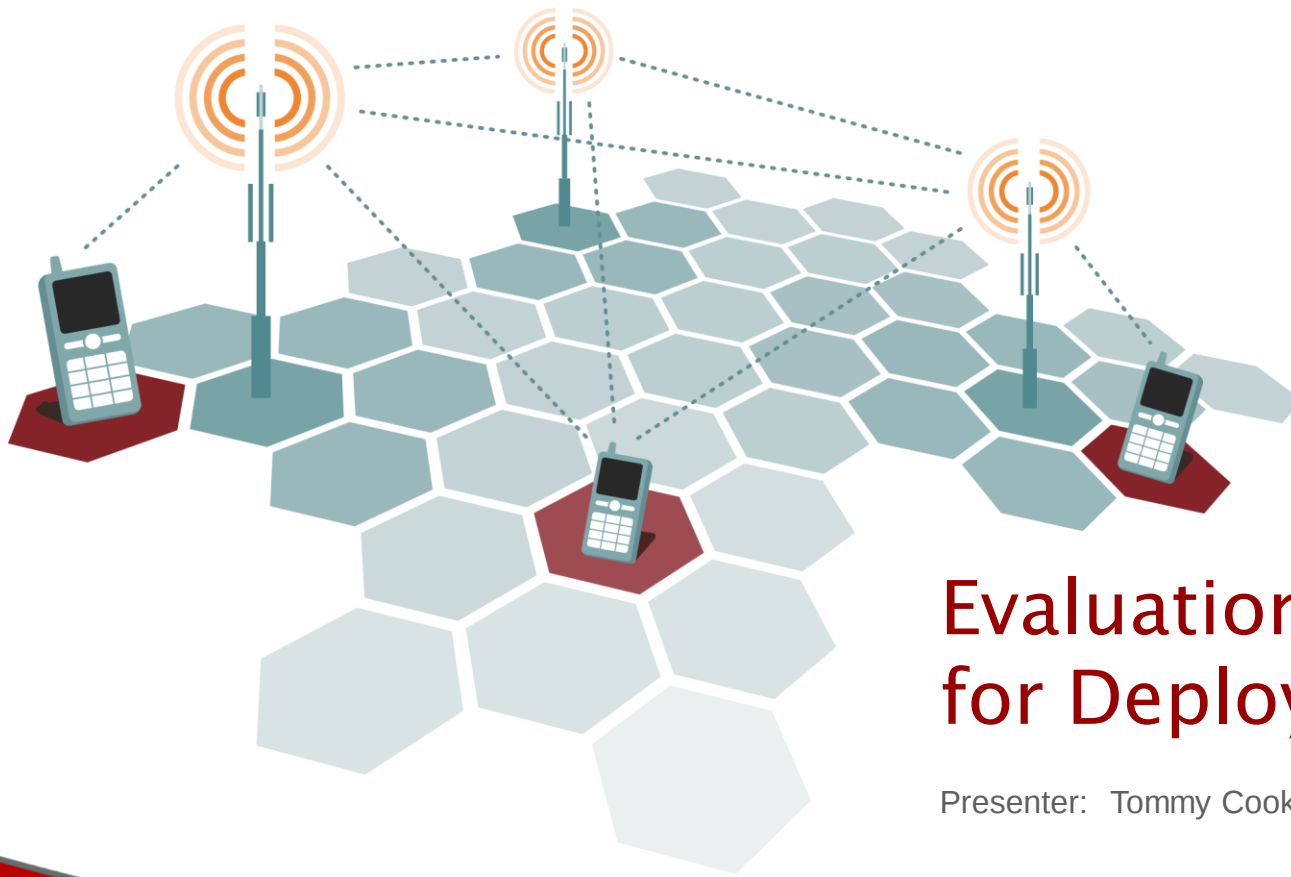




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Evaluation of 1588v2 for Deployment.

Presenter: Tommy Cook, CEO Calnex Solutions Ltd



Presentation overview

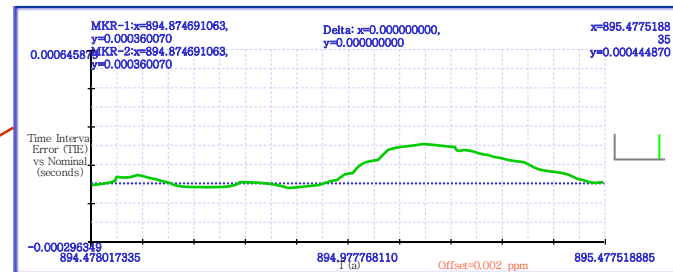
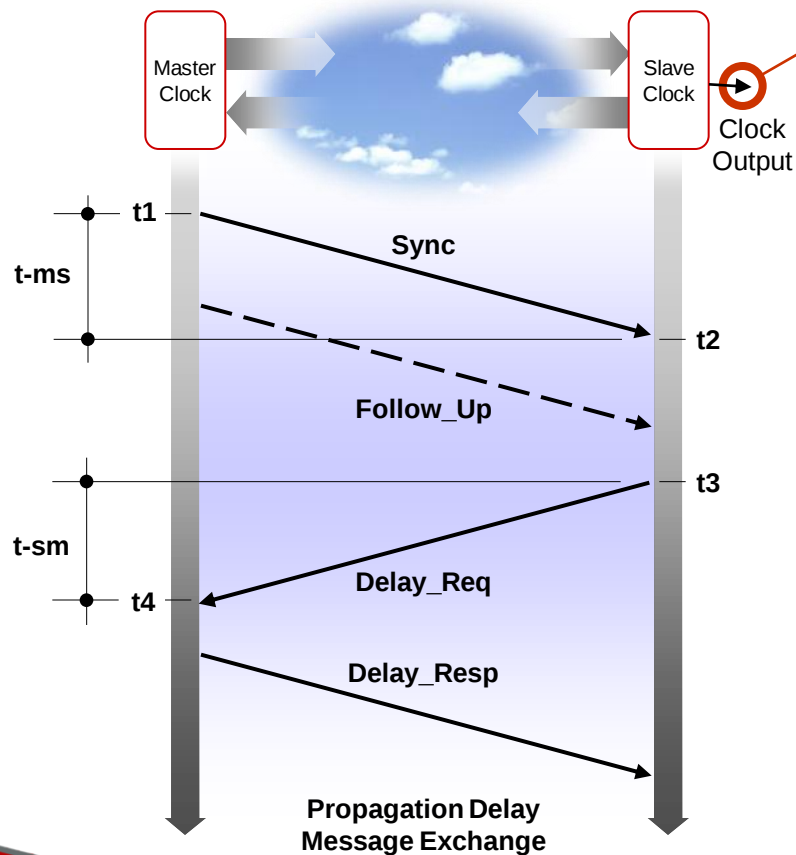
I want to deploy 1588v2 to transfer timing across my network.

What aspects and behaviours do I need to evaluate?

How do I prove equipment is fit for deployment?

- Items for evaluation.
 - Protocol Behaviour
 - Performance in Network Congestion
- Evaluation Plan.
 - Current methodology.
 - Enhanced methodology and Goal for the Future.

Proving 1588v2 clock transfer



Clock Output must comply with the relevant ITU-T clock specification (MTIE & TDEV specification);

- G.81x series of specifications
- (G.823/4 for TDM delivery.)

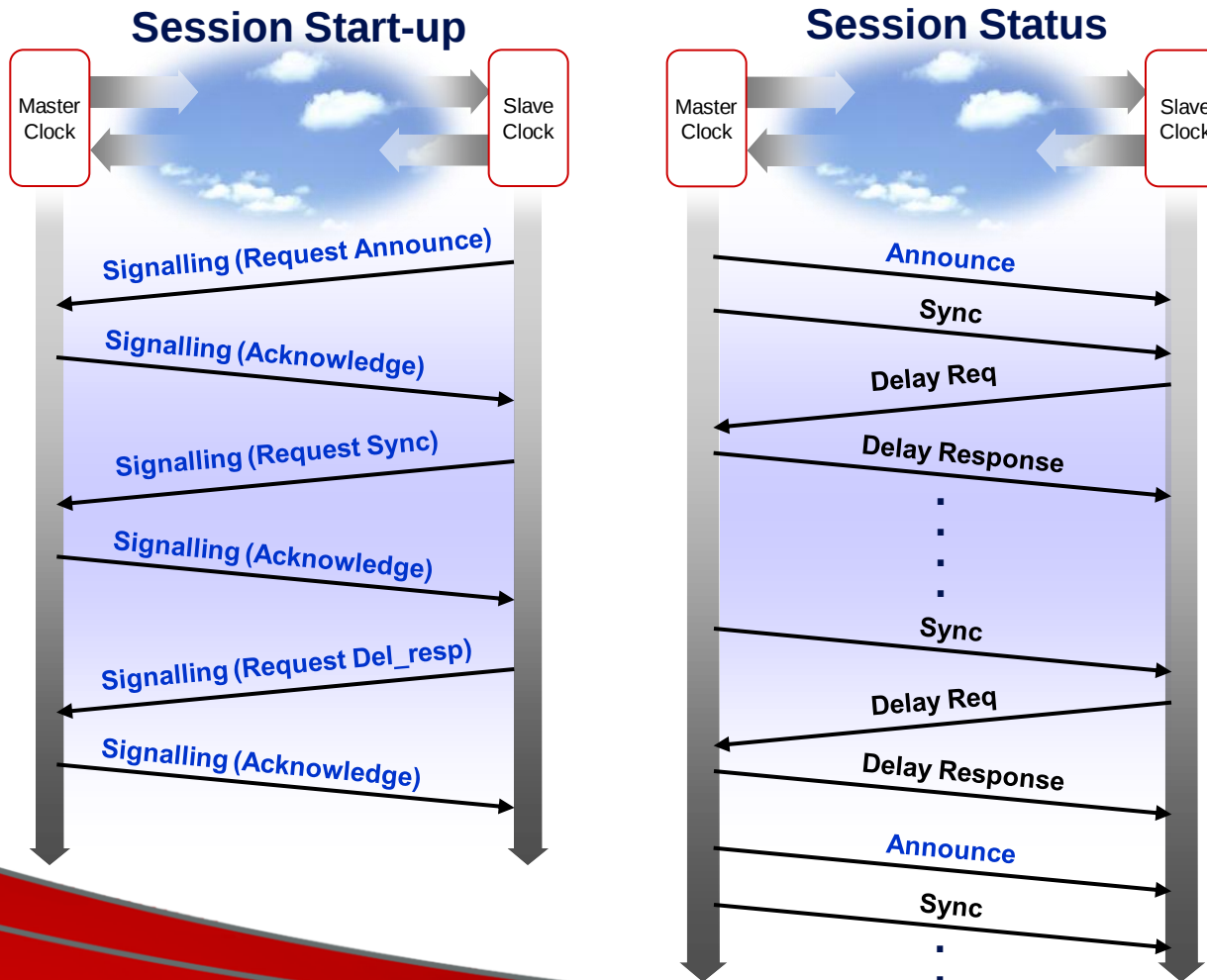


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Protocol Behaviour



Session Management Problems



- Are the Session Management protocol stacks robust to unexpected events?
- Will they always recover and continue as expected?



Calnex Solutions Ltd Handshake Sequence problems.

Port	Packet #	Arrival Time	Inter-Packet Time	Inter-Message Time	messageType	!!	sequenceId
→	29	0.071123510	0.002299195	0.008005435	DEL-RESP		44465
→	30	0.076121745	0.004998235	0.007995355	SYNC		50336
→	31	0.076511595	0.000389850	0.007687280	DEL-REQ		44466
→	32	0.079124625	0.002613030	0.008001115	DEL-RESP		44466
→	33	0.083129260	0.004004635	0.007007515	SYNC		50337
→	34	0.085945115	0.002815855	0.009433520	DEL-REQ		44467
→	35	0.088118380	0.002173265	0.008993755	DEL-RESP		44467
→	36	0.091150535	0.003032155	0.008021275	SYNC		50338
→	37	0.093922395	0.002771860	0.007977280	DEL-REQ		44468
→	38	0.096119015	0.002196620	0.008000635	DEL-RESP		44468
→	39	0.099782075	0.003663060	0.005859680	DEL-REQ		44469
→	40	0.102152130	0.002370055	0.006033115	DEL-RESP		44469
→	41	0.107150845	0.004998715	0.016000310	SYNC		50340
→	42	0.107782150	0.000631305	0.008000075	DEL-REQ		44470
→	43	0.110900600	0.003118450	0.008748470	DEL-RESP		44470
→	44	0.115151480	0.004250880	0.008000635	SYNC		50341
→	45	0.115572470	0.000420990	0.007790320	DEL-REQ		44471
→	46	0.118123155	0.002550685	0.007222555	DEL-RESP		44471
→	47	0.122117715	0.003994560	0.006966235	SYNC		50342
→	48	0.124959830	0.002842115	0.009387360	DEL-REQ		44472
→	49	0.127117390	0.002157560	0.008994235	DEL-RESP		44472
→	50	0.130128910	0.003011520	0.008011195	SYNC		50343
→	51	0.132909110	0.002780200	0.007949280	DEL-REQ		44473
→	52	0.135118025	0.002208915	0.008000635	DEL-RESP		44473
→	53	0.138110455	0.002991440	0.007000555	SYNC		50344

Missing Sync message.

Missing Delay_Response.

sage Time	messageType	!!	sequenceId
08000635	SYNC		50575
07810555	DEL-REQ		44685
08000630	DEL-RESP		44685
08000635	SYNC		50576
07638400	DEL-REQ		44686
08000635	DEL-RESP		44686
07819920	DEL-REQ		44687
08000635	SYNC		50577
06995515	SYNC		50578
08000795	SYNC		50579
	SYNC		50580
	SYNC		50581
	SYNC		50582
	SYNC		50583
	SYNC		50584
	SYNC		50585
	SYNC		50586
	DEL-REQ		44688
	DEL-RESP		44688
	DEL-REQ		44689
	SYNC		50587
	DEL-RESP		44689
	SYNC		50588
	DEL-REQ		44690
	DEL-RESP		44690
	SYNC		50589

- Are the protocol stacks robust to unexpected events?
- Will they always recover and continue as expected?

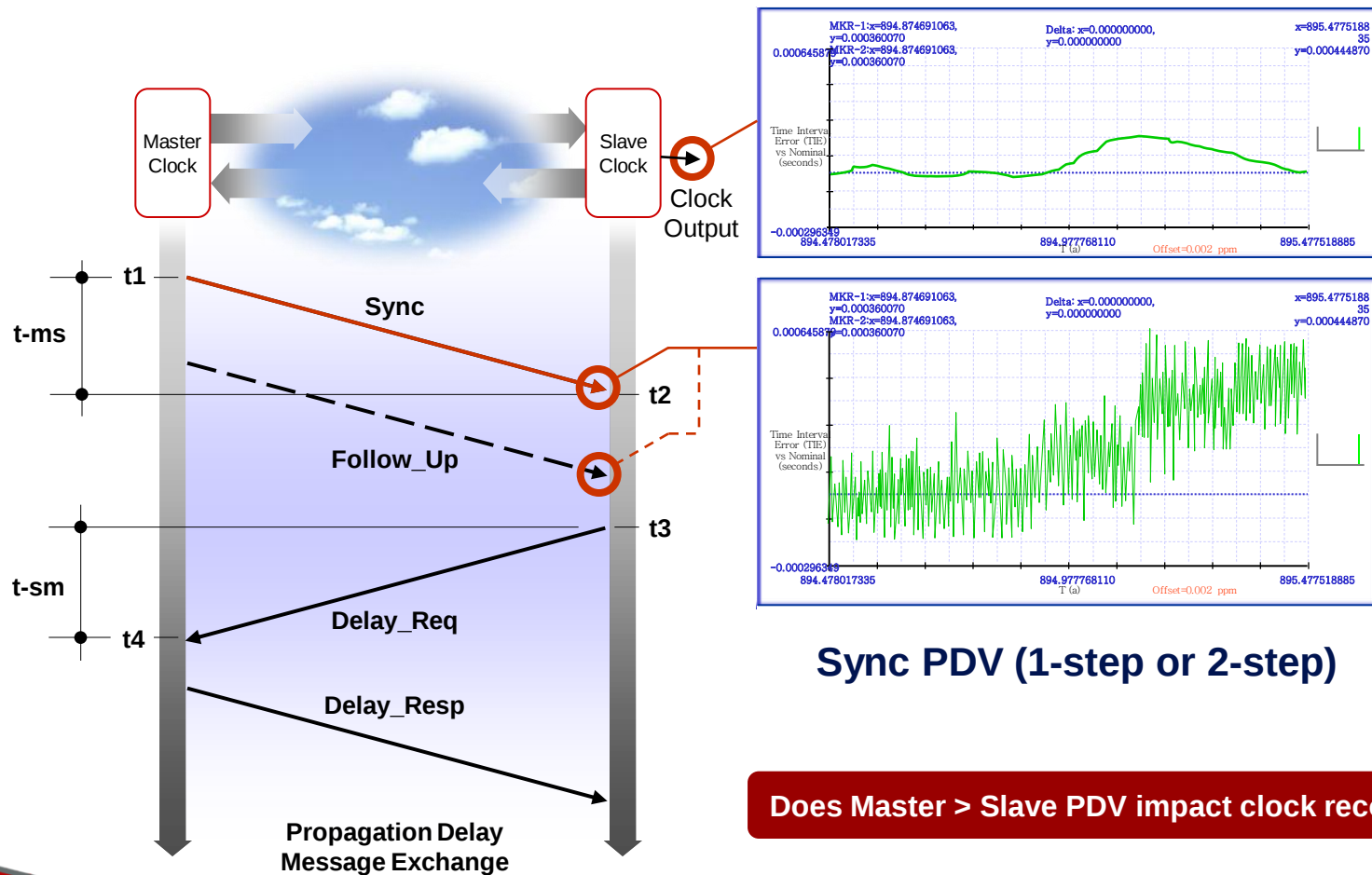
→	717	1.982005540	0.007999195	0.007999195	SYNC		50580
→	718	1.990004250	0.007998710	0.007998710	SYNC		50581
→	719	1.997992885	0.007988635	0.007988635	SYNC		50582
→	720	2.004998480	0.007005595	0.007005595	SYNC		50583
→	721	2.012997675	0.007999195	0.007999195	SYNC		50584
→	722	2.020996390	0.007998715	0.007998715	SYNC		50585
→	723	2.028995105	0.007998715	0.007998715	SYNC		50586
→	724	2.029303420	0.000308315	0.070446400	DEL-REQ		44688
→	725	2.031997985	0.002694565	0.077994190	DEL-RESP		44688
→	726	2.036951420	0.004953435	0.007648000	DEL-REQ		44689
→	727	2.036996220	0.000044800	0.008001115	SYNC		50587
→	728	2.040019260	0.003023040	0.008021275	DEL-RESP		44689
→	729	2.043993175	0.003973915	0.006996955	SYNC		50588
→	730	2.046842460	0.002849285	0.009891040	DEL-REQ		44690
→	731	2.048992850	0.002150390	0.008973590	DEL-RESP		44690
→	732	2.051993810	0.003000960	0.008000635	SYNC		50589



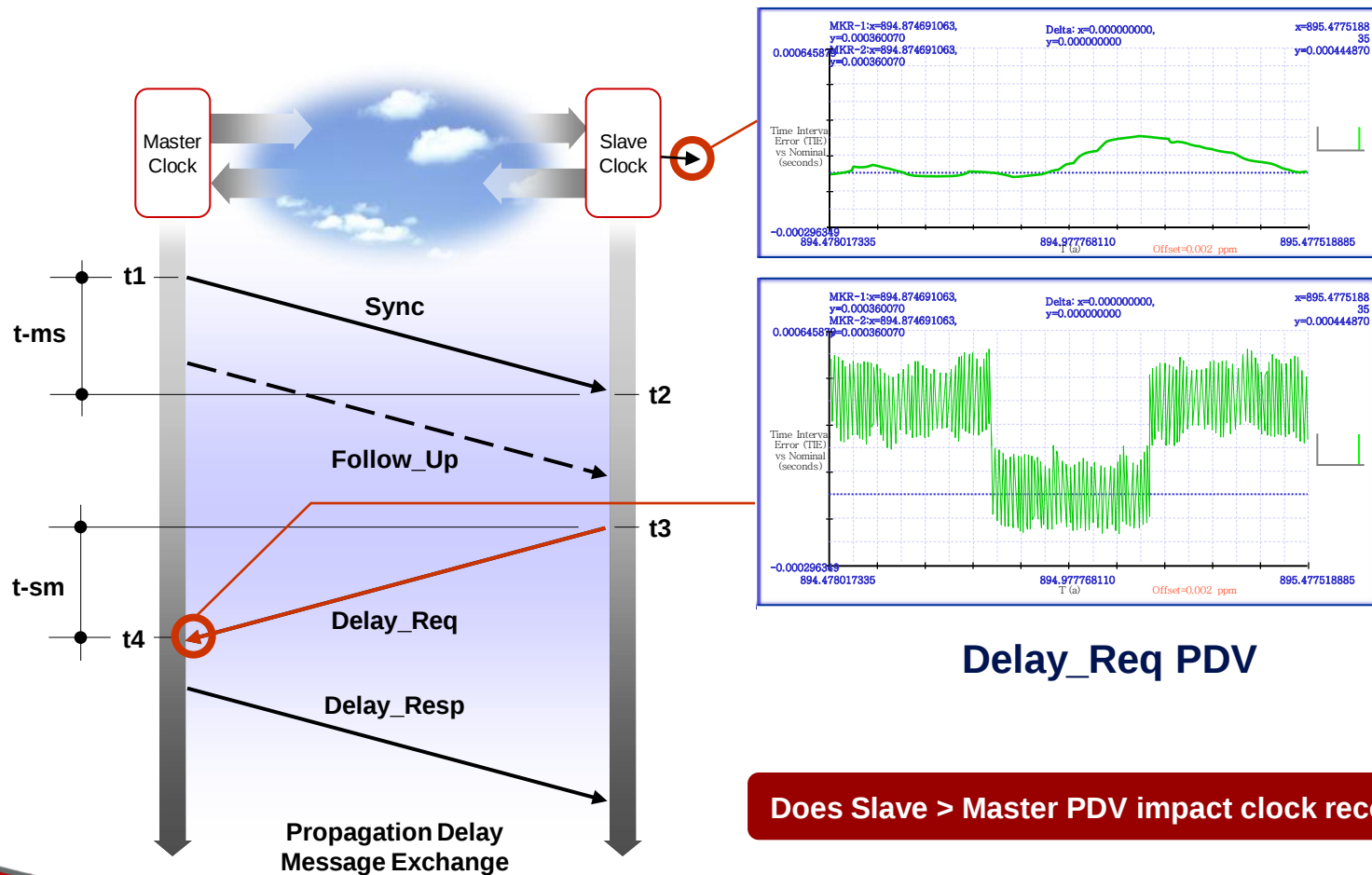
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Network Delay & PDV

Network Impact of 1588v2 clock transfer

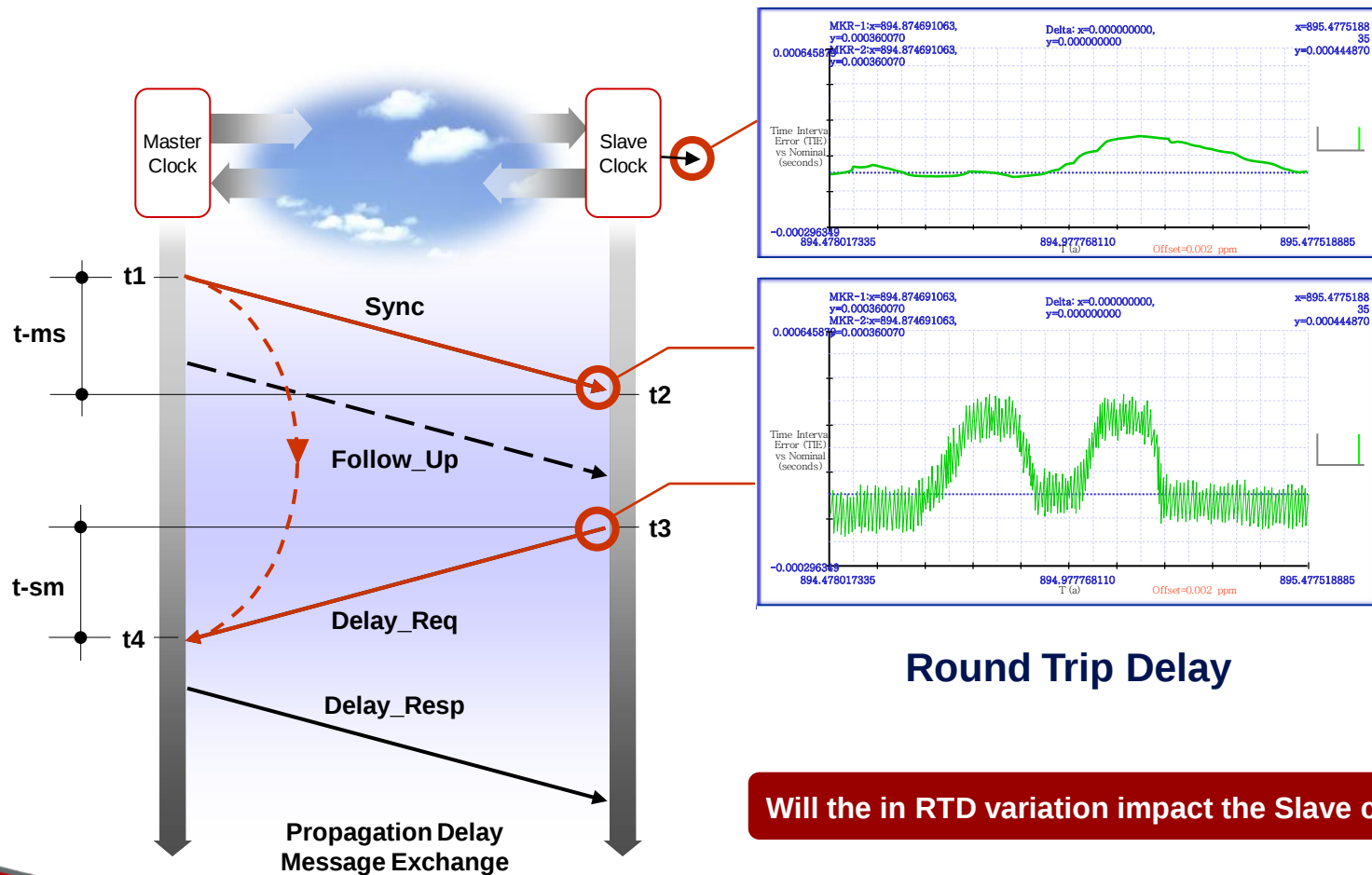


Network Impact of 1588v2 clock transfer

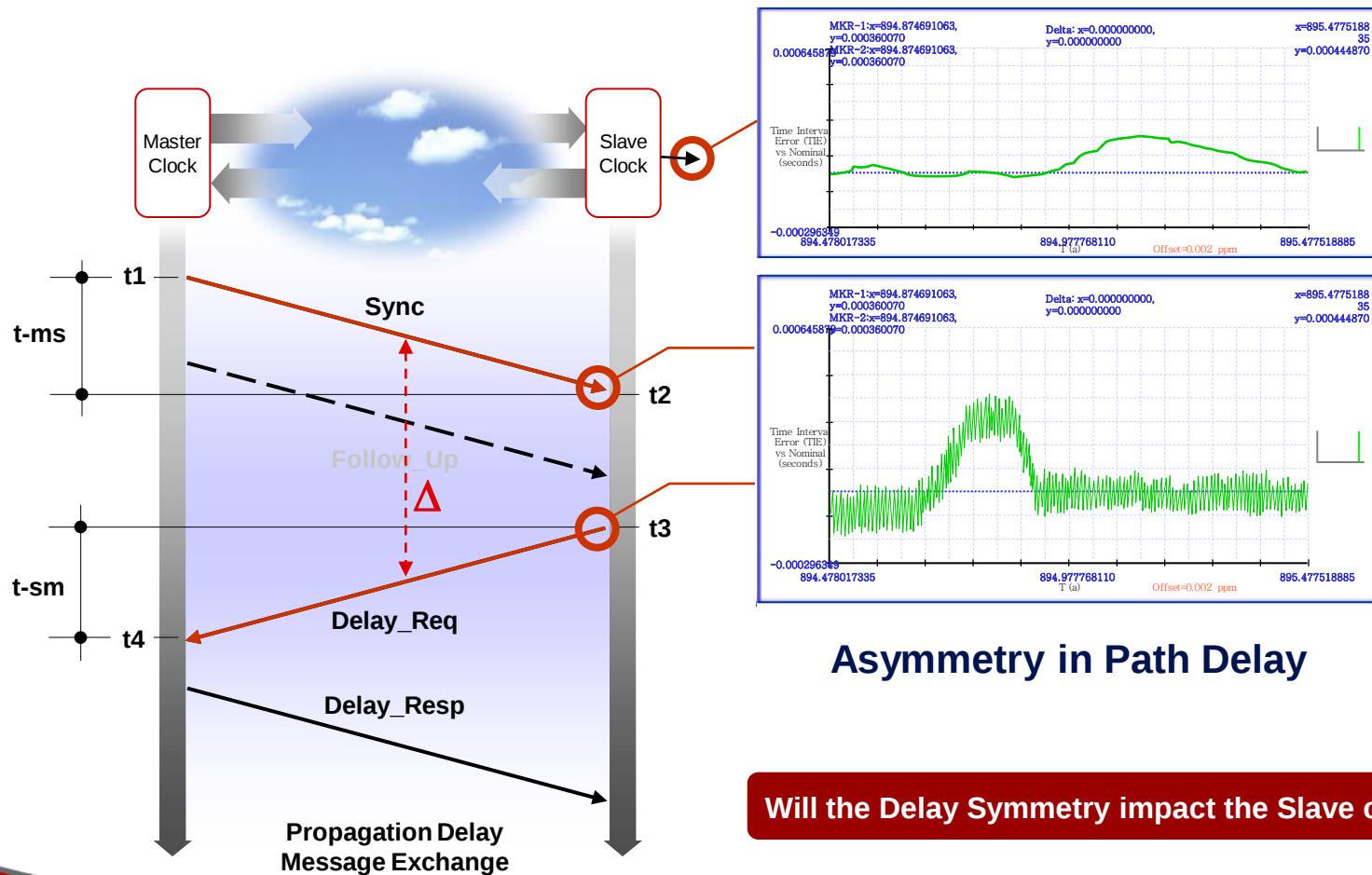


Does Slave > Master PDV impact clock recovery?

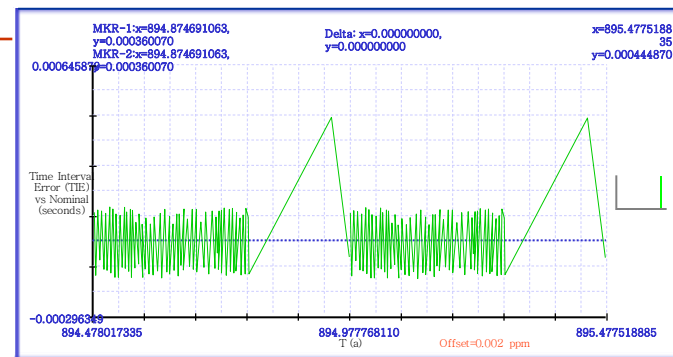
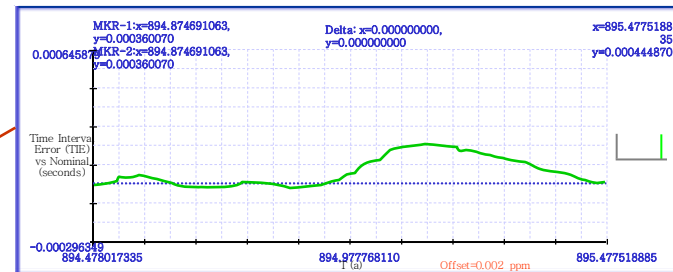
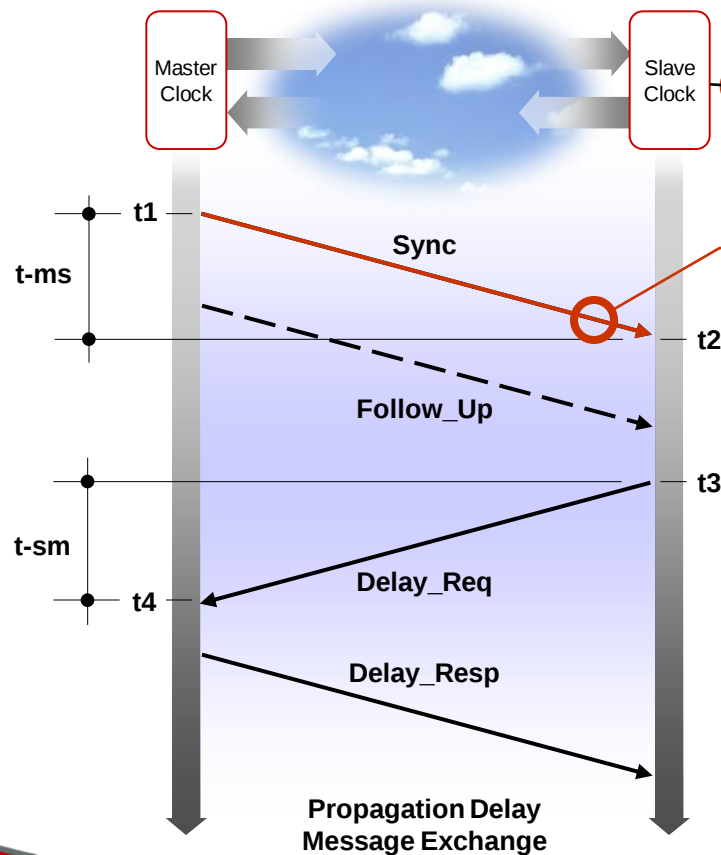
Network Impact of 1588v2 clock transfer



Network Impact of 1588v2 clock transfer



Network Impact of 1588v2 clock transfer

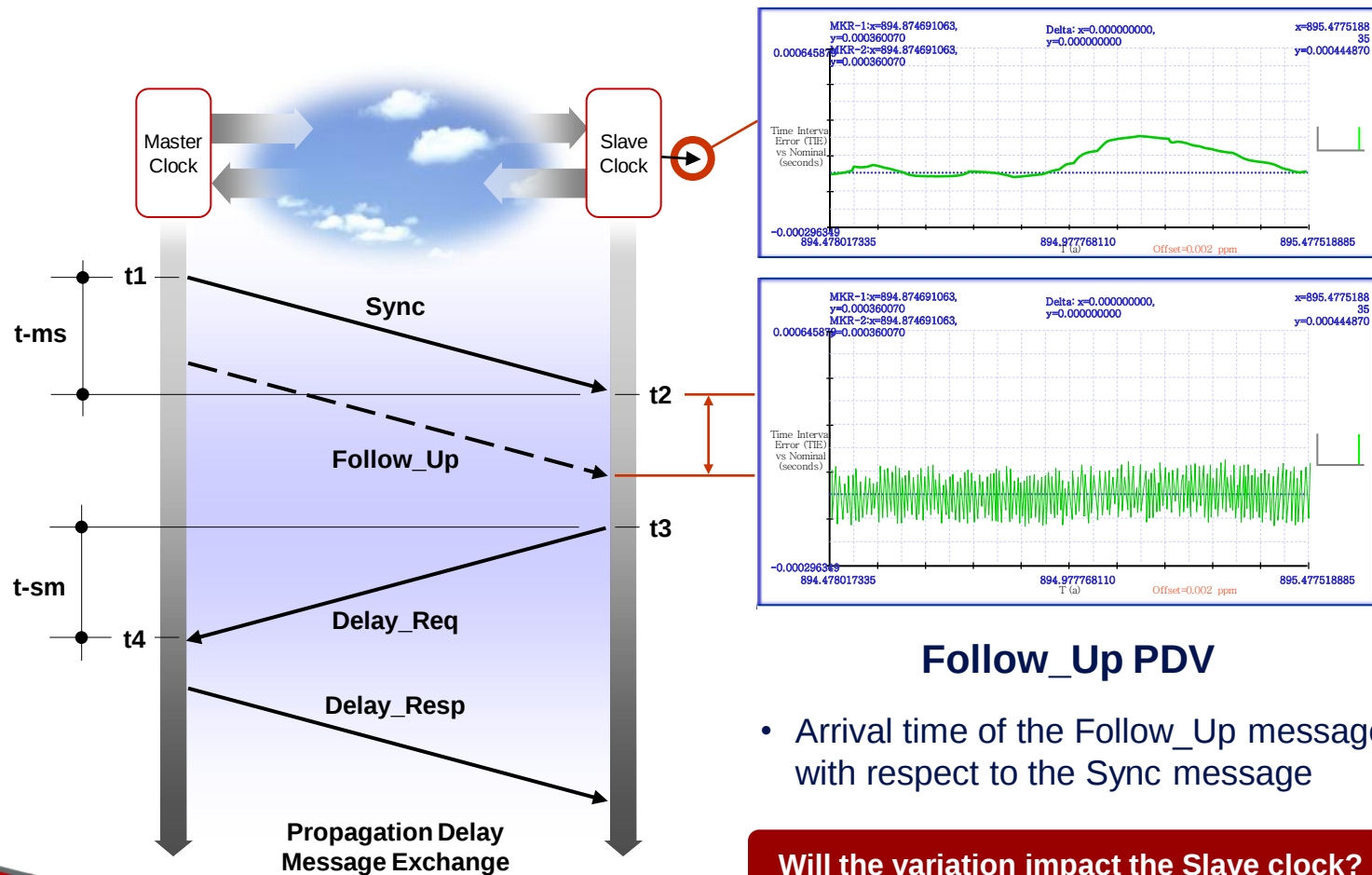


Sync IPG

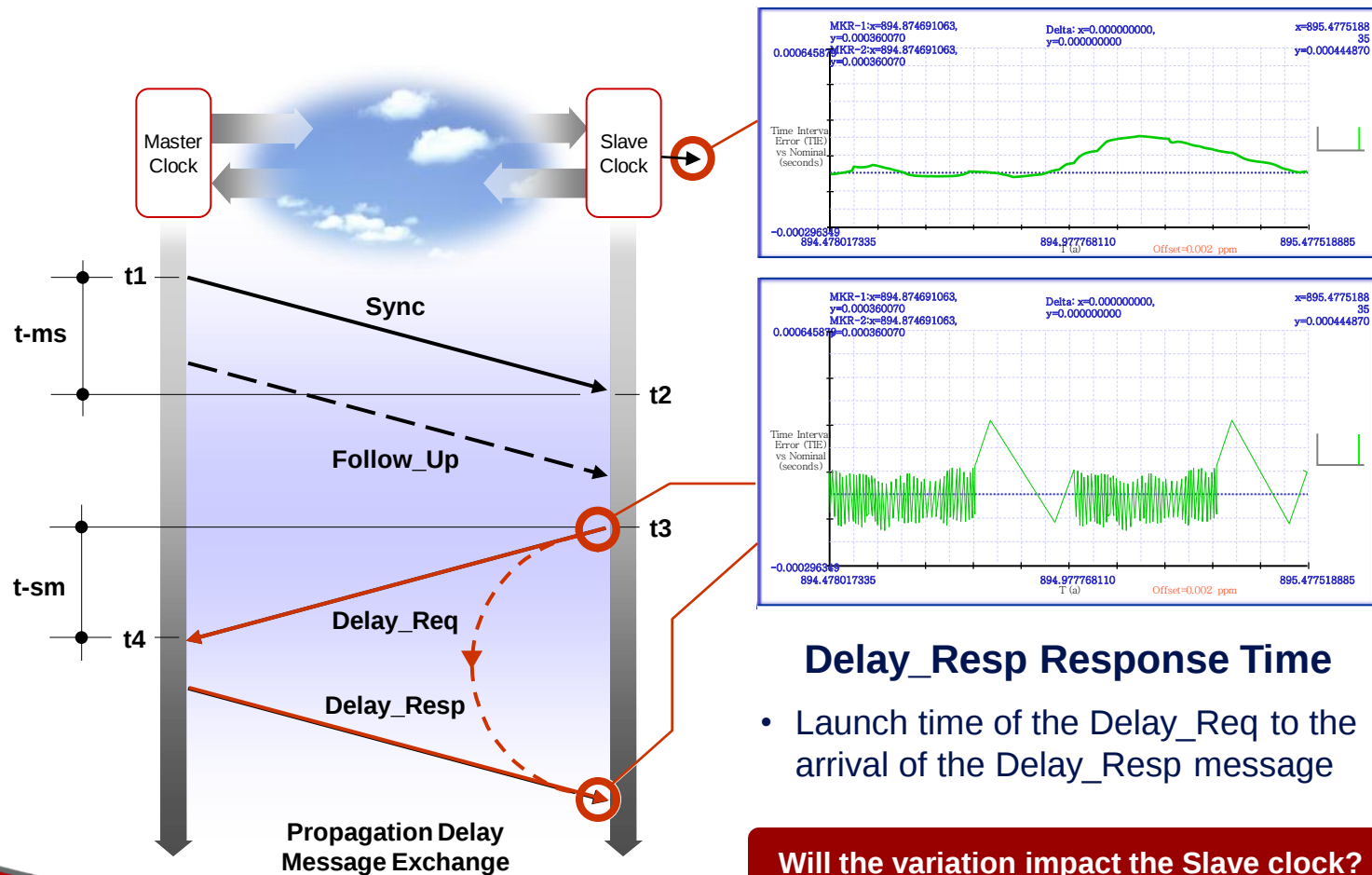
- Monitor variation in arrival time of Sync messages at Slave Clock

Does Slave need regular Sync messages?

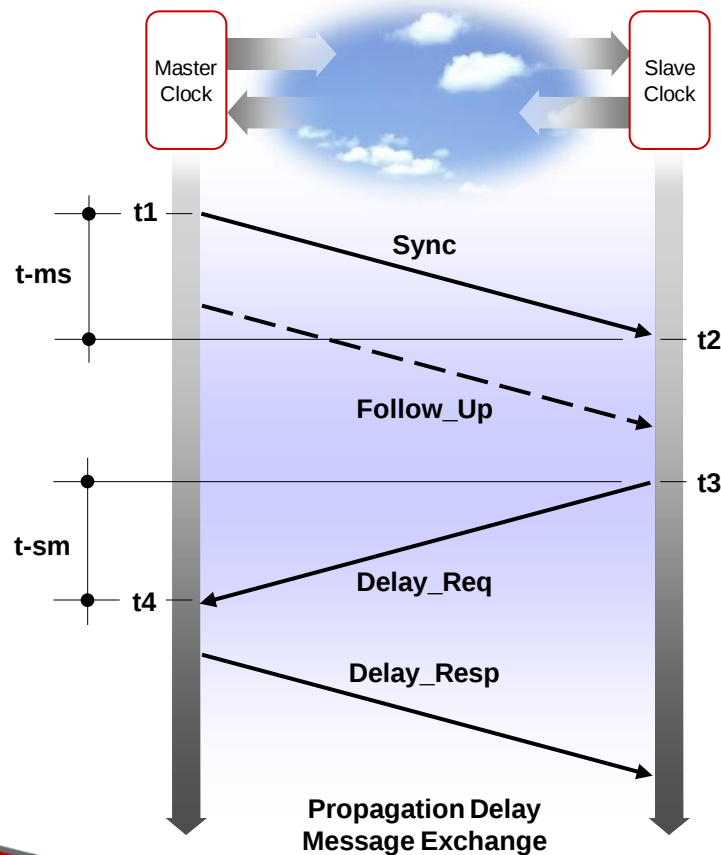
Network Impact of 1588v2 clock transfer



Network Impact of 1588v2 clock transfer



Network Impact of 1588v2 clock transfer



To fully understand the impact of the Network on the Slave clock recovery, the impact of variation and congestion on the following parameters needs to be understood:

- Sync PDV
- Delay_Req PDV
- Round Trip Delay
- Path Asymmetry
- Sync IPG
- Follow-up PDV
- Delay_Resp Response Time

Evaluation Plan



Evaluation Plan

– Approach to date

1. Evaluate Session Management protocol.

- Evaluate Session Start-up and Status Management.
 - Signalling and Announce messages.
- Introduce Network Impairments to each type of message;
 - Drop, Repeat, Delay, Mis-ordered.

2. Evaluate Time Transfer protocol.

- Evaluate Time Transfer message sequence.
 - Sync, Follow-up, Del_req, Del_resp
- Introduce Network Impairments to each type of message;
 - Drop, Repeat, Delay, Mis-ordered.

3. Stress Test impact of Network Congestion and PDV.

- Introduce PDV into Sync & Del_Req.
 - G.8261 Test Cases.
 - Replay Live captures from active network.
- Vary the Round-trip-delay & path asymmetry.
 - Vary the latency in each path.
 - Introduce asymmetry between up-stream & down-stream path latency.
- Emulate IPG variation on Sync, Follow-up & Delay-response.
- Emulate varying Master Response times

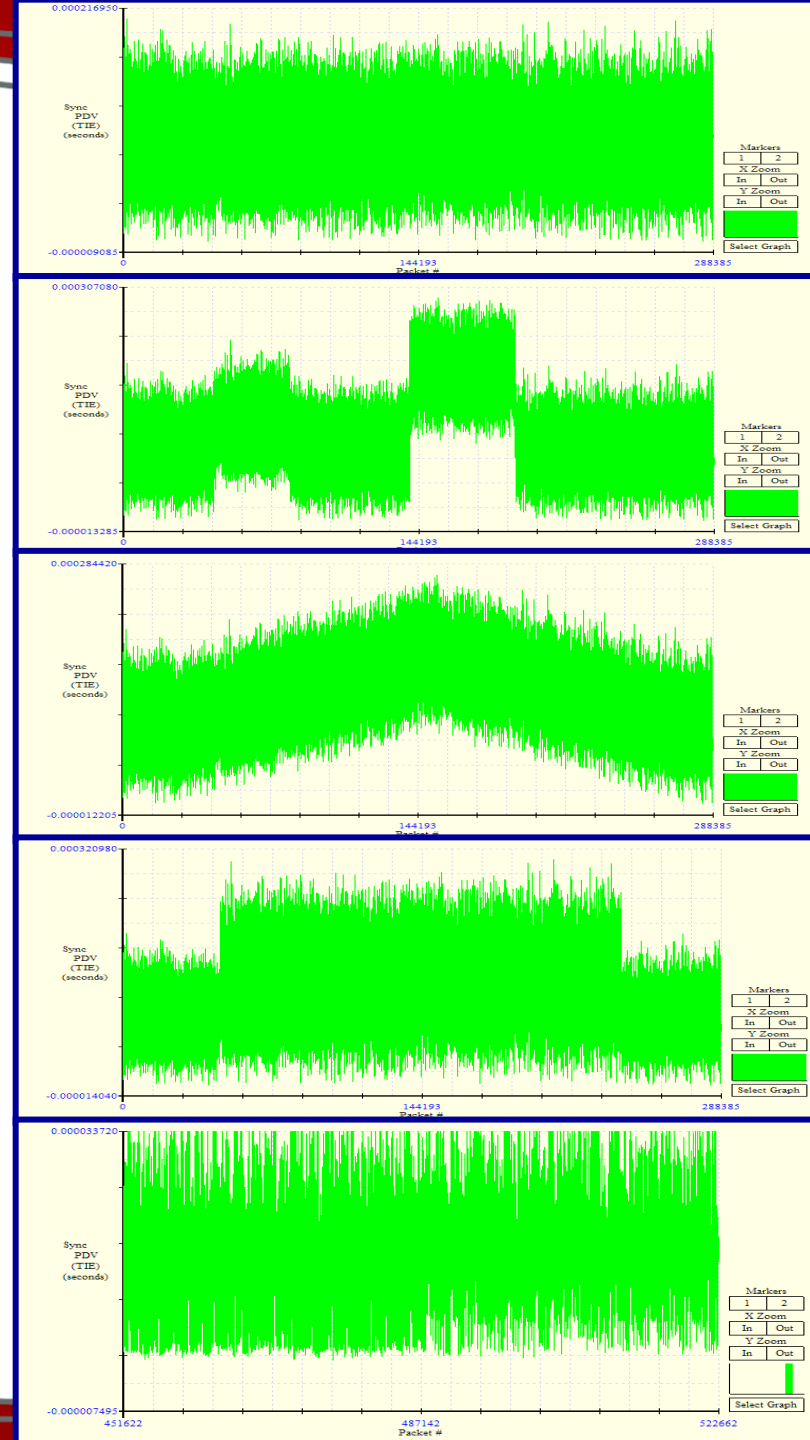


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Evaluation Plan – Enhanced

Characterise & compare
Slave performance with
controlled behaviours.

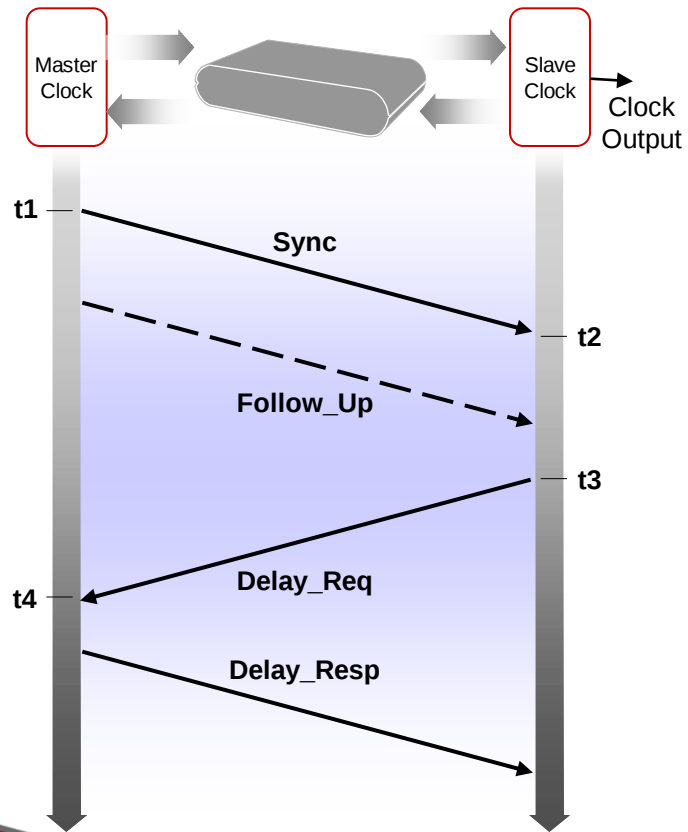
- Emulate recognised network PDV behaviours.
 - Step Noisefloor.
 - Ramp, 24hr varying Noisefloor.
 - PDV amplitude.
 - Deplete Noisefloor.





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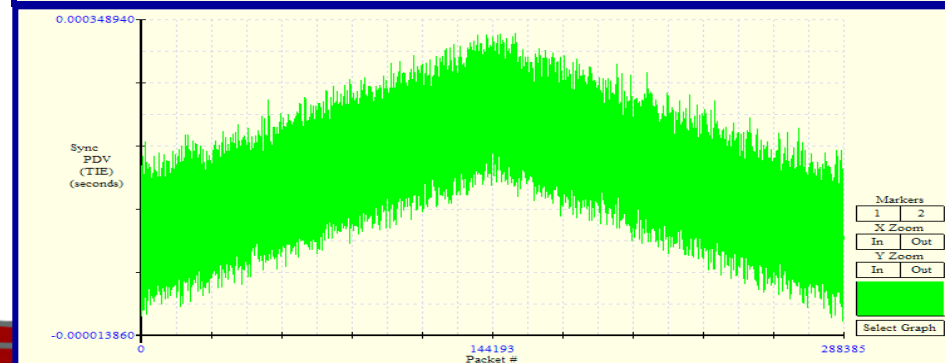
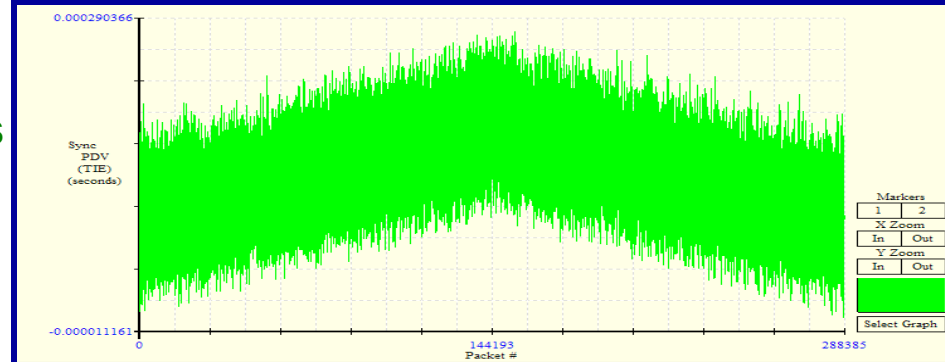
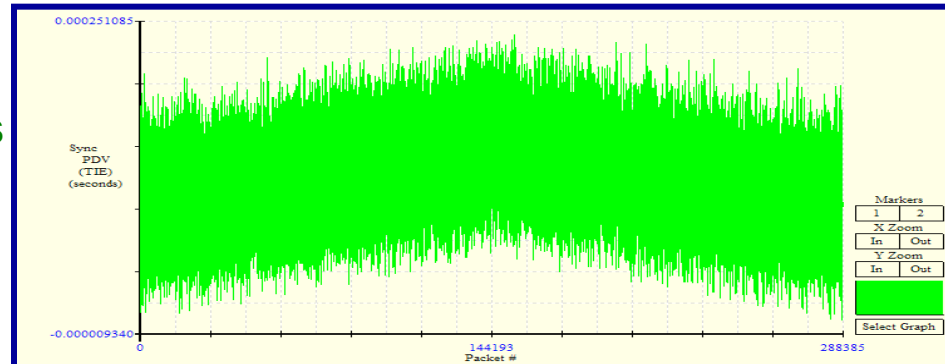
Estimate Performance Limits of Slave



Pass

Pass

Fail





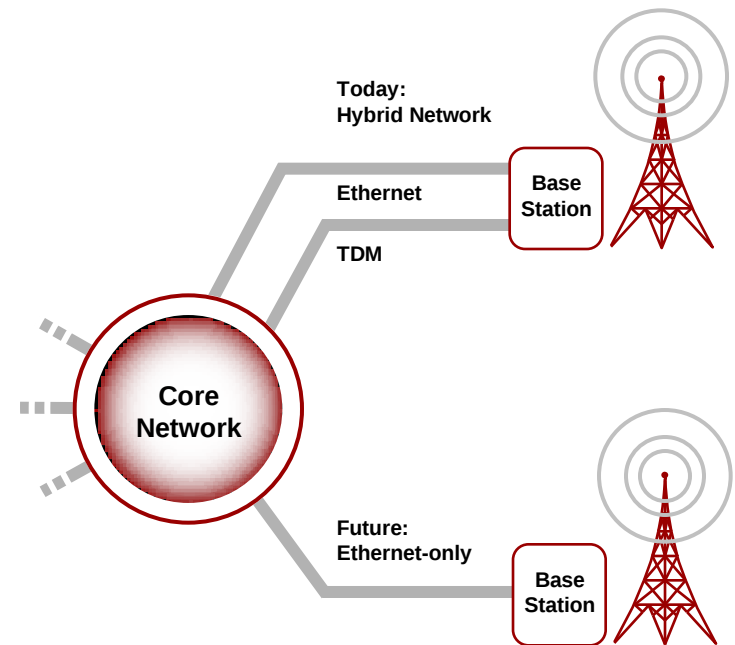
Evaluation for mass deployment– The Goal

Engineer Network to agreed Performance Limits.

- Test network prior to deployment against Performance Limits.
- Manage network to Performance Limits.

What's required to achieve this Goal;

- Agreement on recognised PDV behaviours.
- Establish PDV Limits.
- Tools to emulate and measure network to not exceed Performance Limits.





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Calnex Paragon

- IEEE 1588v2
- CES
- Sync-E
- NTP
- Ethernet OAM

