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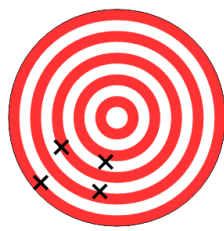


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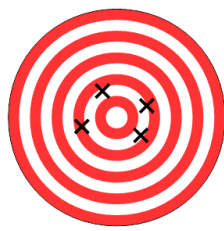


Timing accuracy for ST 2110 networks

- IEEE 1588 Precision Time Protocol
 - SMPTE 2059-2 PTP Profile
- Slave to GrandMaster offset
 - Max +/-500ns
- Well disciplined Endpoints
 - PTP stack stability
 - Filters, control loops
- Well designed networks
 - PTP aware devices
 - Boundary, Transparent Clocks



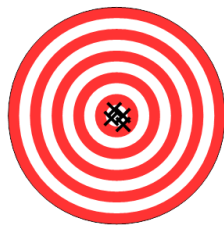
Not Accurate Low Precision



Accurate Low Precision



Not Accurate High Precision



Accurate High Precision

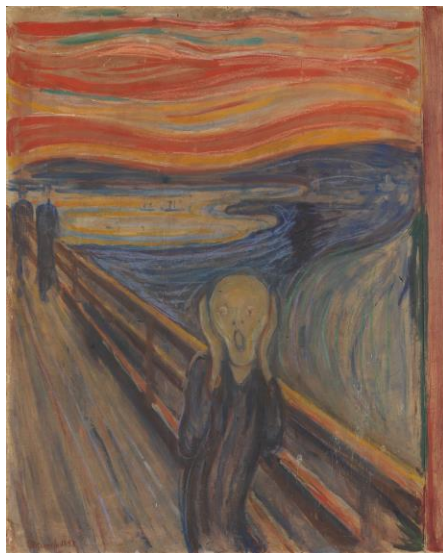


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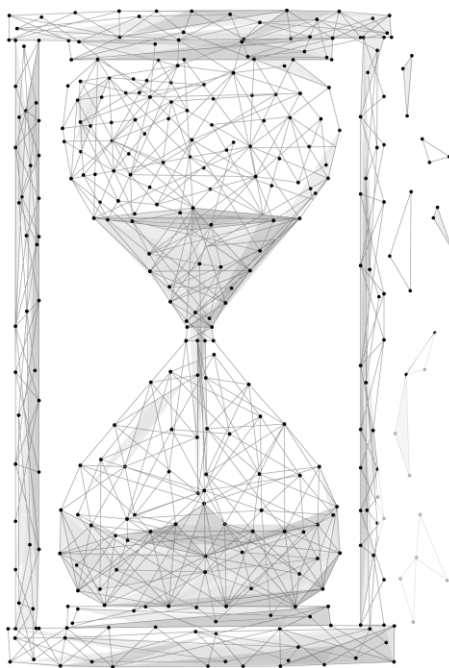


What could possibly go wrong?

- Deadlines
- Planning, lack of PTP experience
- Lack of in-depth testing
- Quality of project gate reviews
- Hardware/software limitations
- Efficiency of fixes/workarounds
- Unscheduled personnel events (reality check)
- “Other urgent project” that needs taken care of



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The clock is ticking



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Timing strategy

- PTP message rates
 - Don't underestimate the impact of changing these rates
 - Must be consistent across the whole PTP domain
 - If changing defaults, test and validate corner cases, and test again!
- Managing the GM hierarchy (BMCA dataset)
 - Priority1, Clock Class, Clock Accuracy, Clock Variance, Priority2, Port ID
 - Setting P1 is like using a sledgehammer, P2 is generally more appropriate
- Where to connect the GMs? (Spine or leaf)
 - It depends, but really it shouldn't make a difference (port cost/availability)



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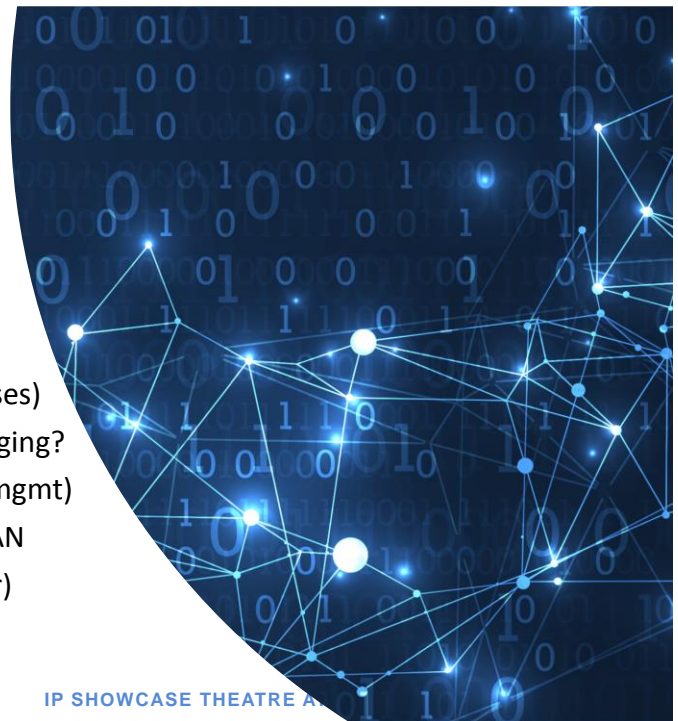


Network design

-
- PTP aware vs. non aware
 - Transparent Clock, Boundary Clock?
 - IPv4, IPv6 transport (Link Local Addresses)
 - Multicast, Mixed Mode, Unicast messaging?
 - PTP message path selection (in-band, mgmt)
 - PTP traffic isolation using VRF/LAG/VLAN
 - Management TLV messages (behaviour)



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Basics: Securing all hosts

- Authentication, Authorization and Accounting (AAA)
 - Connection attempts, timestamp, username, IP address, commands used
- Access Lists (ACLs) to limit who can reach the device, on all interfaces
- Only use TLS encrypted transports (SSH, HTTPS, ...) for all sessions
- No unprotected interfaces! Unauthenticated GM web interface
- Don't forget the physical ports too! Console, serial, auxiliary
- Disable unused services, interfaces, protocols
- Threat modeling



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Securing the PTP network



- Traceable time sources
 - Source diversity, frequency & time traceable
- Acceptable Master Table (AMT)
 - Prevent remotely connected device from attempting GM role takeover
- “Forced master”
 - Prevent locally connected device from attempting GM role takeover
- Threat modeling (again)

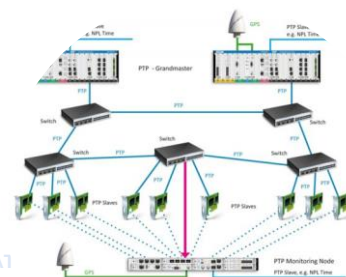
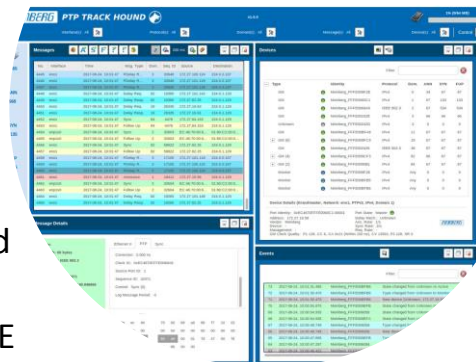


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Monitoring

- Broadcast/Network Controller PTP dashboard
 - Realtime visibility and overview of PTP health
- 1pps signal comparison between GM & SLAVE
 - Out of band signal validation at specific points
- Packet analysis of PTP messages (online/offline)
- PTP message counters for all nodes (trigger alarms)
- Slave port monitoring
 - Transfer slave information to monitoring node
 - Standardized in upcoming IEEE 1588 v2.1



IP SHOWCASE THEATRE AT



Diversity & Failure testing

- Design for diversity
 - ST 2110 with ST 2022-7 for media
 - PTP redundancy != standard feature
 - Stack specific implementations
 - Different designs = different results
- Test for partial and total failure
 - Define key metrics
 - Recovery time (media and PTP)
 - What is gating this?
 - Is it important to reduce?

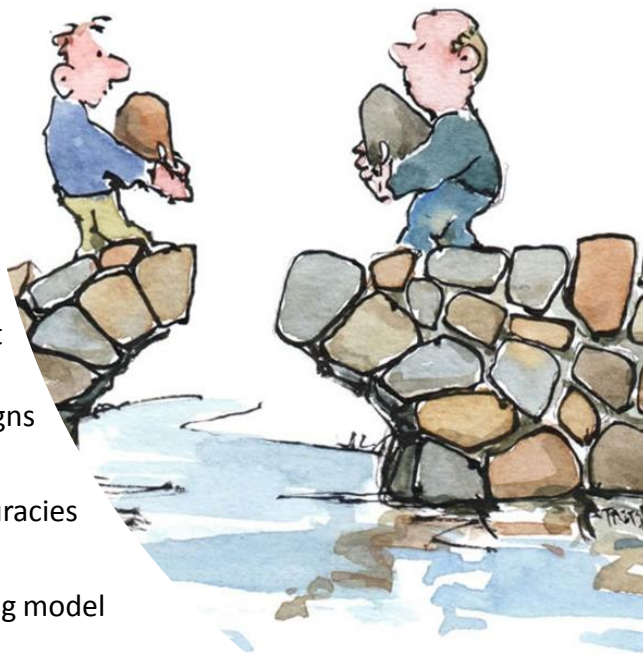


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Vision vs. reality = Compromise

- Do your research
 - Vendor inputs, not just the datasheet
 - Presentations of existing projects
 - Industry publications, reference designs
- Cross check information
 - Early days, limited experience, inaccuracies
- You will need to compromise
 - Common feature baseline & operating model



IP SHOWCASE THEATRE A.



Decision tree = Methodology

- Make a plan and stick to it!
 - Uncertainty will just make things worse
- Test & validate:
 - your design methodology
 - your vendors announced capabilities
 - end to end with all vendor equipment interconnected, including failure scenario
- Work with your vendors around their limitations, constructive process
- Schedule the fixes, enhancements, feature requests and deal breaker deadlines
- Finally, mitigate implementation limitations once everything else has been done



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Plan, test, rinse, repeat

- All PTP networks are equal
 - Some more than others
- Your network will always be unique
 - Slight differences = big impact
- Plan ahead, mitigate limitations, think again
- Test again, again, and again, and some more



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Thank you

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Thank you to our Media Partners



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