60802 Time Sync Ad Hoc 7th November Meeting

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Version 2

Agenda

- Update on Monte Carlo Simulations
  - Reference: David McCall, “60802 Time Synchronisation – Monte Carlo Analysis: 100-hop Model, “Linear” Clock Drift1, NRR Accumulation Overview & Details, Including Equations”, IEEE 60802 contribution, September 2022. https://www.ieee802.org/1/files/public/docs2022/60802-McCall-Monte-Carlo-Multi-Hop-Overview-and-Details-0922-v02.pdf
- Agenda for Plenary Session Ad Hoc & 60802 Time Sync Slots

Monte Carlo Simulation Status Update

- Five threads...
  - Add variability of $T_{residenceTime}$ and $T_{pDelayTurnaroud}$
    - Done – see next slide for questions for the group
  - Add mNRRsmoothingA from single-hop simulation to multi-hop simulation
    - Mostly done
  - mNRR Clock Drift tracking & compensation
    - Extension of single-hop simulation
  - mRR Clock Drift tracking & compensation (mRR from accumulation of mNRR)
    - Requires change to Clock Drift modelling – see slide 6
  - mRR from successive Sync messages
    - Requires same change to Clock Drift modelling

Variability of $T_{residenceTime}$ and $T_{pDelayTurnaroud}$

- Previously modelled as residenceTime & pDelayTurnaround, which are technically the maximum permitted interval
- Now modelled with variability factors and uniform distribution...

Parameter	Default	Unit	Notes
pDelayTurnaround	10	ms	
PDTmax	1		Each $T_{pDelayTurnaround}$ is between PDT_{max} and PDT_{min} x pDelayTurnaround
PDTmin	0.2		
residenceTime	10	ms	
RTmax	1		Each $T_{residenceTime}$ is between RT_{max} and RT_{min} x residenceTime
RTmin	0.2		

Variability of $T_{pdelay2pdelay}$ & $T_{sync2sync}$

Parameter	Default	Unit	Notes
pDelayInterval	1,000	ms	Limited to 1s x 2^n. Typical values are: 1,000ms; 500ms; 250ms; 125ms; 62.5ms; 31.25ms
PDI_{max}	1.3		Each $T_{pdelay2pdelay}$ is between PDI_{max} and PDI_{min} x pDelayTurnaround
PDI_{min}	0.9		
syncInterval	125	ms	Limited to 1s x 2^n. Typical values are: 1,000ms; 500ms; 250ms; 125ms; 62.5ms; 31.25ms
SI_{scale}	1		A factor of 1 means each Tsync2sync has normal variability around the nominal syncInterval value; a factor of 0.5 means half as much variability, etc...

- Question for group: are the default limits for $T_{residenceTime}$ and $T_{pDelayTurnaroud}$ reasonable?

Tracking & Compensating for RR Clock Drift

- Similar to End Station Error, only modelled at final hop...but...looking back at previous RR values for final hop entails modelling entire chain of messages for that hop.
- Noisy signal, so requires looking further back at older messages...and same optimal combination of N & A as for mNRR measurement applies...all of which need to be modelled.
- Going further back in time means assumption that Clock Drift remains constant is...shakey.
- Same applies for mRR from Sync messages

Revised Model for Clock Drift

- Model for each interval, and...
- Account for sudden changes in rate of change
  - If there is a transition, then model in two parts

60802 Time Sync Ad Hoc – Next Steps

Key:
Can progress now
Contribution required
Dependant on other items

- **Messaging & Algorithms**
  - **Align pDelay & Sync messaging; reduce variability of** $T_{pdelay2pdelay}$ **&** $T_{sync2sync}$ – investigation of possible mechanism
    - Contributions requested
  - **NRR & RR drift measurement & compensation** – Monte Carlo & Time Series simulations to determine efficacy and robustness
- **Clock Filters & Control Loops**
  - **Continued discussion** based on latest Time Series simulation results
- **Sync Message Timestamping** (using synced ClockSlave to timestamp)
  - **Assessment** (**simulations**?) based on results of Clock Filters & Control Loops discussion.
- **Rate Ratio Measurement** (best method – via NRR accumulation or direct via Sync messaging)
  - **Analysis** of Rate Ratio measurement via Sync messaging, similar to [2]. Subsequent Monte Carlo **simulation** and assessment.
- **Normative vs. Informative**
  - **Discussion** on normative requirements for error generation
    - Possible **discussion** of normative requirements for error tolerance if NRR and/or RR drift measurement & compensation is adopted.
  - Everything else is informative. Some will be obvious. Others may require **discussion**.
- **Unified Proposal**
  - Dependant on progress of above subject areas.

Backup