

IEEE-1588 and Synchronous Ethernet – the Whole is Greater Than Its Parts

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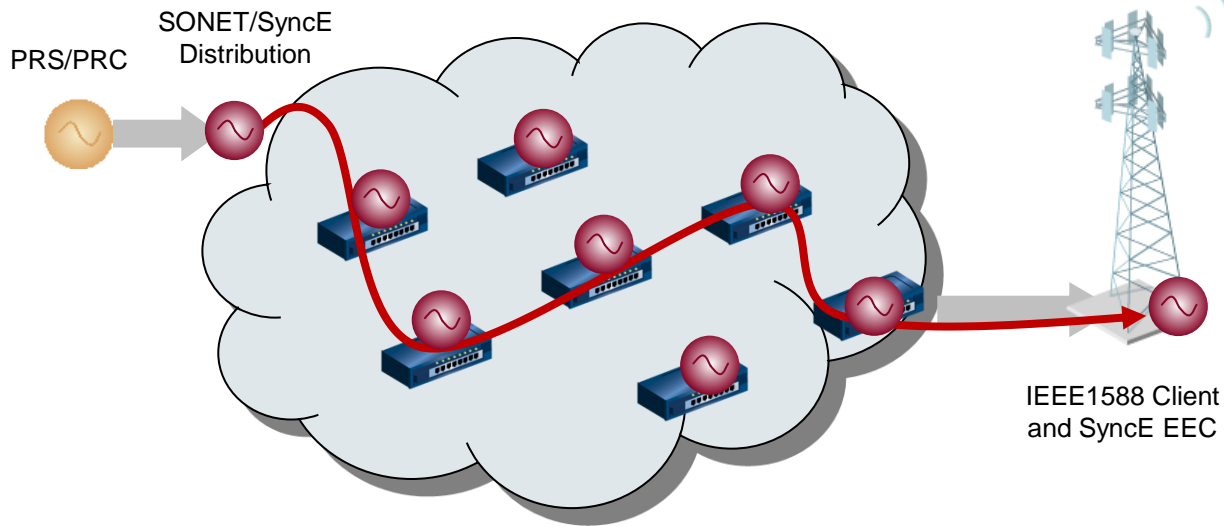
Introduction








- Delivery of Frequency via Synchronous Ethernet
- Methods for delivering phase
 - Phase over Unaware networks
 - Phase over Partially aware network
 - Phase over Aware networks
- Comparison of results using different methods

Use case – SyncE for frequency distribution

- Advantages
 - Synchronous Ethernet extends the SONET/SDH timing model to Ethernet
 - Meets all existing frequency requirements via the bit rate of the Ethernet physical layer
 - Independent of packets and loading
 - Need to upgrade equipment in the Ethernet packet chain to support SyncE
 - Need unbroken chain of SyncE equipment from frequency source to end application
 - May use SONET or PDH to add timing to Ethernet at some intermediate point in the network (i.e. at egress from SONET over packet network to Ethernet network)
- Fully approved in ITU-T G.8262

SyncE Syntonization



	G.811 PRC
	G.8272 PRTC
	G.811 PTM
	G.8263 Opt. 2
	G.8273.2 BC
	"G.8261" OC
	End Application

Transition from Frequency to Frequency and Phase

Terminology: Aware networks

- Aware
 - Addition of Boundary clock at each node in the network
 - According to ITU model current under study
 - Split up the network in to smaller pieces
 - Needed for end-to-end time of day performance

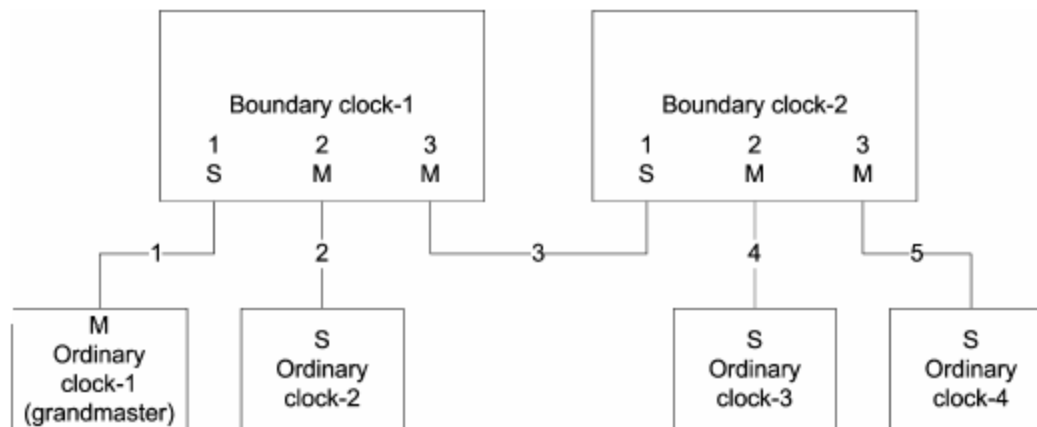


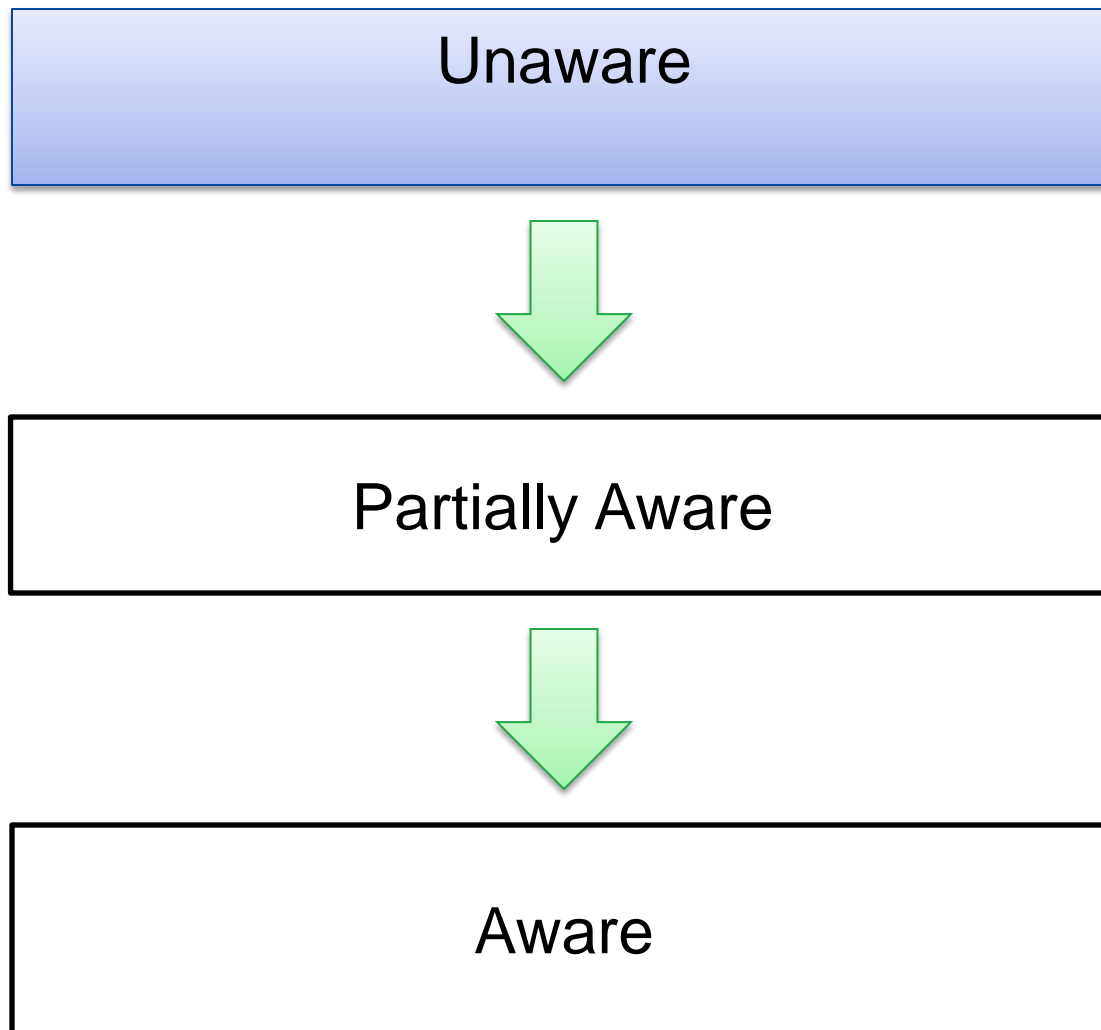
Figure 10—Simple master-slave clock hierarchy

From IEEE Std 1588-2008 page 32

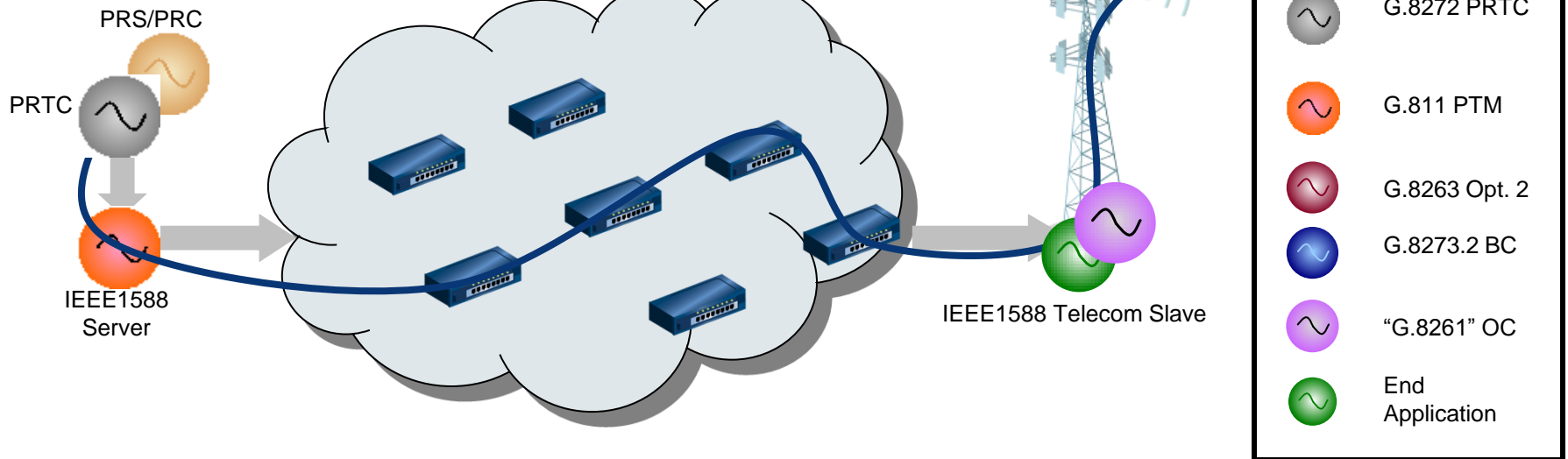
Network Types

- Unaware networks
 - No processing of the PTP packets at intermediate nodes by Boundary Clocks
- Partially Aware
 - Some Boundary Clocks in the network but not at every node
 - May be needed for existing networks during transition
 - May allow phase transfer without upgrading all network elements in network
- Aware Networks
 - All nodes in the network have Boundary Clocks

Network Types



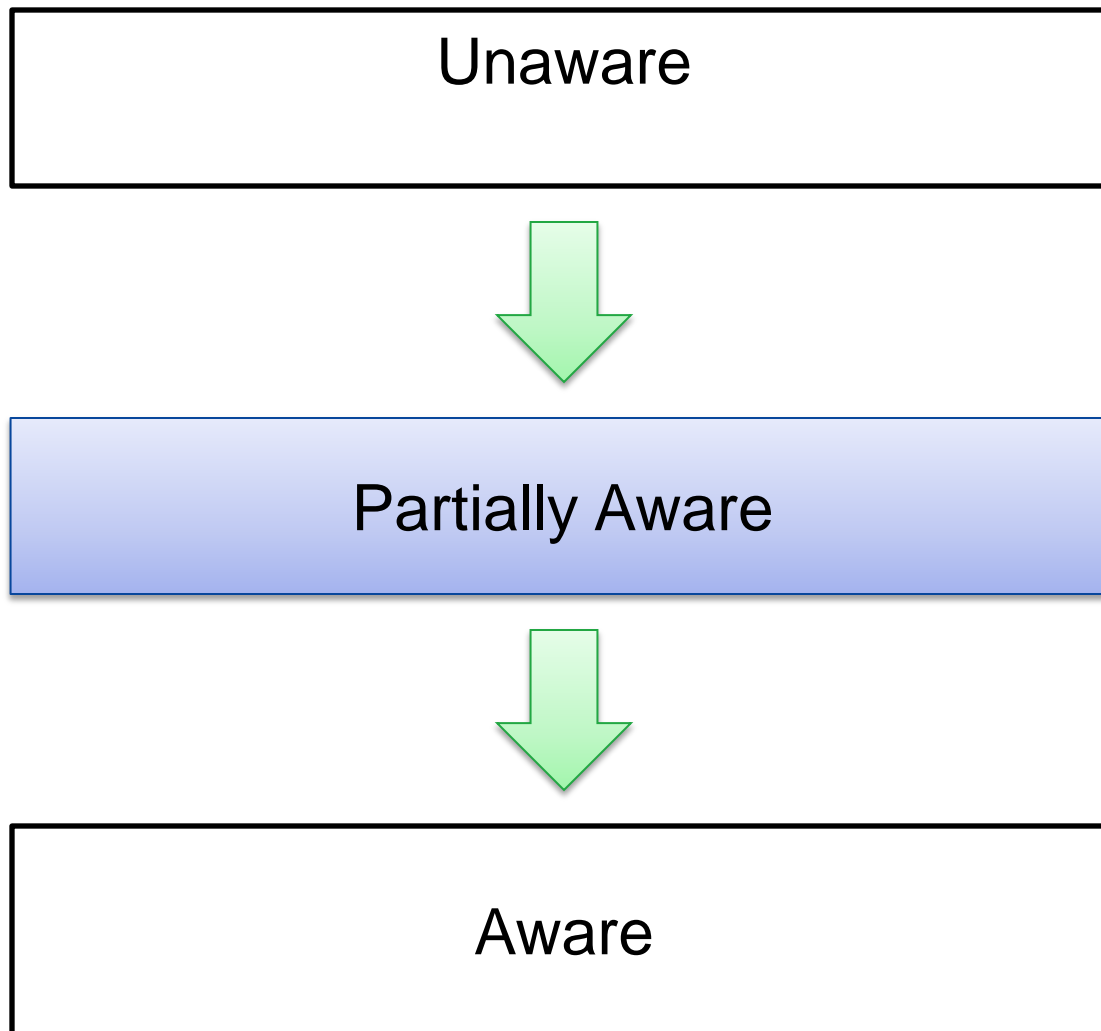
Unaware No On-Path Support



Telecom profile for unaware frequency

- ITU-T G.8265., Precision time protocol telecom profile for frequency synchronization
 - Published in October 2010
 - Includes the set of PTP options to allow frequency transport
 - Integrate with the existing G.781 selection mechanism using SSM and existing frequency sources

Network Types



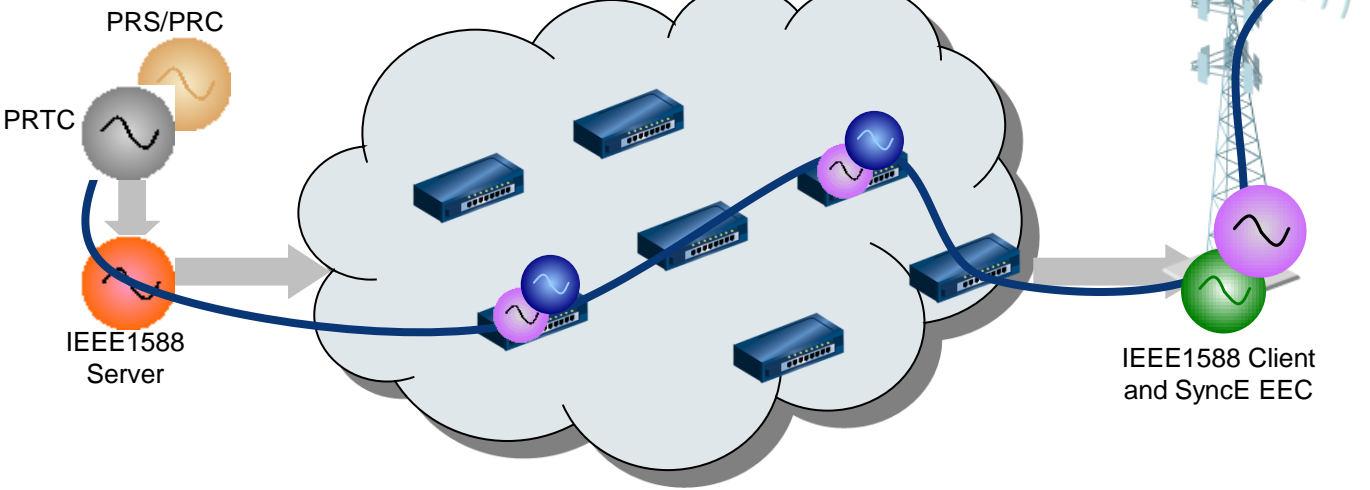
Use case

Phase over Partially aware networks

- Not currently under study in standards
- Too many network types and configurations
- Unaware phase profile
- Unaddressed in standards
- Challenges
- May be possible in a managed network
 - Single carrier with careful engineering of link utilization and routing

Aware Network

Partial On-Path Support without SyncE Syntonization



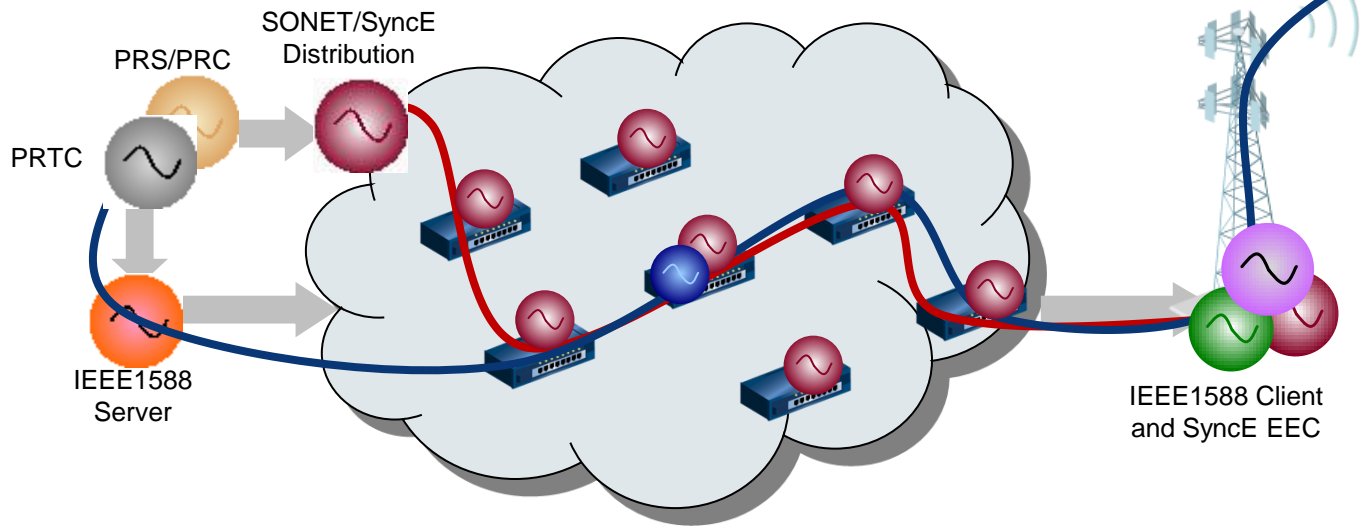
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|--|-----------------|
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| | G.8272 PRTC |
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| | G.8263 Opt. 2 |
| | G.8273.2 BC |
| | "G.8261" OC |
| | End Application |

Results

Results pending

Aware Network

Partial On-Path Support with SyncE Syntonization

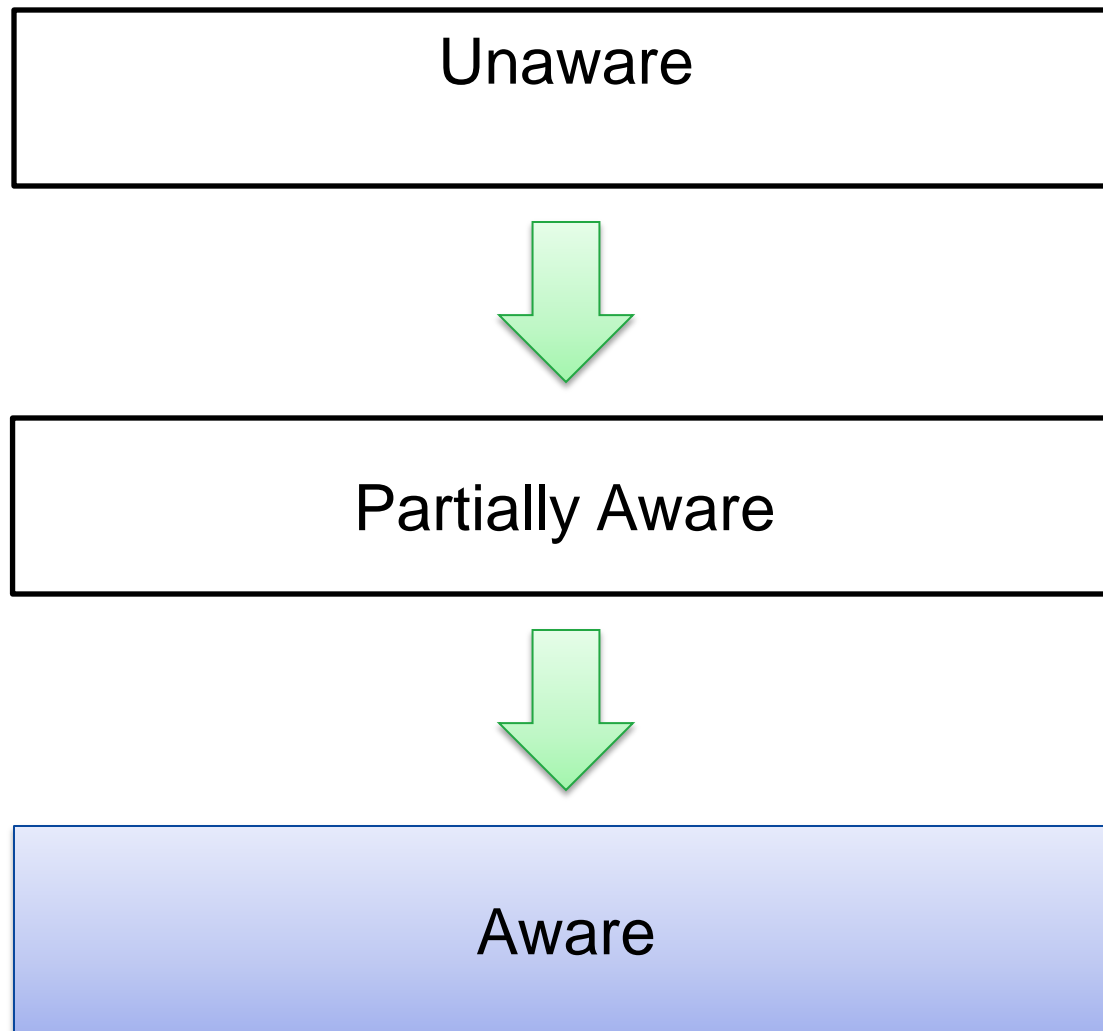


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Results

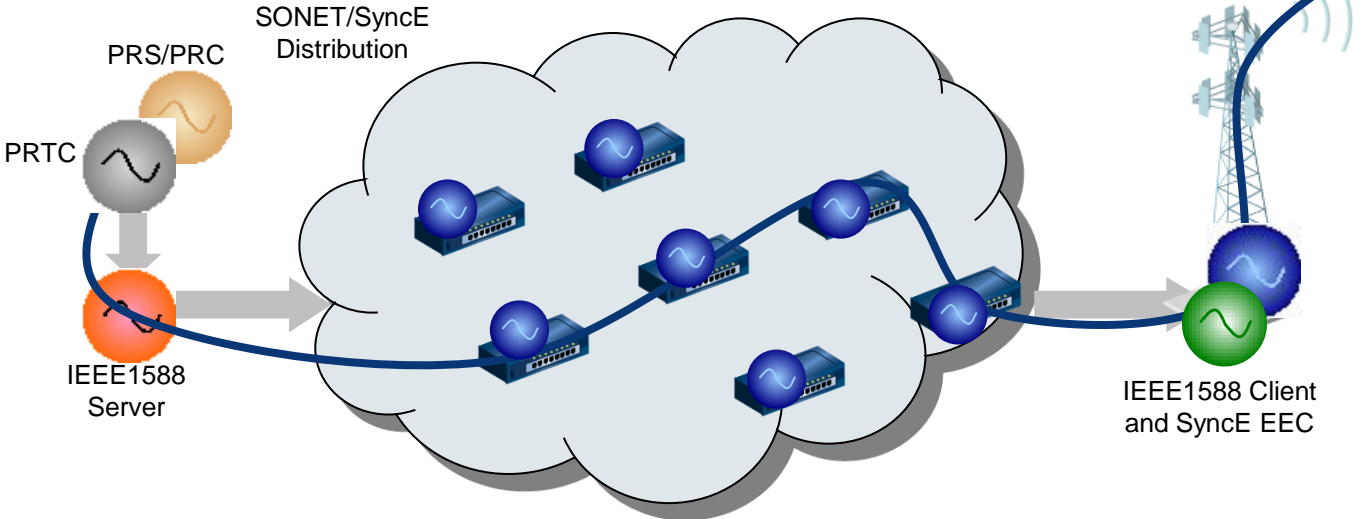
Results pending

Network Types



Aware Network

Full On-Path Support without SyncE Syntonization



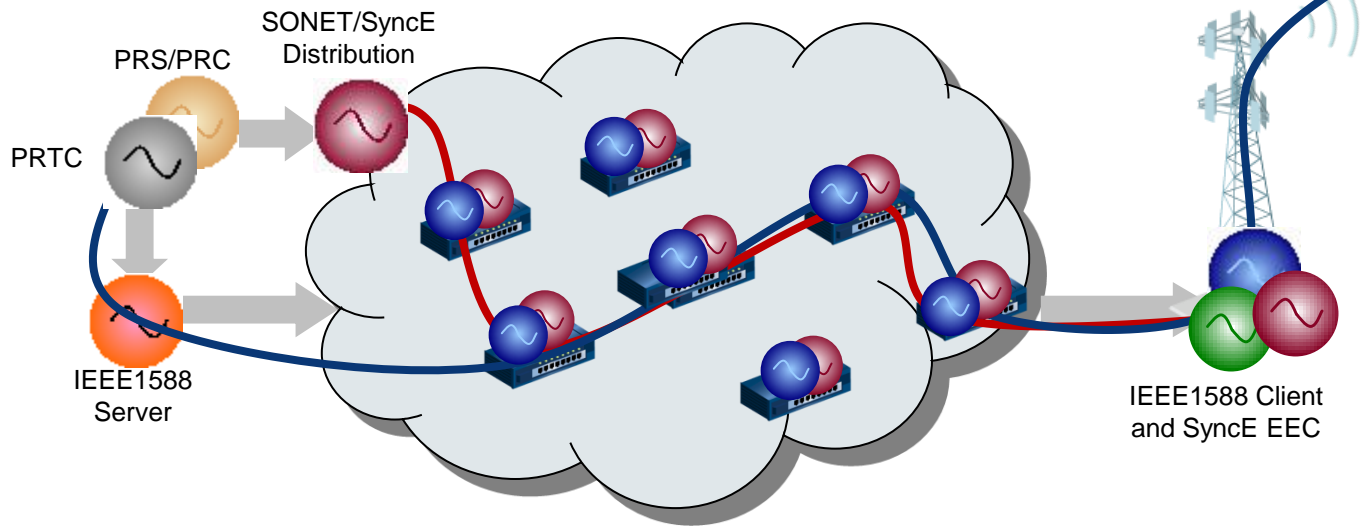
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
Results – Aware Network

Results pending

Aware Network

Full On-Path Support with SyncE Syntonization



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Results – Aware Network

Results pending

Summary

- Phase transfer results for various networks as shown in this presentation
- The use of aware network with SyncE support give the best performance
- The use of SyncE provides improvement in the partially aware case
- SyncE and IEEE-1588 together gives the best performance

Phase transfer (ns)	Partially Aware	Aware
No SyncE support	-	Better
With SyncE support	Good	Best