Power Matters

Microsemi

# Delivering and Maintaining phase in a production Network

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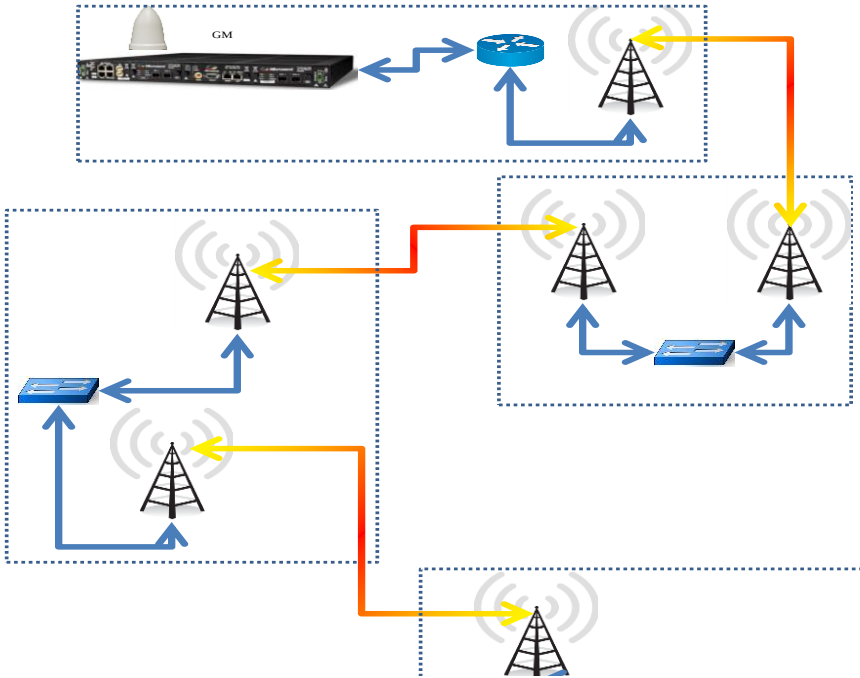
# Agenda

- Share with you experience from multiple phase network deployments
- All results show here came from customer data and field tests
- Share the Challenges the customer faced and how we overcame them

# Deploying Phase - common issues

- Many PTP phase networks have been deployed using a hybrid solution to deliver 1.5 µS
- Using a mix of G.82x5 standards to work in a hybrid environment
- Too costly to *Rip & Replace* when migrating to Phase.
- Every network is unique
- Every Client has different performance

# Going the Distance

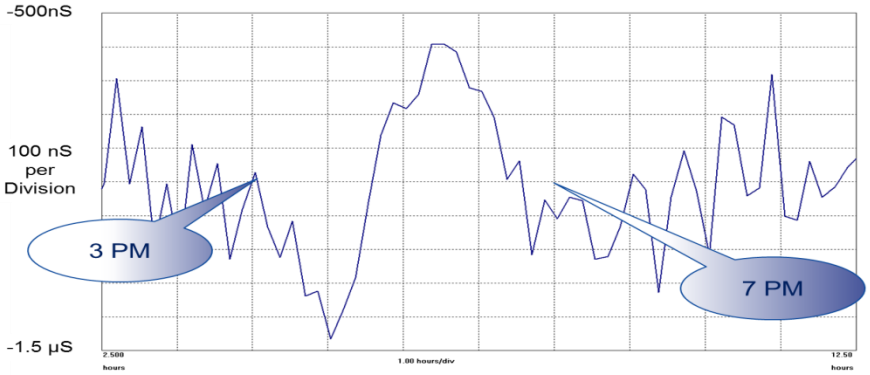



- No one wants to put a GM at ever cell site.
- More Microwave Hops mean spending the asymmetry budget
- 2 – 4 hops is deployable, when engineered correctly

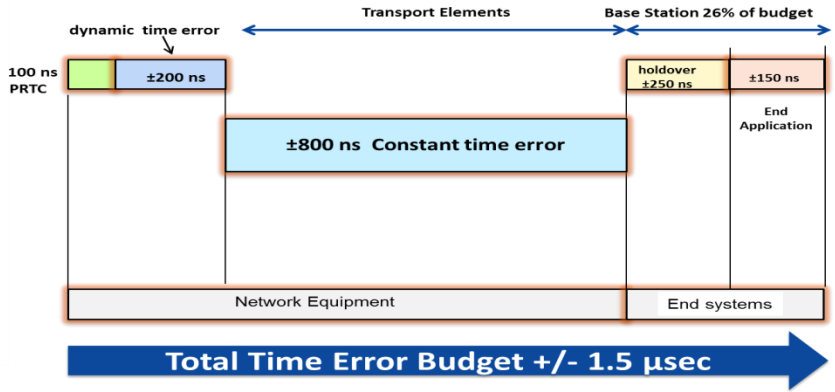
# Spending the Budget

- Dynamic asymmetry eats at the budget
  - Often found to exceed the “200nS” that was allocated

- 2 – 4 Microwave hops, and the 1.1 µS budget is used

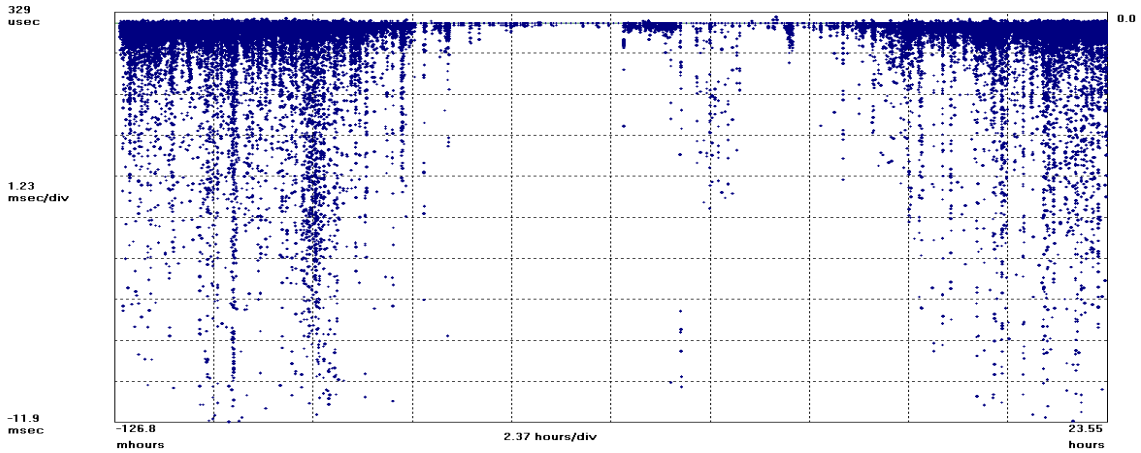


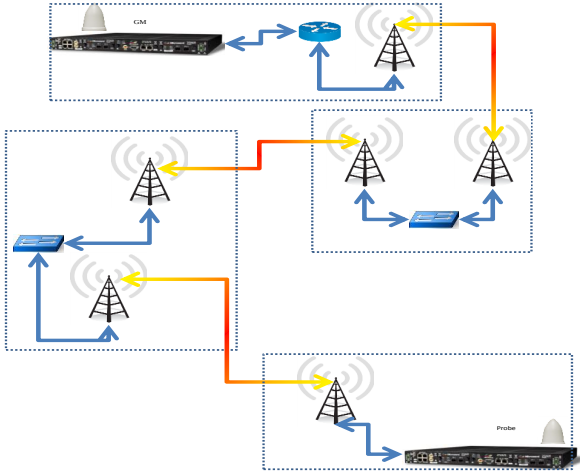

- 850nS of dynamic asymmetry over 4 hours



# Test each Unique network

- Test PDV – to give “ball park” indications
- Always test the Client with its 1pps output
- Engineer the network to improve PTP
- QOS can be misleading an harmful

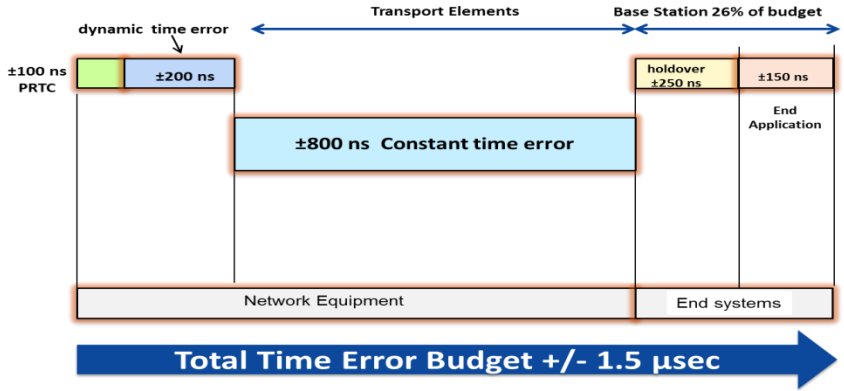


# Holdover

- Reserving Holdover allowance eats into the precious asymmetry budget - Typical to only have ~250nS in reserve
- Holdover budgets of 1µS are an unrealistic luxury
- APTS or external Frequency feed is needed to extend holdover

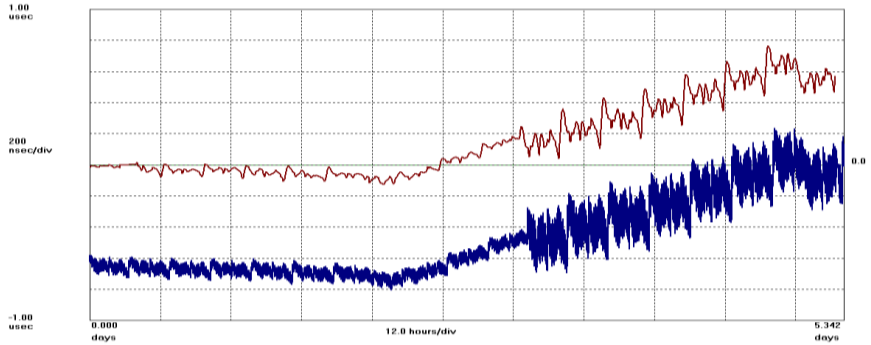
| Oscillator | stability | 250nS |
|---|---|---|
| Stratum 3e | 1e-8 | Minutes |
| OCXO | 1e-10 | 3 hours |
| Rubidium | 5e-12 | 20 hours |
| G.811 Cs | 1e-12 | 3 days |
| 5071 | 5e-13 | 6 days |
| ePRTC | 6e-14 | 50 days |

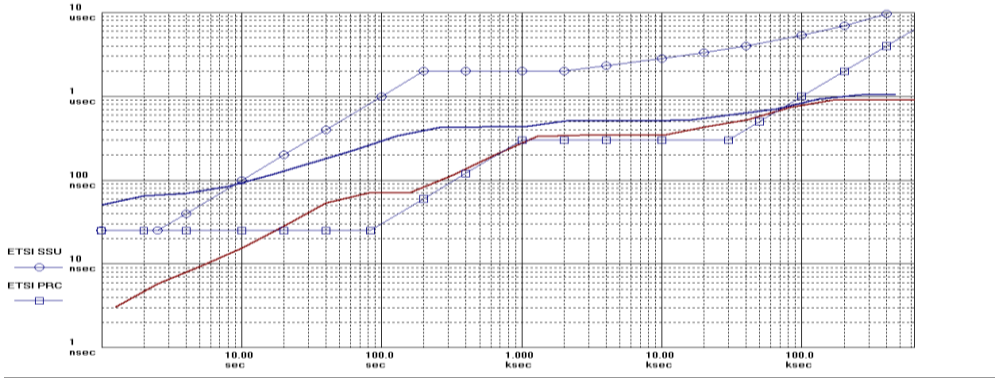


# Practicality in a Network

- When there is a GNSS issue at a site, it needs to be resolved before the 250 nS holdover budget is used.
- This could be entirely impractical and requires a huge OPEX to support.
- APTS can bring backup sources from deeper within the network to the edge Grandmasters.
- A good APTS algorithm can extend holdover from 2-12 hours to 7+ days, still holding the 250 nS

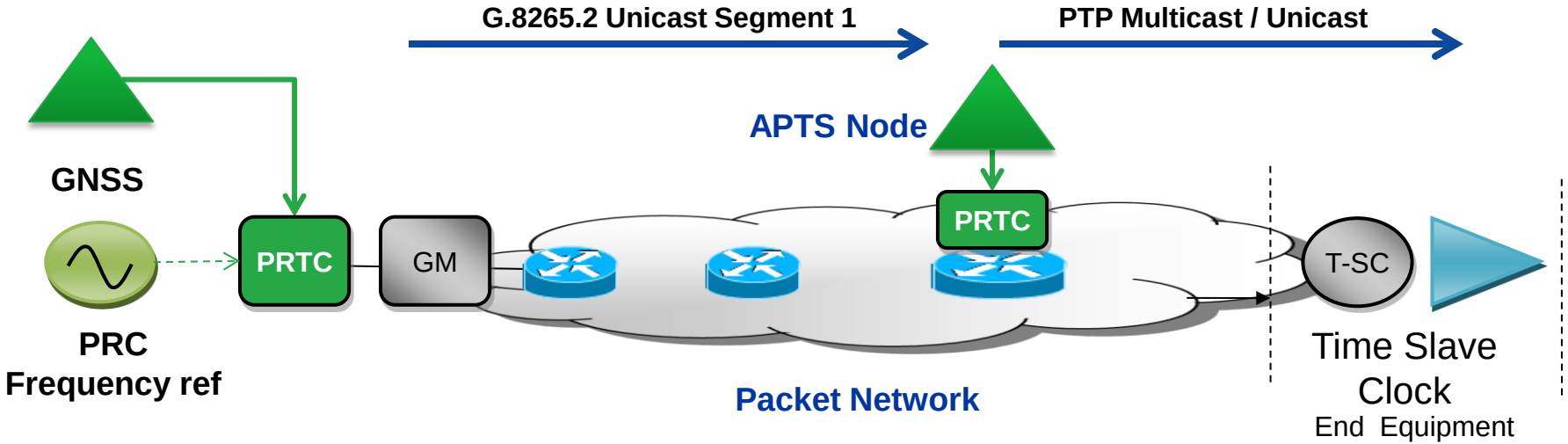
# Sync-E / TDM  as a GM Assist Test




- Jitter and Wander on a SyncE / TDM backup will directly show on a GM when in holdover.
- An “Almost G.811” input in the example, shows ~800nS error during 5 day holdover – despite high quality oscillator to filter.
- A low performance oscillator in the GM will not filter network jitter and wander

# Using Assisted Partial Timing Support (APTS)

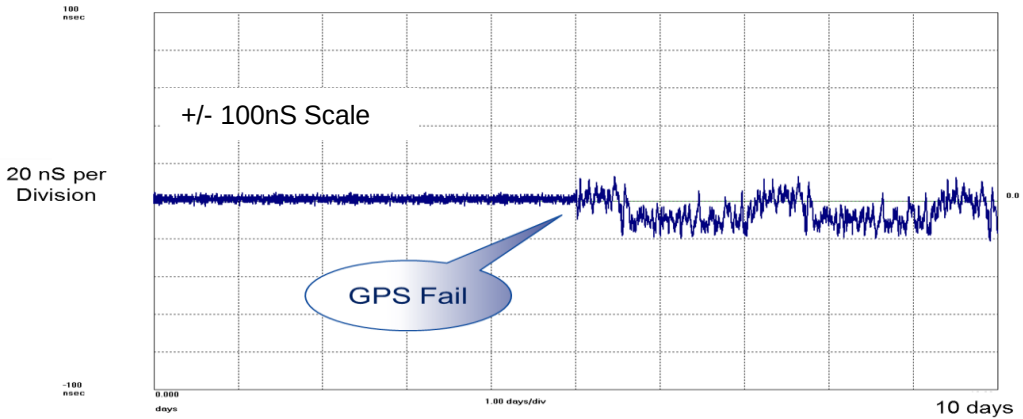



- APTS PRTC maybe placed at any point on the sync chain

- Works extremely well with Indoor GNSS technology for Urban deployments

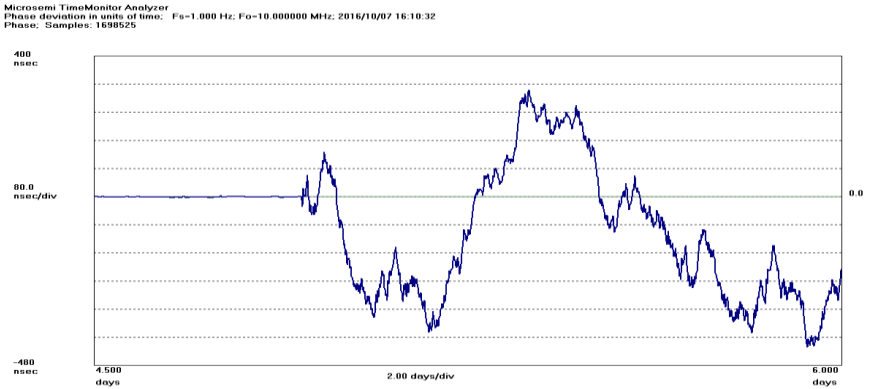
# APTS – Core Fed over DWDM Test

- Customer A had a good IP network, carried over DWDM
  - Ran MPLS and syncE did not reach the edge.
- DWDM has large asymmetry
  - This example, had 27µS
- APTS Calibrated the Path
- Provided splendid holdover during 5 day test.

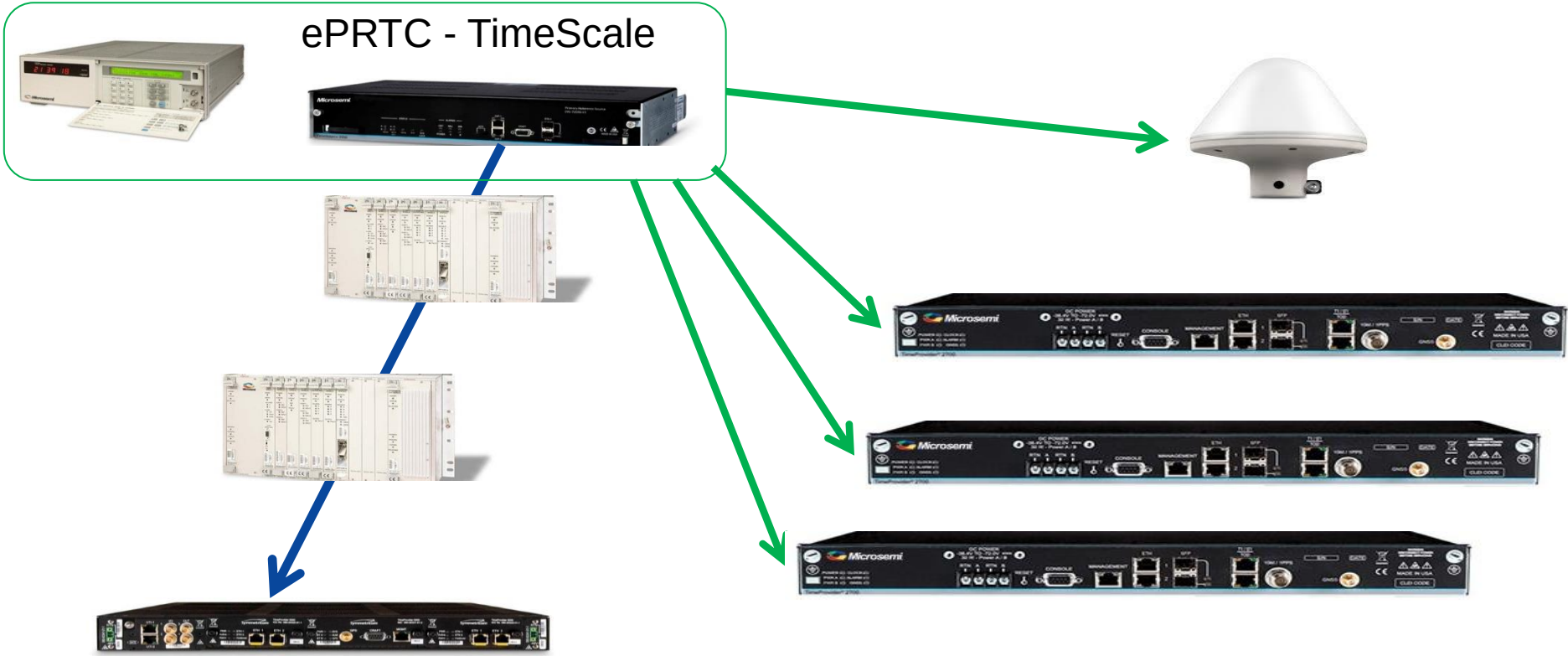


# APTS Deployment on a Long Microwave Chain

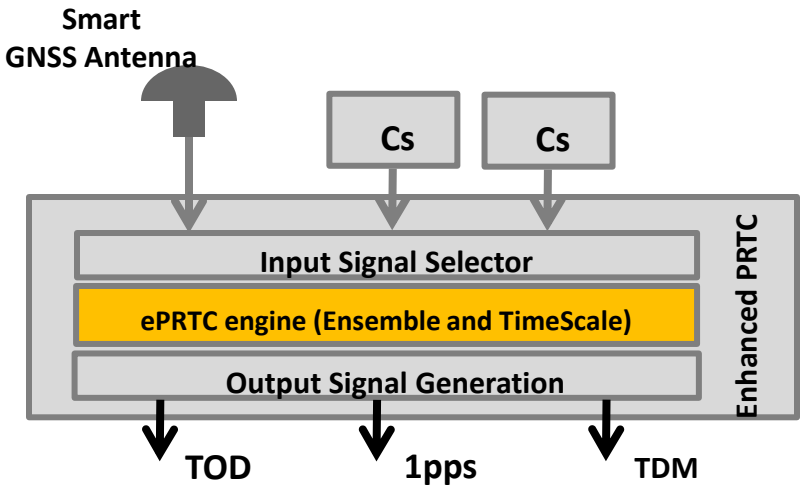
- Customer B has a Long Microwave chain
  - Every 4 hops, was placed a APTS GM
- APTS is still affected by dynamic asymmetry
  - Balance between fewer hops and a  Robust Holdover solution
- An East / West principle was used to correct from the nearest GM in either direction
- Performance
  - +/- ~ 320nS
  - No drift



# EPRTC Filter and Firewall the Network



# Enhanced PRTC – block diagram




- Multiple inputs
- GNSS smart antenna input
- Secure management interface
- ePRTC engine ensembles cesium clocks, “aligns to GNSS”, and generates autonomous timescale
- Detects Spoofing
- Long term holdover – Months

# Conclusions

- PTP for Phase can be delivered over existing PTP frequency networks
- Dynamic Traffic can eat a large part of the budget.
- Filters are Vital, False economy to remove or compromise them
  - Don’t forget Wander and jitter
- Without a Holdover and protection - the network can’t possibly be practical for operational deployment.

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# Thank you

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