Demonstrating time compliance to regulators and other non-technologists

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What is STAC?

- STAC facilitates the STAC Benchmark Council:
  - ~300 financial firms and ~50 tech vendors
  - Establishes standard technology benchmarks and testing software
  - Promotes dialog
  - Includes the STAC-TS Working Group (time sync)



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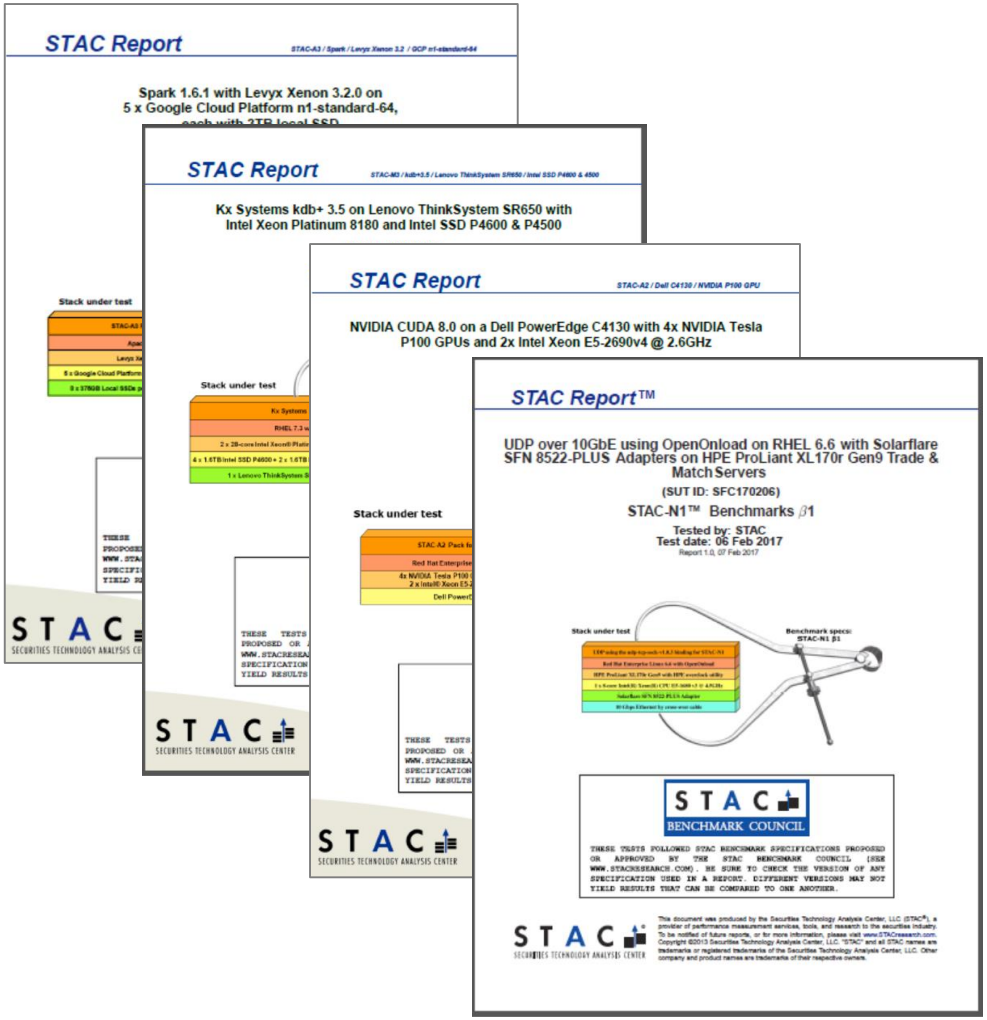
SECURITIES TECHNOLOGY ANALYSIS CENTER

What is STAC?

- STAC also performs independent benchmark audits



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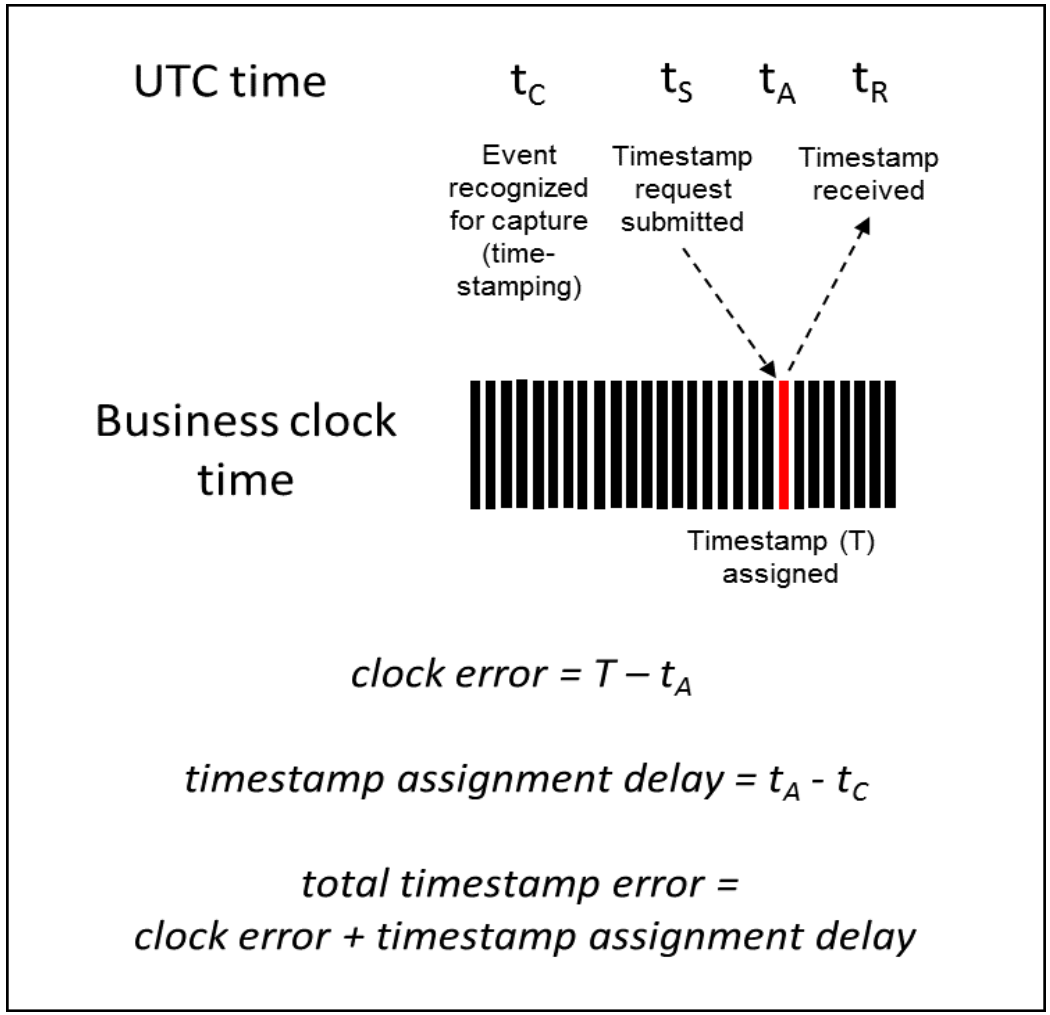
RTS 25 compliance challenges

- Some issues get a lot of attention
  - How should I get accurate time to my sites?
  - How should I synchronize my host clocks?
  - Should I use network capture?
- Other issues sometimes get less attention than they should
  - For example..

Application-level error

Error in application timestamps that is <u>independent</u> of clock error



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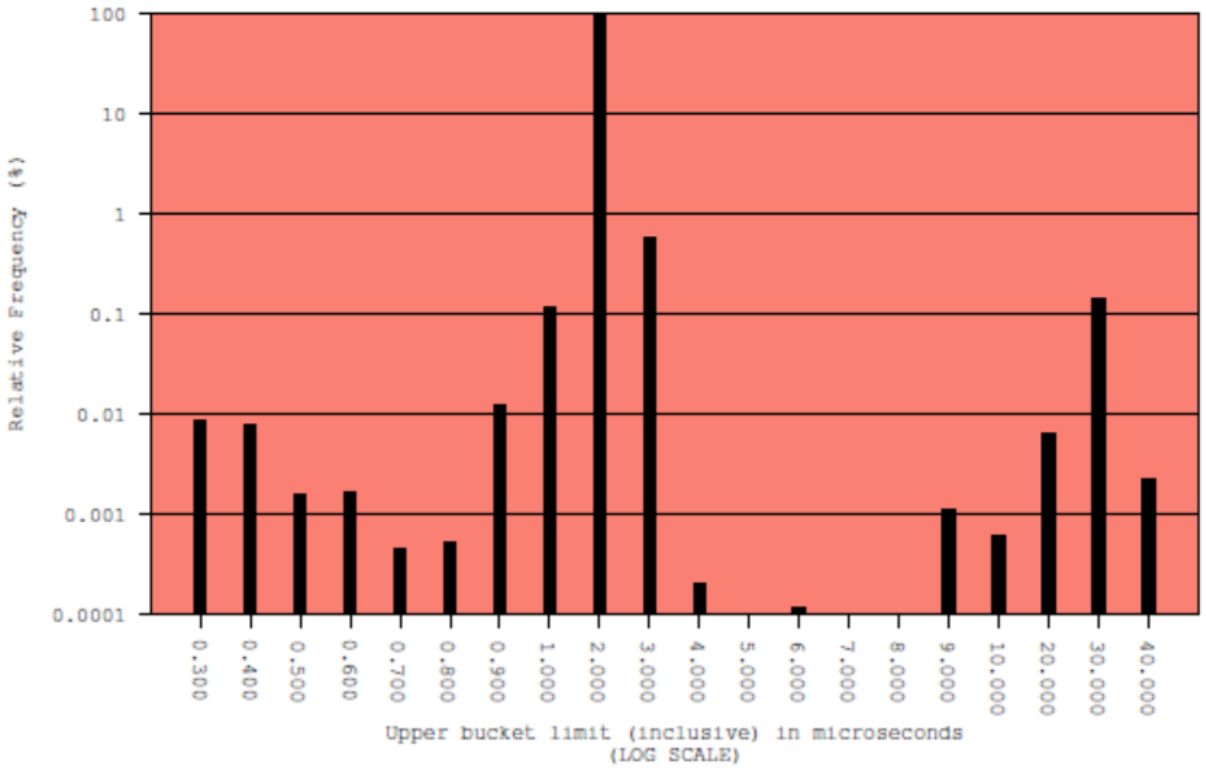
Not-uncommon distributions of app-level error

Percentiles (µsec)

Percentile	Error
Max	21,177.625
99.9999%	10,012.557
99.999%	32.836
99.99%	27.150
99.9%	21.833
99%	1.773
95%	1.640

Log-log histogram



- Takeaway: You need to test application-level error carefully

(BTW, I grabbed these from different reports. They are not from the same system.)

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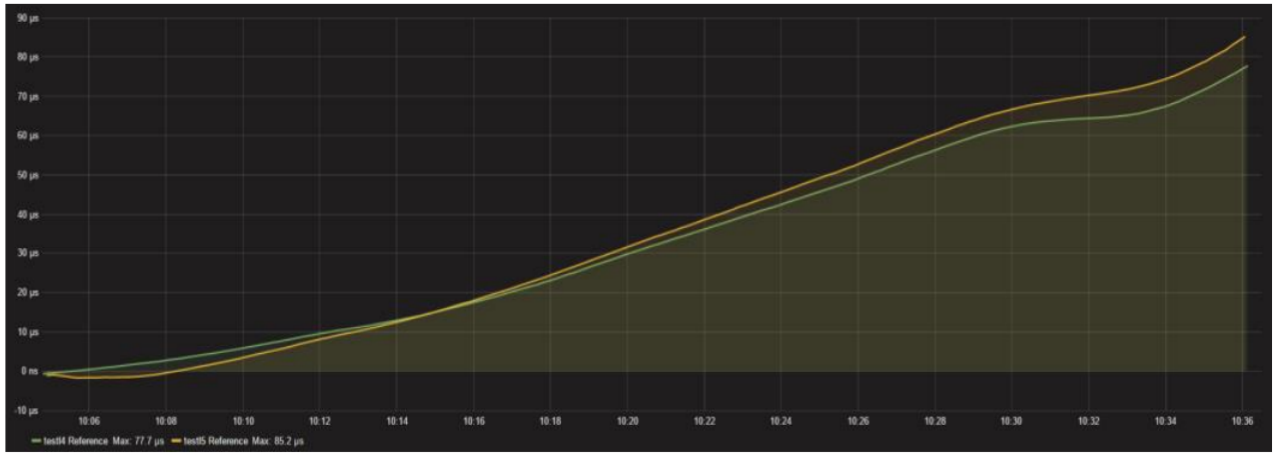
Holdover of host clocks

- What happens if a daemon dies? Or a connection to the upstream clock is lost?
- Unfortunately, a lot:

	Offset (us)	
Time (s)	Server A	Server B
60	0.4	1.6
120	1.3	1.4
300	5.8	3.6
600	15.4	15.3
1200	44.5	50.4
1800	75.8	83.0



- Takeaway: You need to test host-clock holdover and track daemon health in production carefully

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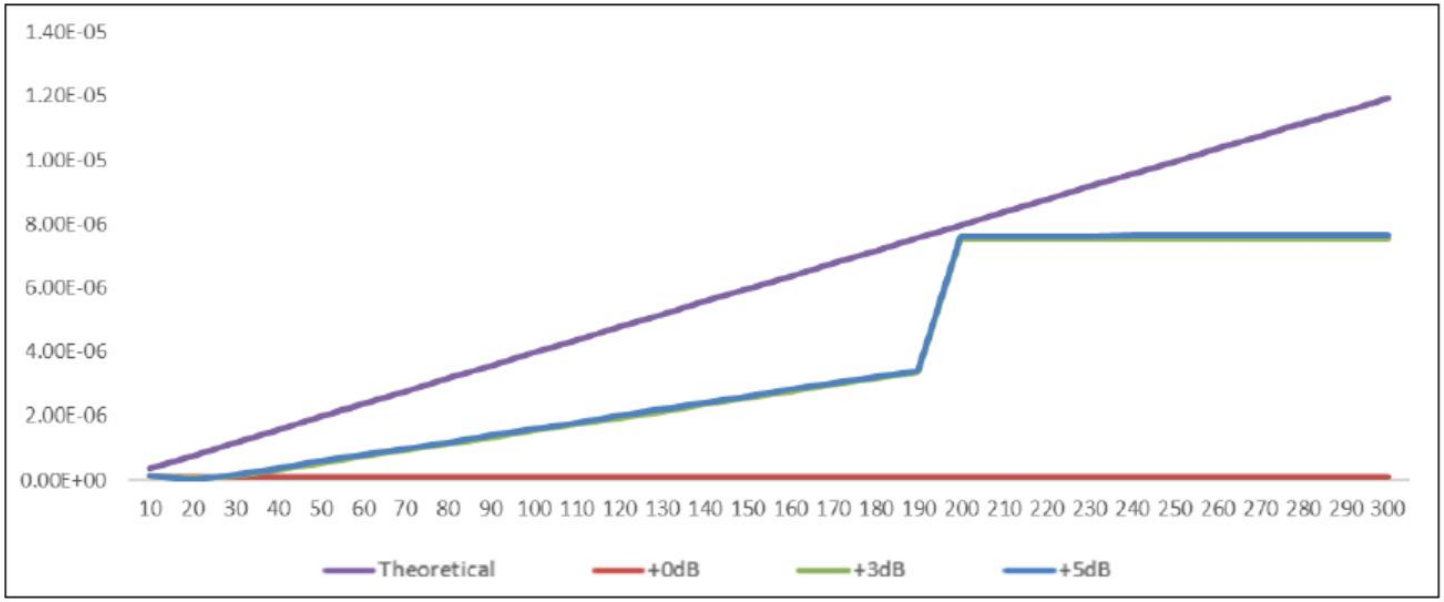
GNSS spoofing and jamming

- Vulnerabilities of GNSS (e.g., GPS) are well known
- Will regulators treat those issues as exceptions?
- What are the potential impacts on our architecture?



Courtesy Spectracom, a member of STAC-TS

Example: Test the impact of a Frequency Offset on a disciplined oscillator

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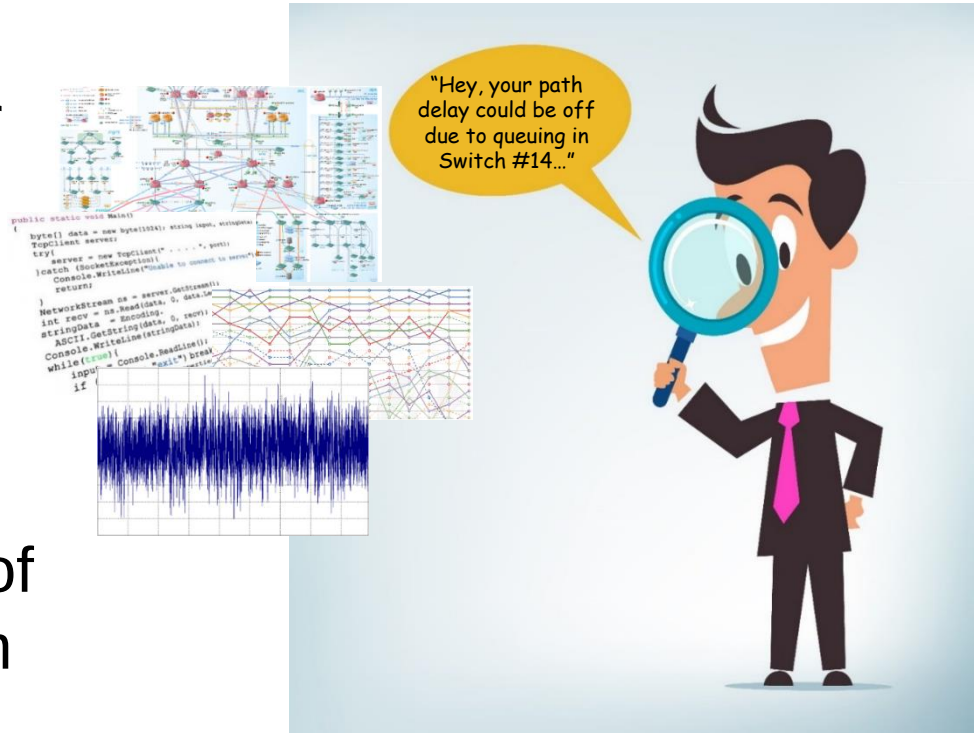
But these are just challenges with complying

The thing about RTS 25…

- Firms must not only comply; they must <u>demonstrate</u> that they comply
- That's trickier than with other regs

  Regulators themselves can't judge a technical implementation*
- And remember: the burden of proof is on the regulated firm
- This is a recipe for confusion and cost



* For that matter, neither can most compliance teams or senior execs

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The key to demonstrating compliance

- The key is not a checklist of technologies
  - "We use GPS in every location with PTP to every server" (or whatever)
- There are many ways that great technologies can yield bad results
  - Trust me, we see it every day!
- The key is:
  - Testing
  - Monitoring
- These tell you how things actually work

Why is monitoring important for compliance?

- Can’t rely just on testing
  - Testing says what can happen
  - Monitoring says what actually has happened
- Testing isn’t perfect
  - E.g., lab conditions may not have anticipated a production scenario
- ESMA says so
  - “Relevant and proportionate monitoring of the system should be required…”

Why is testing important for compliance?

- Can't rely solely on monitoring
  - Driving by the rear-view mirror is not best practice
  - Some things can't be monitored, e.g.:
    - Application-level error
    - Error in holdover
- Can't rely on manufacturer specs
  - Sometimes wrong, usually ambiguous
  - Many solutions have no manufacturer to turn to
- ESMA says so
  - "Relevant and proportionate testing of the system should be required…"

So what are some best practices for testing?

- Test all unique configurations
- For each, cover all links in the traceability chain
- Test conditions at least as bad as production
  - Including foreseeable exception scenarios
- Use non-parametric statistics
- Integrate test data with monitoring data
- Very nice to have:
  - Automate execution and analysis of tests
  - Automate end-to-end traceability analysis

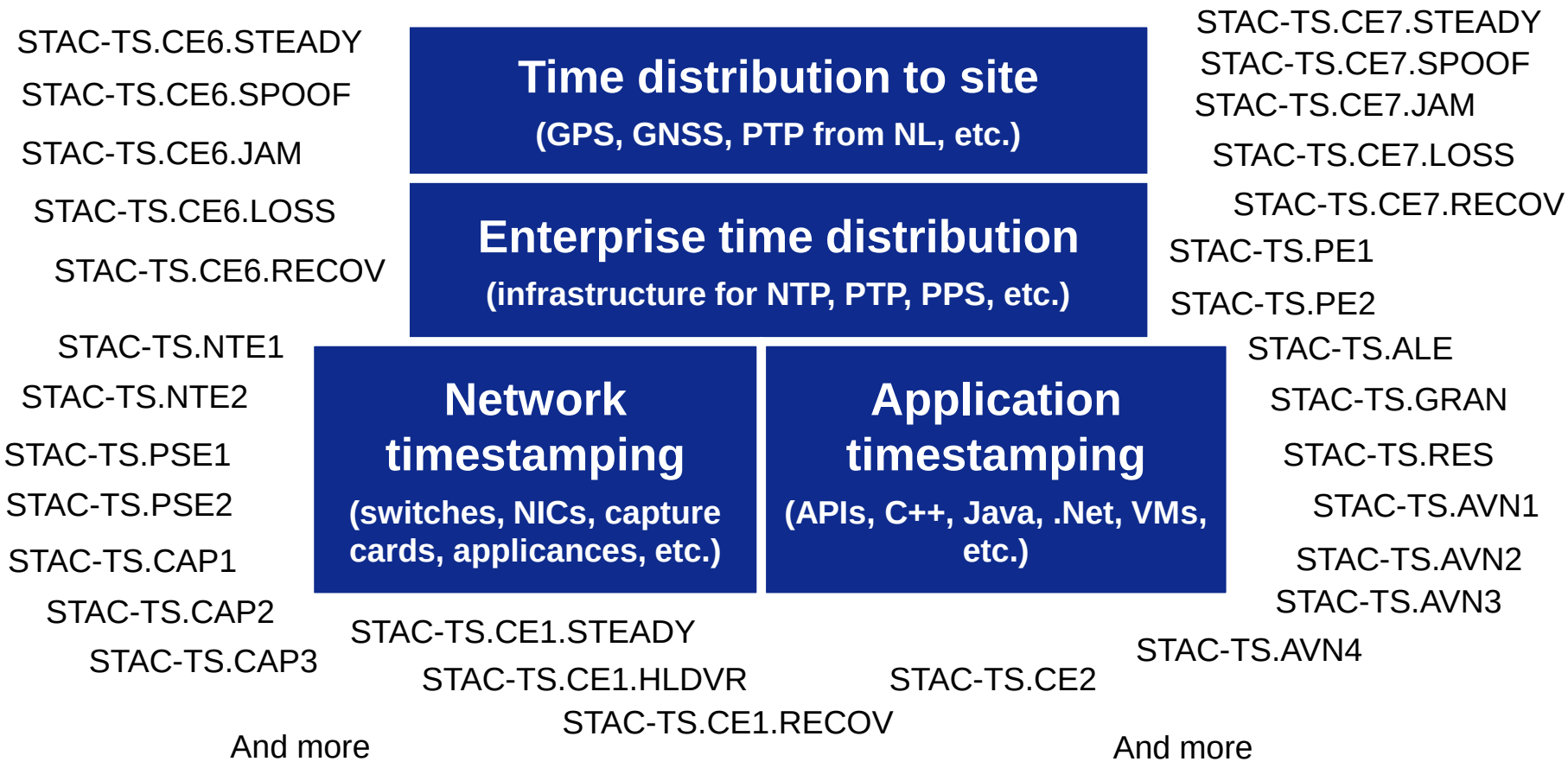
Best practices and standards

- Best practices evolve as the industry learns and compares notes
- A standards process codifies best practices
  - And updates them as best practices evolve
- Standards reduce costs
- Standards give regulators a reference point

The purpose of STAC-TS

- Provide testing standards and tools that reflect industry best practices
  - Software for traceability reporting
  - Software for load gen, measurement, analytics
- Enables firms to:
  - Justify traceability at any point in time
  - “Self certify” or get audits (e.g., annual compliance certification)
- Also provides basis for STAC to publish results using the standards

STAC-TS taxonomy



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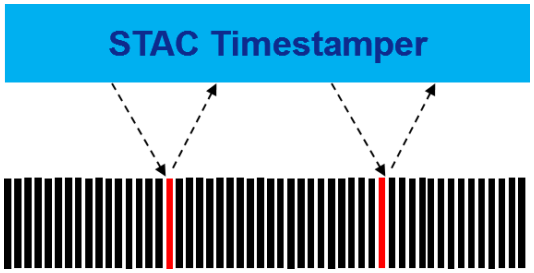
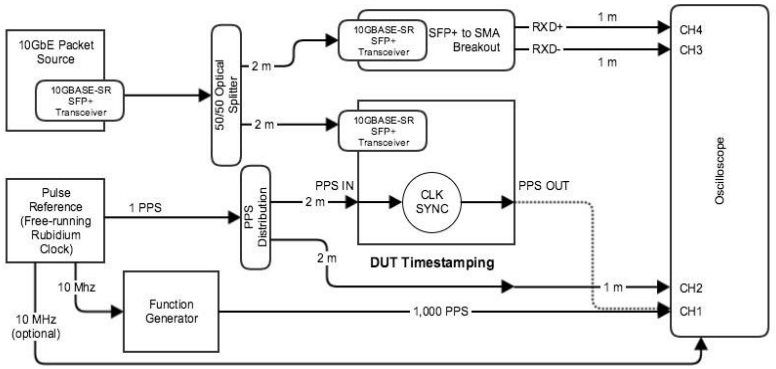
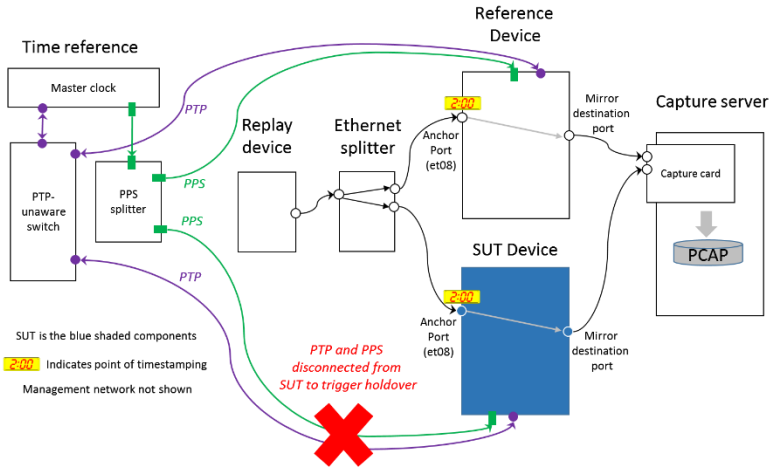
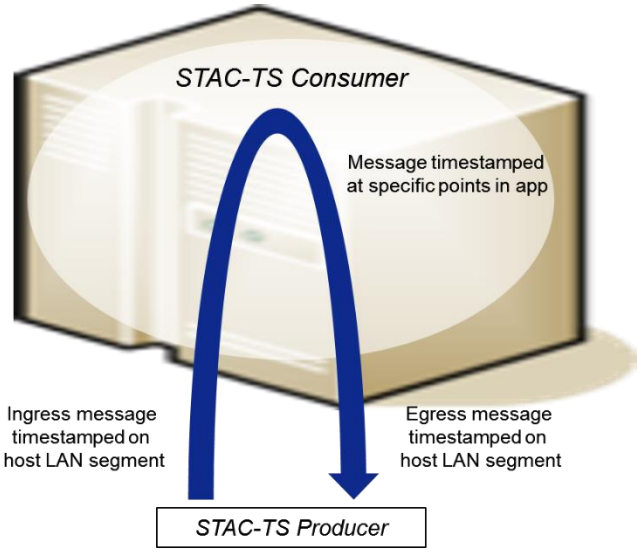
STAC-TS goal: Right tool for the job

Example: STAC-TS.ALE - A quick but thorough way to assess application-level error









Example: STAC-TS.AVN - An easy way to prove compliance of an entire solution

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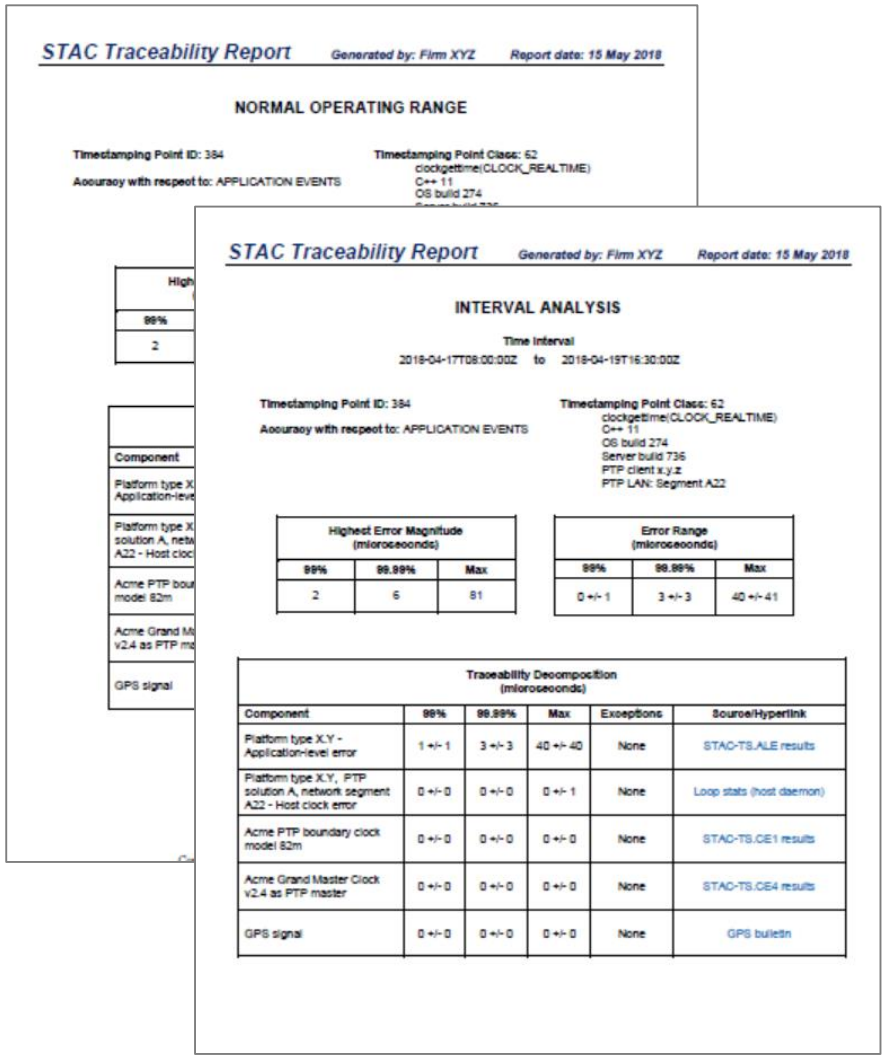
STAC Traceability Report (in development)

- Reports the accuracy of a timestamping point using its traceability chain
- Links the traceability chain to source data
- Integrates test and monitoring data
- Can draw from internal STAC-TS results and results on STAC site
- Run in batch to create STAC Traceability Survey



STAC Traceability Report — Generated by: Firm XYZ — Report date: 15 May 2018

NORMAL OPERATING RANGE

Timestamping Point ID: 384

Accuracy with respect to: APPLICATION EVENTS

Timestamping Point Class: 62
clockgettime(CLOCK_REALTIME)
C++ 11
OS build 274

STAC Traceability Report — Generated by: Firm XYZ — Report date: 15 May 2018

INTERVAL ANALYSIS

Time Interval
2018-04-17T08:00:00Z to 2018-04-19T16:30:00Z

Timestamping Point ID: 384

Accuracy with respect to: APPLICATION EVENTS

Timestamping Point Class: 62
clockgettime(CLOCK_REALTIME)
C++ 11
OS build 274
Server build 736
PTP client x.y.z
PTP LAN: Segment A22

Highest Error Magnitude (microseconds)		
99%	99.99%	Max
2	6	81

Error Range (microseconds)		
99%	99.99%	Max
0 +/- 1	3 +/- 3	40 +/- 41

Traceability Decomposition (microseconds)

Component	99%	99.99%	Max	Exceptions	Source/Hyperlink
Platform type X.Y - Application-level error	1 +/- 1	3 +/- 3	40 +/- 40	None	STAC-TS.ALE results
Platform type X.Y, PTP solution A, network segment A22 - Host clock error	0 +/- 0	0 +/- 0	0 +/- 1	None	Loop stats (host daemon)
Acme PTP boundary clock model 82m	0 +/- 0	0 +/- 0	0 +/- 0	None	STAC-TS.CE1 results
Acme Grand Master Clock v2.4 as PTP master	0 +/- 0	0 +/- 0	0 +/- 0	None	STAC-TS.CE4 results
GPS signal	0 +/- 0	0 +/- 0	0 +/- 0	None	GPS bulletin

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Summary

- Complying with RTS25 is not the only challenge
- Demonstrating compliance is the other
- Think about how to persuade a non-technologist that you comply
- Follow standards where they exist
- If you're interested in STAC-TS, see www.STACresearch.com/TS