

# 60802

# Time Sync Update

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Version 1

# Agenda for the Week

- Summary of “Consensus Approach” to achieving Time Sync goal
- Drift Measurement TLV
- Normative Requirements & Informative Text
- NRR Algorithm & Simulation (Thursday / Friday)
- RR Algorithm & Simulation (Thursday / Friday)

# Summary of “Consensus Approach”

...or what we hope will be the consensus approach?

# Combination of Approaches

1. Sync Interval & pDelay Interval
2. NRR Calculation from Sync Messaging
3. Better NRR Measurement Calculation
4. Mean Link Delay Averaging
5. NRR Drift Tracking & Compensation
6. RR Drift Tracking & Compensation

# 1 – Sync Interval & pDelay Interval

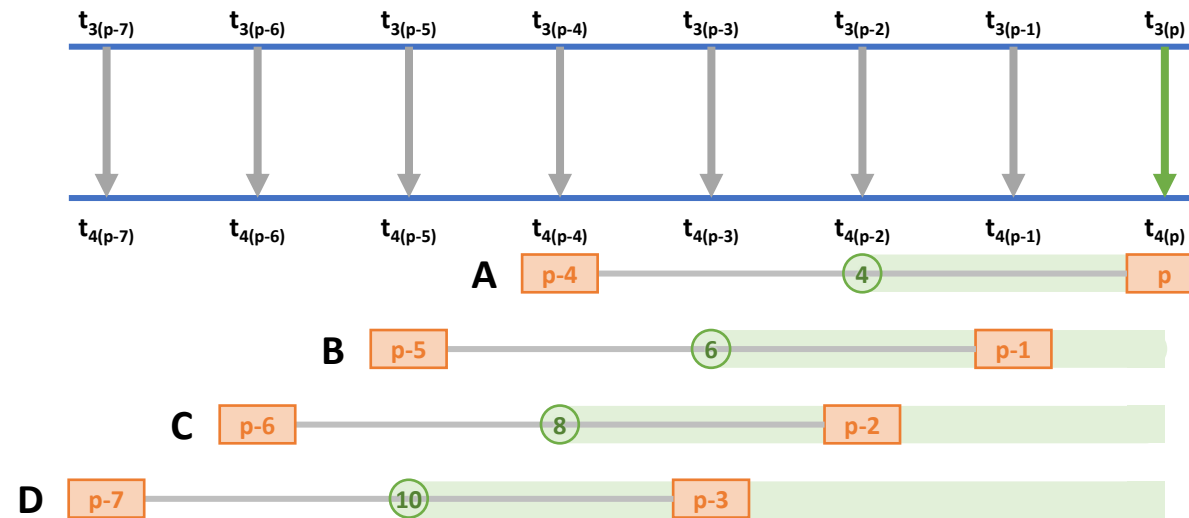
- 125 ms nominal Sync Interval & pDelay Interval
  - Balance between frequent updates vs. message frequency / bandwidth utilisation vs. timestamp / clock drift error balance
  - Min limit 120ms; max limit 130ms
  - Improves timing consistency of NRR calculation which improves error cancellation node-to-node

# 2 – NRR Calc from Sync Messaging

- New TLV added to Sync or Follow-up Message
  - Includes TX timestamp of Sync message
  - Allows use of same NRR as usual, just using Sync vs. pDelayResp message timestamps
- Limits time between NRR calculation and use during Sync message processing to Mean Link Delay + Residence Time
- Also dramatically reduces timing inconsistency, improving error cancellation node-to-node
- pDelay can still be used...but it will be hard to meet device-level performance requirements if other measures aren't taken (e.g. use of a TCXO)
- pDelay might still be used initially after reconfiguration, before sufficient Sync messages have been transmitted. It is not planned to fully define this behaviour in this version of 60802

# 3 – Better NRR Measurement Calculation

- Use older Sync (pDelay) messages (N) for initial calculation
- Take an average of previous calculations (A)
- Choose N & A (e.g. 4 & 4) so that each timestamp is only used once...



# 4 – Mean Link Delay Averaging

- Long average of pDelay-pDelayResp measurements to calculation Mean Link Delay
- IIR filter with, long term, each measurement contributing  $1/1000^{\text{th}}$  to the average
- Careful management during startup
  - Need for normative requirements on this point still TBD
- After 40+ measurements, should eliminate of 95%+ of error



# 5 – NRR Drift Tracking & Compensation

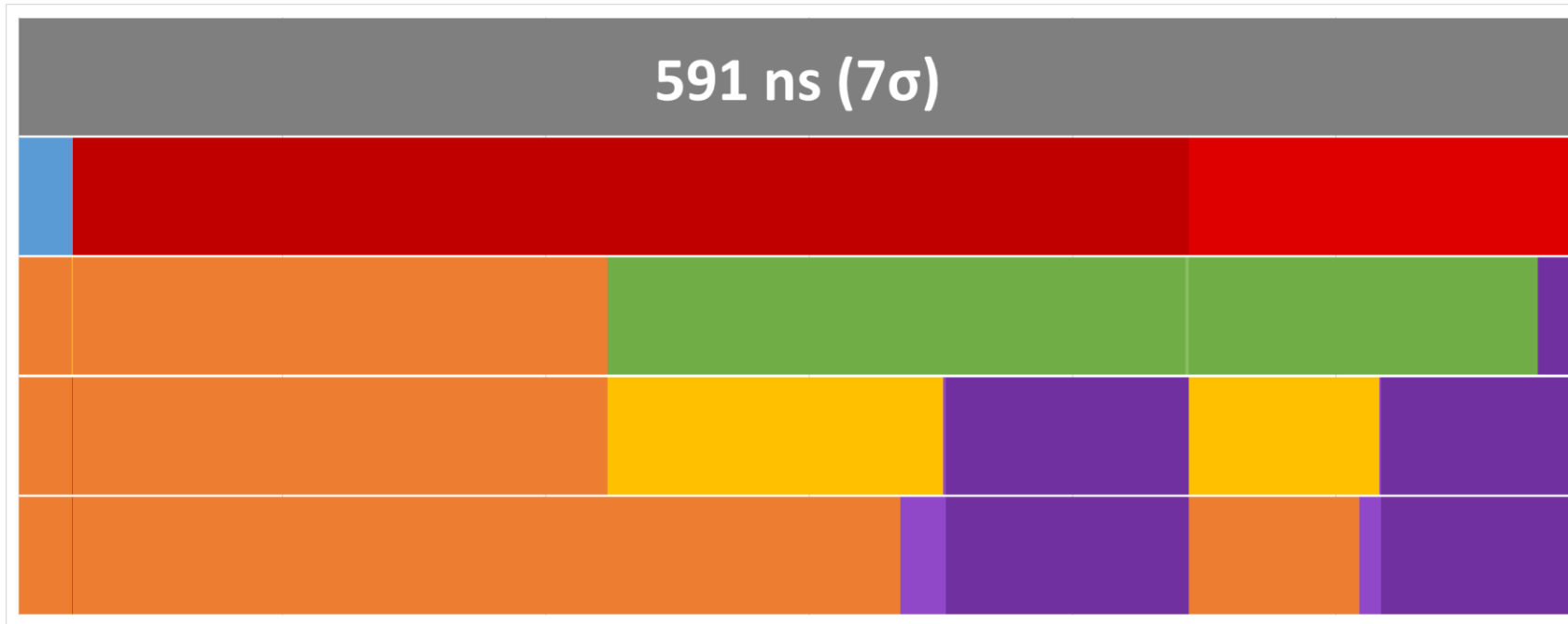
- Separate measurement of NRR, but using similar principle of overlapping N & A values
  - Separate because different balance between Timestamp Error & Clock Drift error is optimal for tracking & compensation vs. calculation of RR
- Then estimate drift from a previous measurement, going back P calculations.
- Known effective measurement times for both measurements...extrapolate to Sync value calculation point.
- Simulations indicate that 90%+ of clock drift error can be eliminated.

# 6 – RR Drift Tracking & Compensation

- Targeting RR related drift error due to time between calculation of RR at previous node (during Sync TX) and use at current node (during Sync TX)
  - So...current node is tracking RR drift at previous node, i.e. looking only at incoming RR values in Sync message.
  - **Not** tracking it's own RR drift...which does lead to an error in Residence Time measurement...but one orders of magnitude smaller
- Harder to do that NRR measurement due to increasing amounts of Timestamp error that accumulates down the chain
- Info on where node is in the chain (stepsRemoved) would be useful in optimising parameters.
- Also harder to simulate.
  - Not yet clear how effective it will be...but back-of-envelope calculation indicates 50%+
  - Not yet clear if stepsRemoved information & different parameter values at different nodes will be needed (but still think stepsRemoved info in TLV would be useful for optimisation beyond informative text, even if not essential)
- This is where there remains a lot of work to do (between now and March plenary)

# Good News

- With current assumptions of algorithm effectiveness...



Input Errors		
Drift Type (Half-sinusoidal Temp Ramp)	4	
GM Clock Drift Max	+1.35	ppm/s
GM Clock Drift Min	-1.35	ppm/s
Fraction of GM nodes w/ Drift	80%	
non-GM Clock Drift Max	+1.35	ppm/s
non-GM Clock Drift Min	-1.35	ppm/s
Fraction of non-GM Nodes w/ Drift	80%	
Temp Max	+85.	°C
Temp Min	-40.	°C
Temp Ramp Rate	±1	°C/s
Temp Ramp Period	125	s
Temp Hold Period	30	s
GM Scaling Factor	100%	
non-GM Scaling Factor	100%	
Timestamp Granularity TX	±4	ns
Timestamp Granularity RX	±4	ns
Dynamic Time Stamp Error TX	±4	ns
Dynamic Time Stamp Error RX	±4	ns
Input Parameters		
pDelay Interval	125	ms
Sync Interval	125	ms
pDelay Turnaround Time	10	ms
residenceTime	10	ms
Input Correction Factors		
Mean Link Delay Averaging	90%	
NRR Drift Rate Correction	90%	
RR Drift Rate Error Correction	50%	
pDelayResp → Sync Type (Gaussian)	4	
pDelayResp → Sync Max	100%	
pDelayResp → Sync Min	0%	
pDelayResp → Sync Target	10	ms
mNRR Smoothing N	4	
mNRR Smoothing M	0	
Configuration		
Hops	100	
Runs	1,000,000	

# Drift Measurement TLV

# Process

- Added to ASdm
- PAR and CSD modification discussion this afternoon
- Comment on next draft of ASdm
  - Including detailed contribution?
- Current intent is that TLV includes...
  - Sync message TX timestamp (similar to pDelayResp)
  - stepsRemoved (same as Announce)
  - Grand Master Identity (same as Announce)

# 802.1ASdm PAR & CSD – Proposed Modifications

- Available here...
  - <https://www.ieee802.org/1/files/public/docs2023/dm-McCall-draft-PAR-modification-0123-v01.pdf>
  - <https://www.ieee802.org/1/files/public/docs2023/dm-McCall-draft-CSD-modification-0123-v01.pdf>
- Also, another proposed addition...

# Proposed Further ASdm PAR Modification...

- PAR Scope...
  - “This amendment also adds the option to create application specific profiles to select and deselect specific, currently mandatory, functionality, identified by this amendment. It preserves backward compatible behavior in the case of the absence of an application specific profile by defining defaults.”
- PAR Need...
  - “Applications in some environments (e.g. in some centrally configured networks) do not require certain, currently mandatory, functionality. In order to allow for an efficient implementation of these applications, the amendment introduces the option to define application specific profiles outside of this standard. These profiles can select and deselect specific functionality identified by this amendment.”

# Normative Text

Review Draft...



# Thank you!