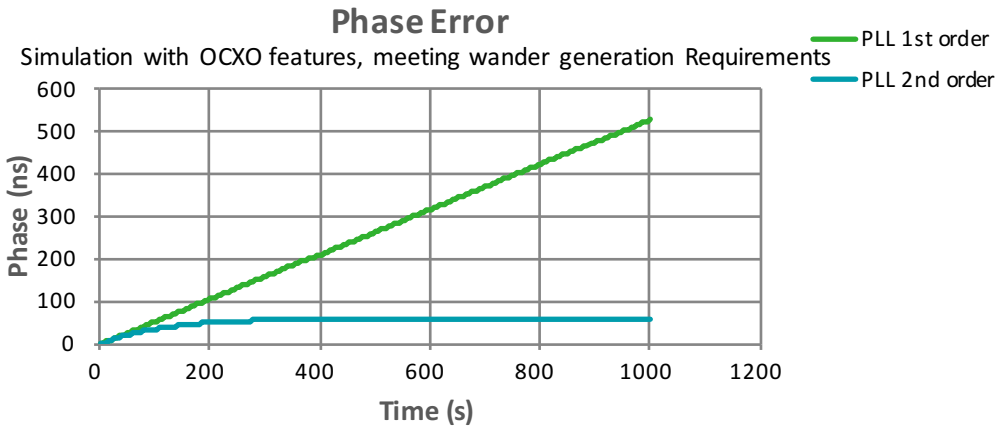
- **A common oscillator for physical and protocol layer timing**
  - A common oscillator that can cover most requirements
- **Oscillator technology is improving**



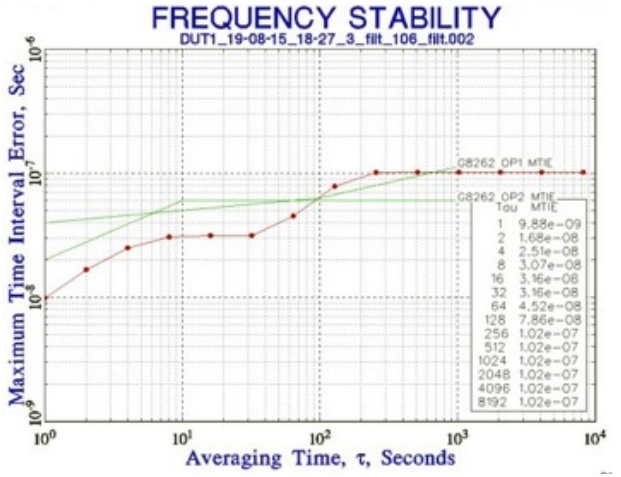
Oscillator requirements

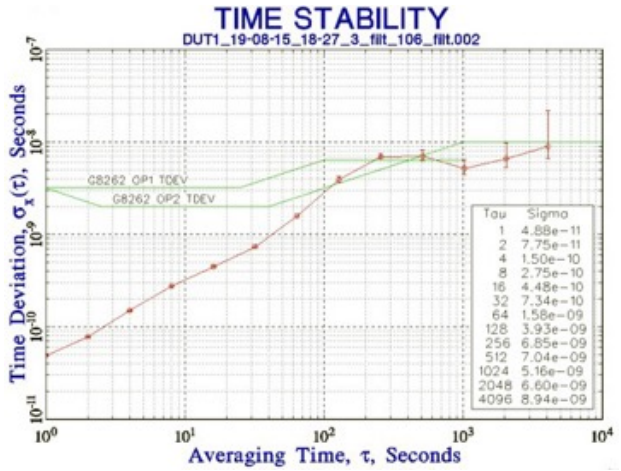
T-BCs without physical layer support

- In practice SyncE may not possible as it needs to be full deployed, it does not pass through unaware NE's like PTP.
- 40 ns MTIE requirement over temperature at 0.05 Hz:
  - The required temperature sensitivity is <3 ppb/°C
  - Assume: 2nd order PLL, 0.5 °C/min ramp
- An ovenised solution is required for such applications

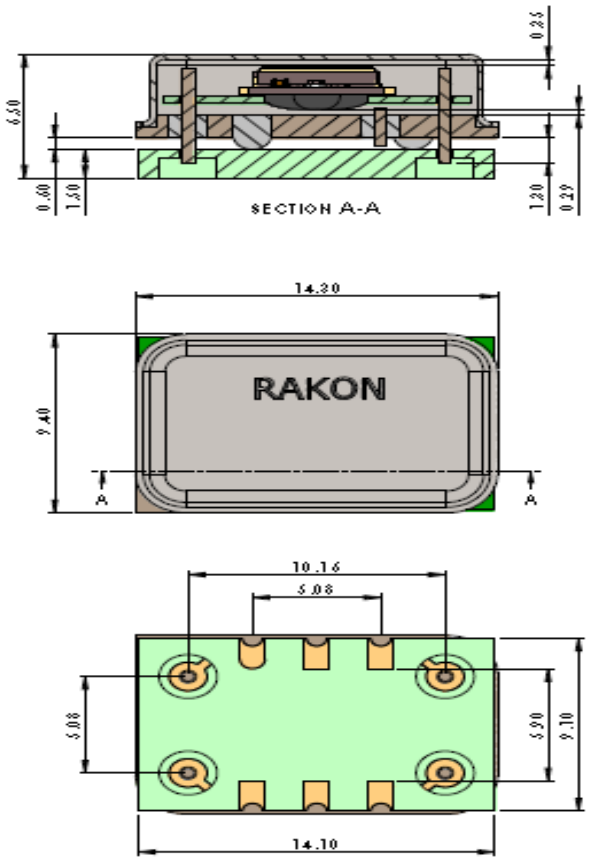


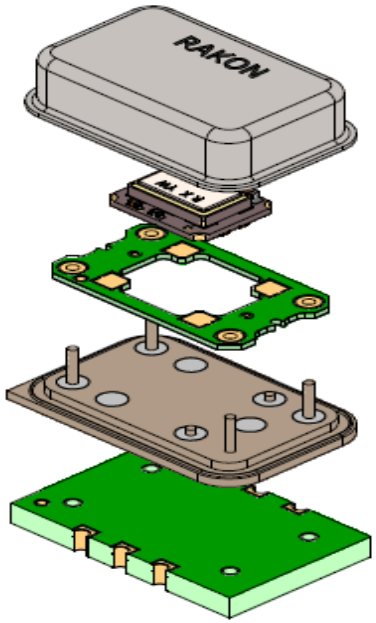
TCXO results failing the requirements





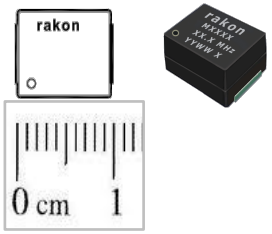
Miniature IC-Based OCXOs

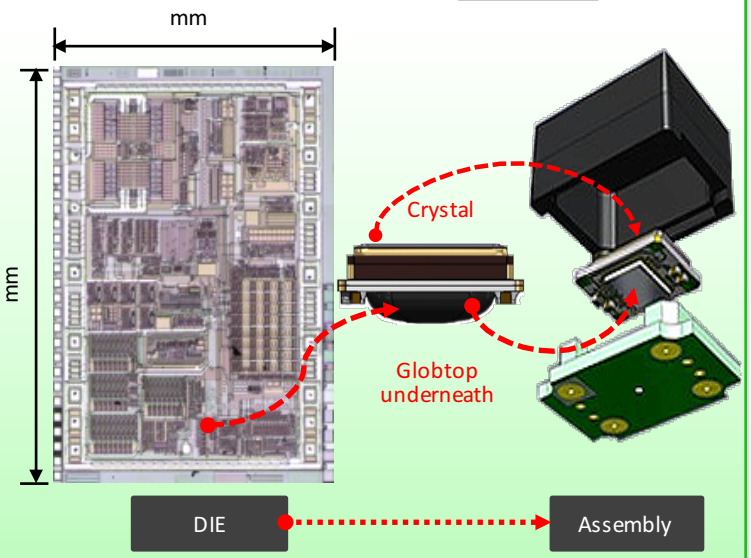




IC OCXO

- Unique ASIC
- Small profile
  - 9.7 x 7.5 mm, 14x9mm
- Excellent stability; 5-50ppb
- Low power consumption
- High Reliability





Summary

- Enhancing the packet synchronisation performance is primarily driving enhanced Physical Layer clocks
- Packet Networks introduce numerous application scenarios for SyncE supported clocks
- Networks are still evolving and numerous synchronisation topologies are possible
- The right oscillator section is important for clocks for right performance
- Oscillator technology has improved tremendously in the past years
- Standardization bodies should take advantage of state of the art oscillators

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