One Oscillator - Many packet clocks

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1 Topics

- Equipment Clocks and Oscillators
- Packet Clocks
- Evolution of Standards
- Application Examples

2 Equipment Clocks examples

- Traditional Equipment Clocks
- Packet Equipment Clocks

3 Clocks and Reference Oscillators

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Impact of Oscillators on Clocks

Type of clocks

- OCXOs
- TCXOs
- VC

4 ITU – T Equipment Clocks

	Standard	Description	Remarks on oscillators
	G.813	SEC	300/2000 ppb ; 40/10ppb/day ageing
	G.8262	EEC	300/2000 ppb ; 40/10ppb/day ageing
	G.8262.1	eEEC	TBD
	G.8263	PEC - F	10ppb; 1ppb/day ageing
	G.8273.2	T-TBC/T-TSC	300/2000 ppb ; 40/10ppb/day ageing
	G.8273.3	T-TC	TBD
	G.8273.4	Assisted/Partial	TBD

5 3GPP Clock requirements

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- **Air Interface**
  - 50ppb measured at 1ms
  - 3us worst case between base stations
  - X ns for other applications -> Absolute
  - Y ns for other applications -> Relative

- **Network**
  - 16ppb for Network Interface

6 Other Clocks / Master Clocks

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- **G.8266 – The telecom grandmaster clock for frequency synchronization (PEC-M-F)**
  - Type I is based on [ITU-T G.812] Type I
  - Type II is based on [ITU-T G.812] Type II
  - Type III is based on [ITU-T G.812] Type III

7 Clocks in Mobile Networks

- A network diagram showing Mobile networks with front-haul and the backhaul networks

- Traditional Mobile network relied on GPS and oscillator for synchronisation and thus high end oscillators
- Mobile network, unlike the traditional days, not relies on many sources of synchronisation and reliance on oscillator is lower
- A reasonable oscillator with few hours of Holdover may be enough
- Ideal candidate is a 1ppb temperature stable, 0.2ppb/day ageing device

8 Clocks in Transport Networks

- A transport diagram with Backhaul, aggregation and transport system

- Traditional circuit switched clocks used Stratum 3 level of stability
- As packet networks evolved, Stratum 3E level of stability were required
- As the packet networks become complex and requirements become stringent, Stratum 3E+ stability is considered
- Ideal candidate is a 1ppb temperature stable, <0.2ppb/day ageing device

Grand Master Clocks

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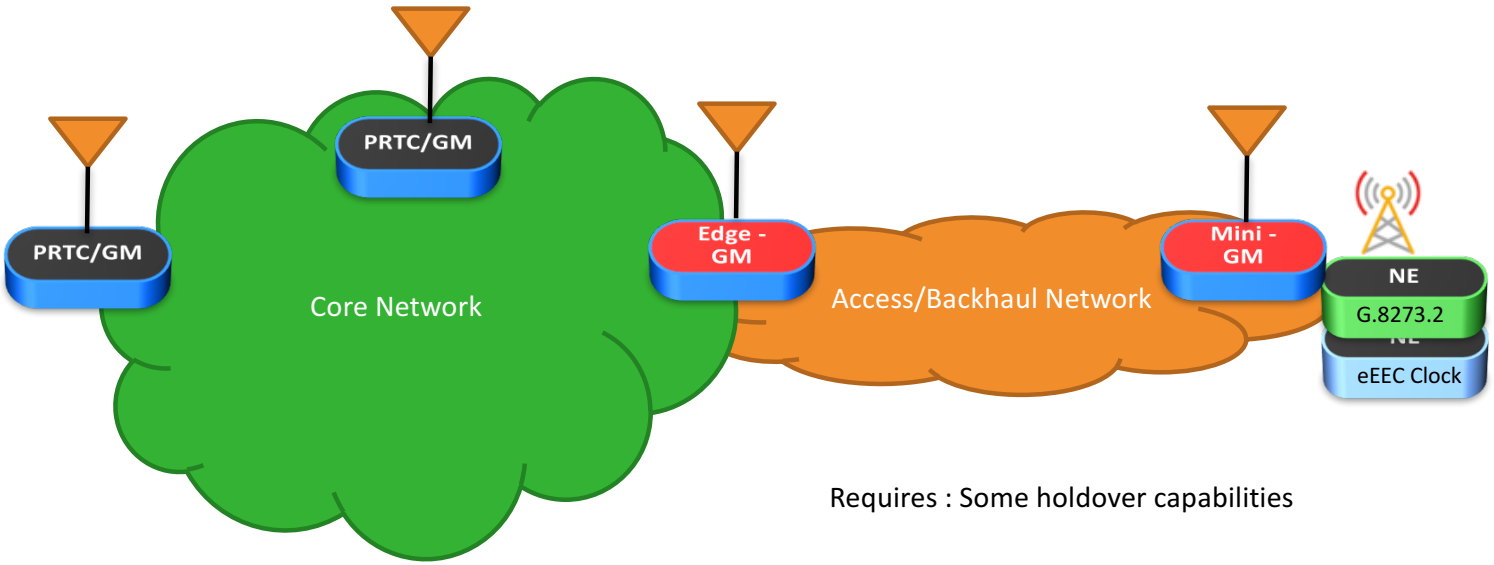
Emergence of Edge/Mini Grand Masters

- Clocks with short – Medium term holdover



Requires : Some holdover capabilities

10 Searching for an optimal clock

- **Mobile networks**
  - Reducing long holdover : Redundant synchronisation mechanisms
- **Aggregation and Transport Networks**
  - Optimizing Clocks : Increasing network resilience, Introduce Short holdover
- **Edge Grand Masters**
  - Flattens Network Sync Hierarchy : Introduces “Basic Grand Masters” with short / Medium holdover

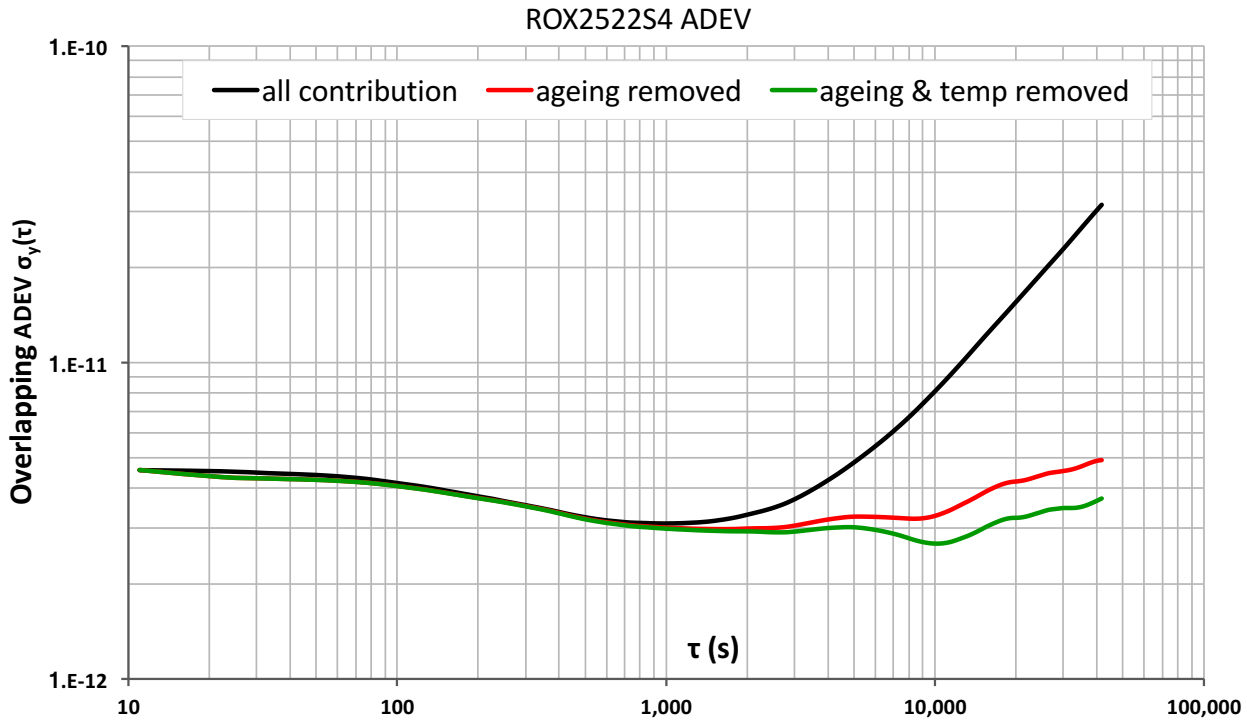
- **An optimal clock is a Stratum 3E+ Clock**
  - One lever higher stability than a Stratum 3E Clock

11 General characteristics

	Stratum 3E Clock	Stratum 3E+ Clock
Temperature Stability	10ppb	1ppb
Ageing	1ppb/day	0.2ppb/day
Frequency Slope	1ppb/Deg C	0.1ppb/ Deg C
Size	25x22, 14x9	24x22
Power	0.75W - 1.5W	0.75W - 1.5W
Overall Stability	4.6ppm	2ppm

12 Advancement in oscillators

Compensation Techniques



13 Summary of Standards Compliance

14 Acknowledgements

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Thank you