



# Putting time-sync and capture standards to use

Peter Lankford  
Founder and Director, STAC

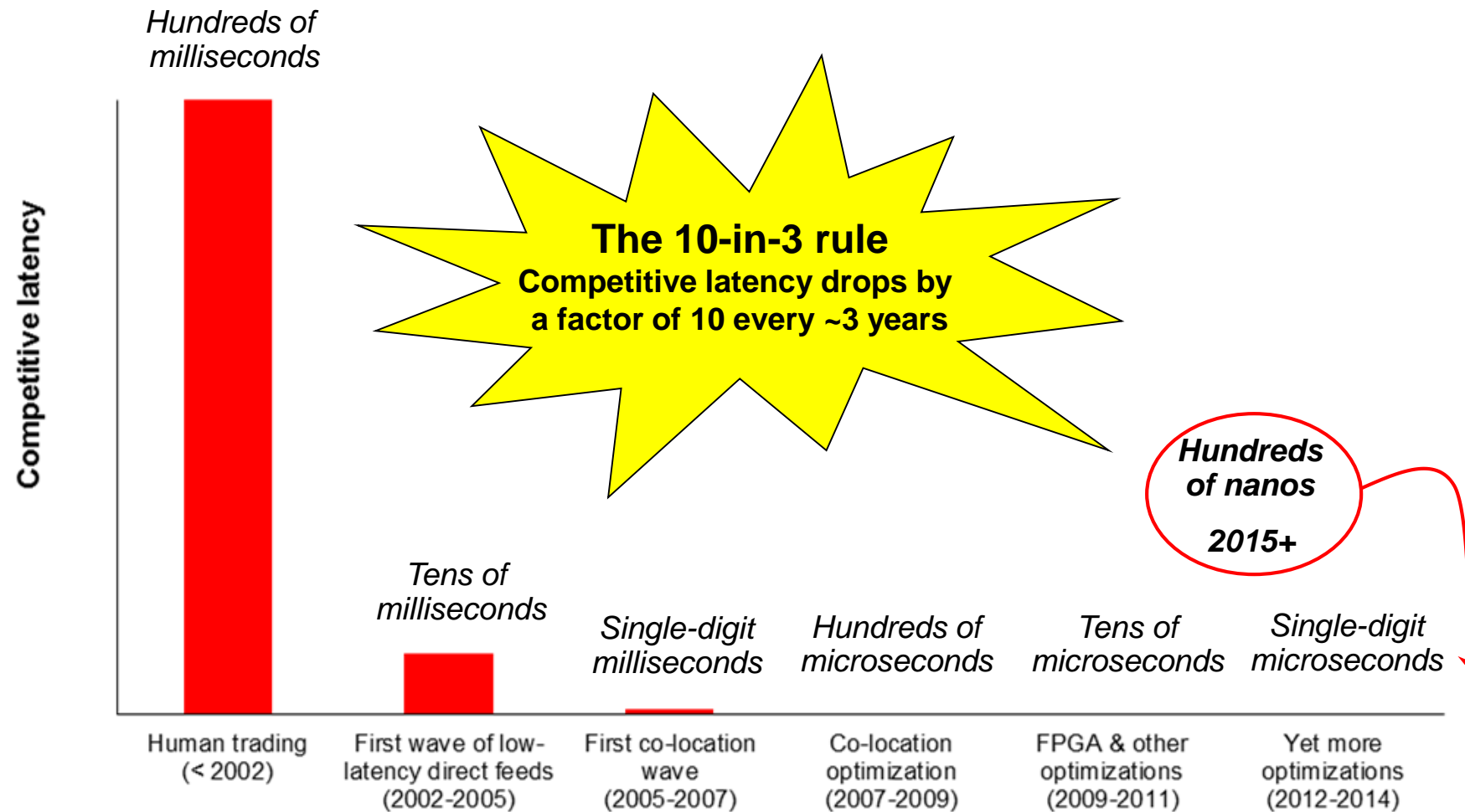
[peter.lankford@STACresearch.com](mailto:peter.lankford@STACresearch.com)

# Summary

- STAC-TS is a set of standards and tools for assessing components and solutions for **timesync**, **timestamping**, and **event capture**
- Purposes:
  - Help trading firms and exchanges comply—and demonstrate compliance—with regulations like MiFID2
  - Help ULL firms vet measurement products
- STAC is starting to offer STAC-TS tools and research
- No additional charge to premium subscribers
- Additional offerings (e.g., customer-funded audits) are under discussion

# First: A quick review of the problems

# The latency race requires increasingly accurate measurement



# Implications

- Enterprise timestamps must be increasingly accurate relative to one another
- Enterprise timestamps must be increasingly accurate relative to counterparties (e.g., exchanges)
  - This often means accuracy relative to UTC or UTC(k)
- Dave @ Metamako's presentation relates to this

# Two issues with MiFID 2 time compliance

1. Complying with the mandated accuracies
2. Demonstrating that you comply

Depending on the type of firm, #1 may be simple or complex

All firms face questions on #2

<i>Type of trading activity</i>	<i>Description</i>	<i>Max. divergence from UTC</i>	<i>Timestamp granularity</i>
Activity using high frequency algorithmic trading technique	High frequency algorithmic trading technique	100 microseconds	1 microsecond or better
Activity on voice trading systems	Voice trading systems as defined in Article 1(7) of RTS transparency requirements in respects of bonds, structured financial products etc.	1 second	1 second
Activity on request for quote systems where the response requires human intervention or where the system does not allow algorithmic trading		1 second	1 second
Activity of concluding negotiated transactions		1 second	1 second
Any other trading activity		1 millisecond	1 millisecond

# Can't I just rely on manufacturer's specs? Hmm...

- Do the manufacturer's specs cover all the ways you're using the product?
- Are manufacturers clear about what they measured and what statistics they're presenting?
  - Nope
- Have you ever seen a device that behaved differently from the manufacturer's specs?
  - Some STAC-TS members say this happens all the time. They always do their own testing.
- Is there a reason manufacturer specs come with a disclaimer?
  - **The information contained herein is subject to change without notice.**

# Consider this...

- Spec sheet for a leading Rubidium-based grand master clock:
  - 24-hour holdover of 1 microsecond
- Spec sheet for a “high-precision oscillator” in a leading switch:
  - 24-hour holdover of “single-digit nanoseconds”
- The switch purports to be hundreds of times better than the grand master clock



# ...and this...

What's the “manufacturer's specification” of the accuracy of this timestamping method:

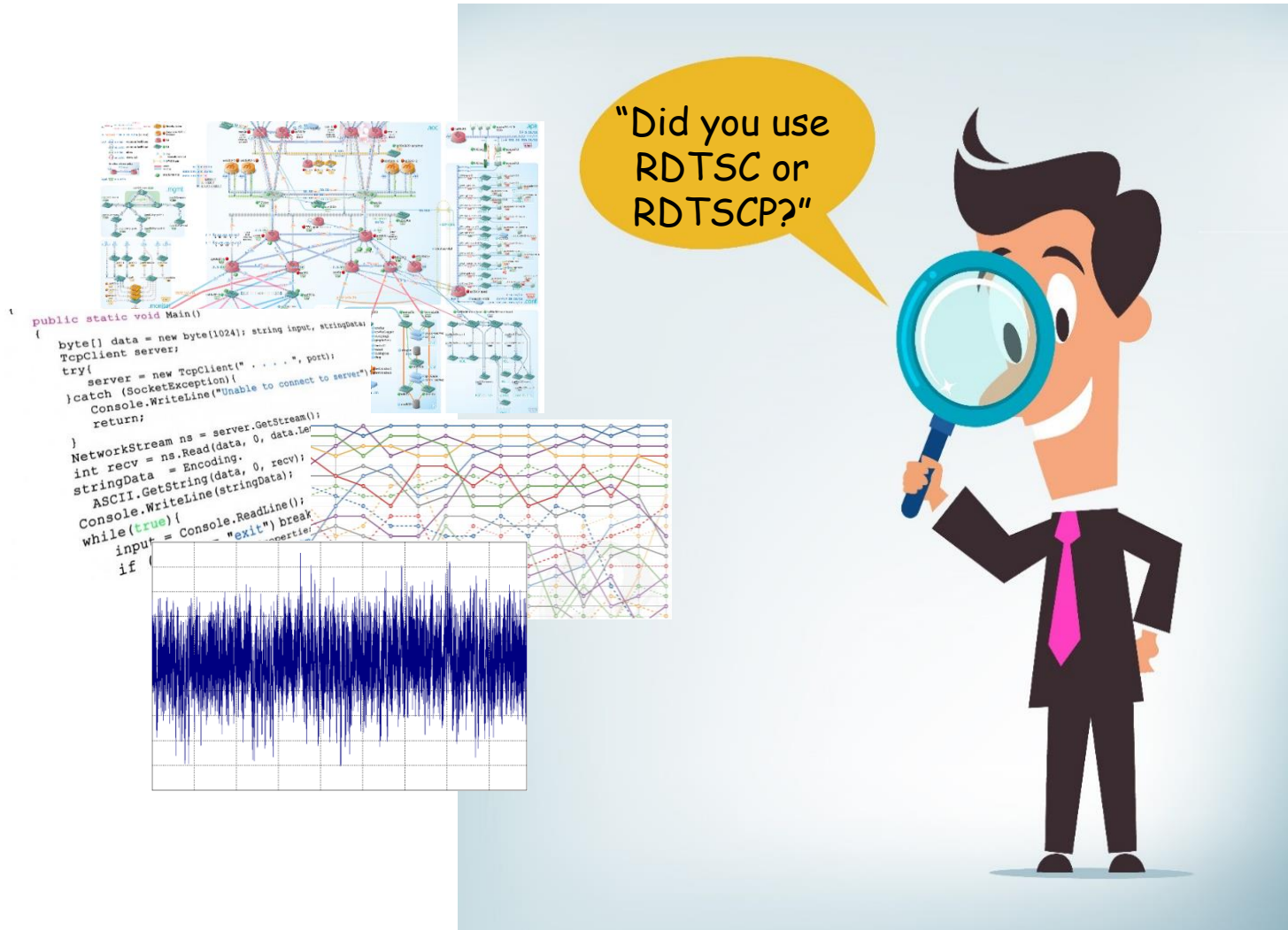
- API: `system.nanoTime()`
- JVM: OpenJDK 7
- OS: Red Hat Enterprise Linux 6.6
- Time sync software: `linuxptp`
- PTP hardware assist: Intel 82576 NIC
- PTP traffic on same port as transactions
- Server: Dell PowerEdge R730 Server
- Processors: 2 x six-core Intel E5-2643 v3 @ 3.4GHz
- Etc.

Spoiler: there ain't one

“Relevant and proportionate testing of the system should be required...”

# STAC-TS aims to bridge the knowledge gap

Regulators  
can't judge  
your technical  
implementation

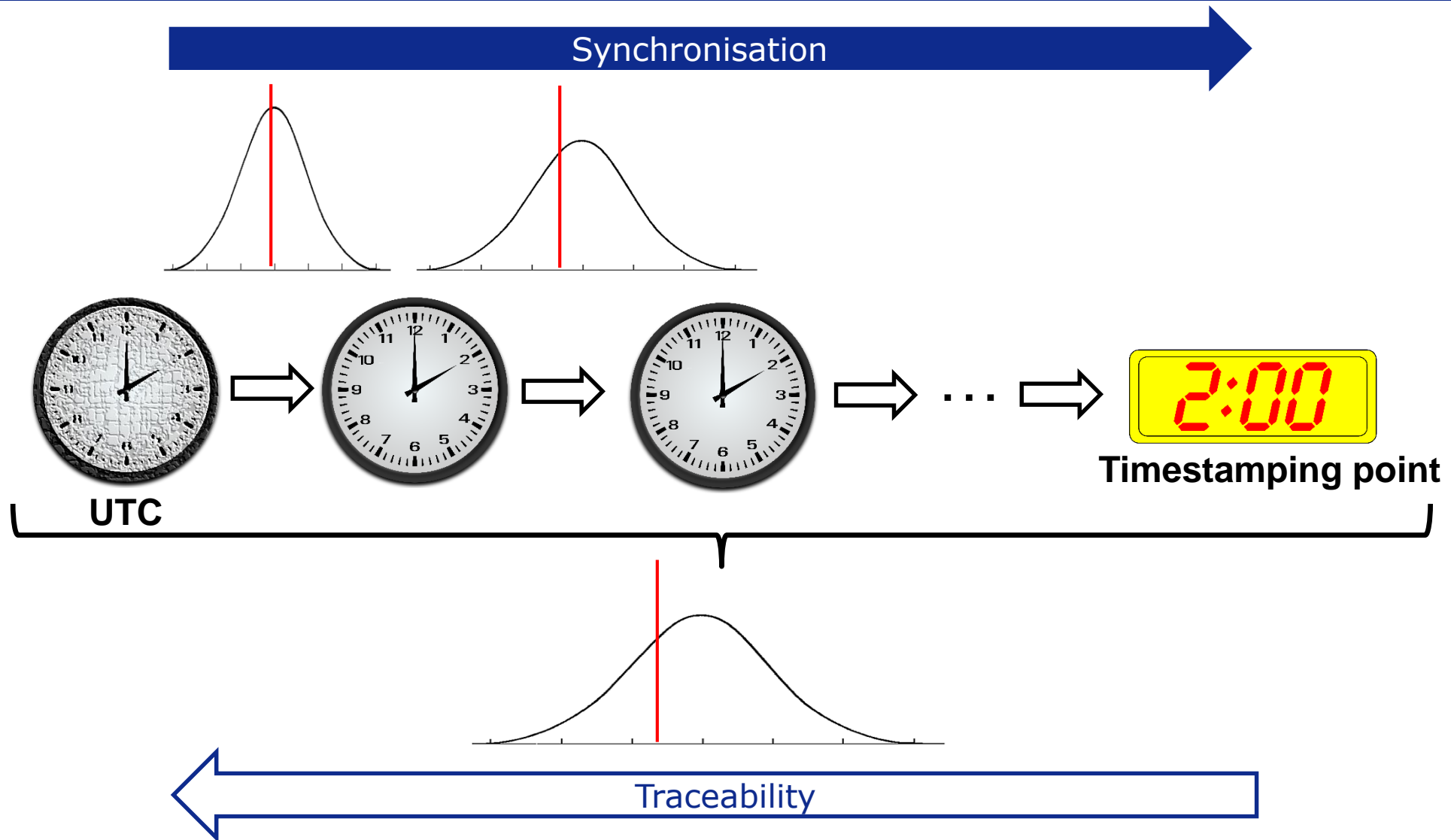


# STAC-TS aims to bridge the knowledge gap

But regulators  
can check  
whether you've  
followed best  
practices



# Traceability of each timestamp is a chain



# STAC-TS taxonomy for that chain (SUT categories)

**Time distribution to site**

(GPS, GNSS, PTP from NL, etc.)

**Enterprise time distribution**

(infrastructure for NTP, PTP, PPS, etc.)

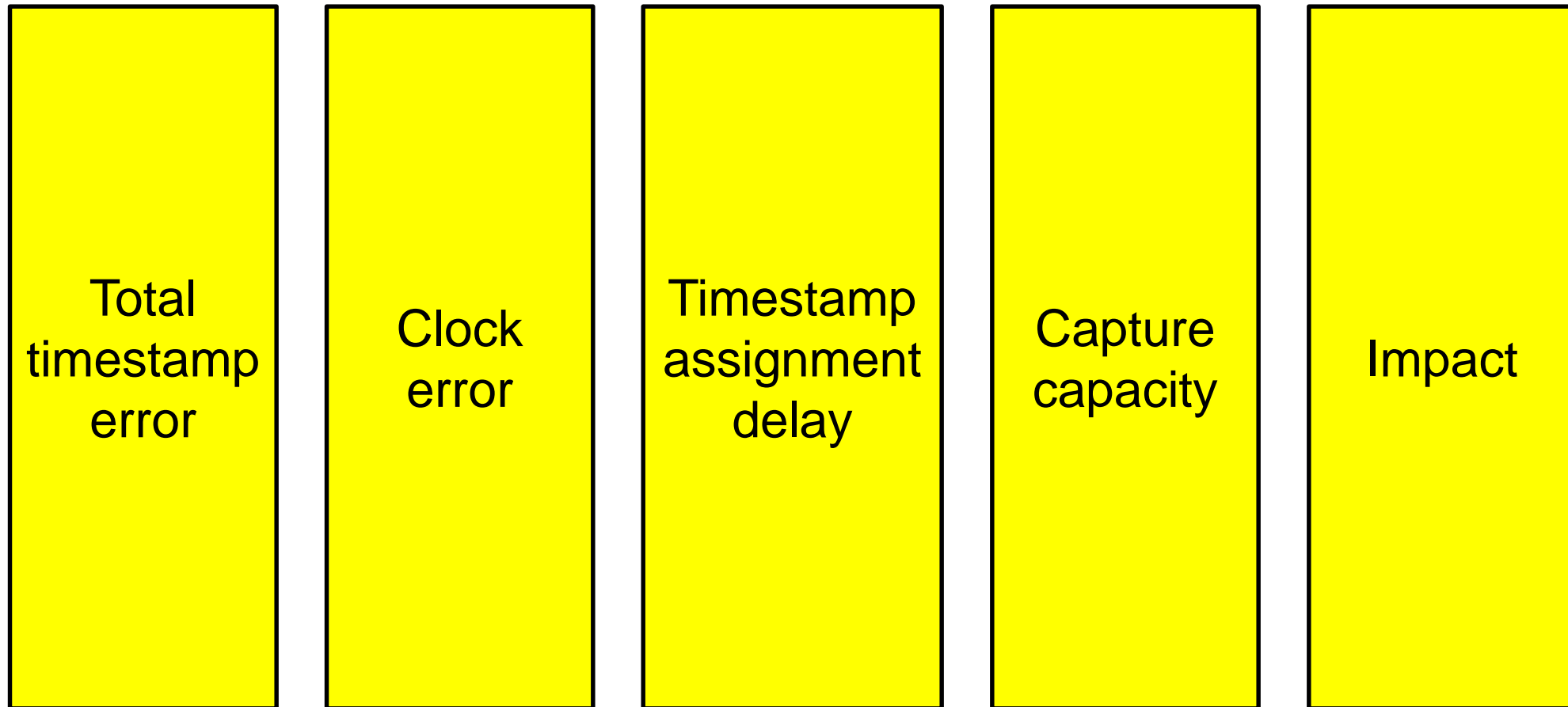
**Network  
timestamping**

(switches, NICs, capture  
cards, appliances, etc.)

**Application  
timestamping**

(APIs, C++, Java, .Net,  
VMs, etc.)

# STAC-TS taxonomy for types of measurement



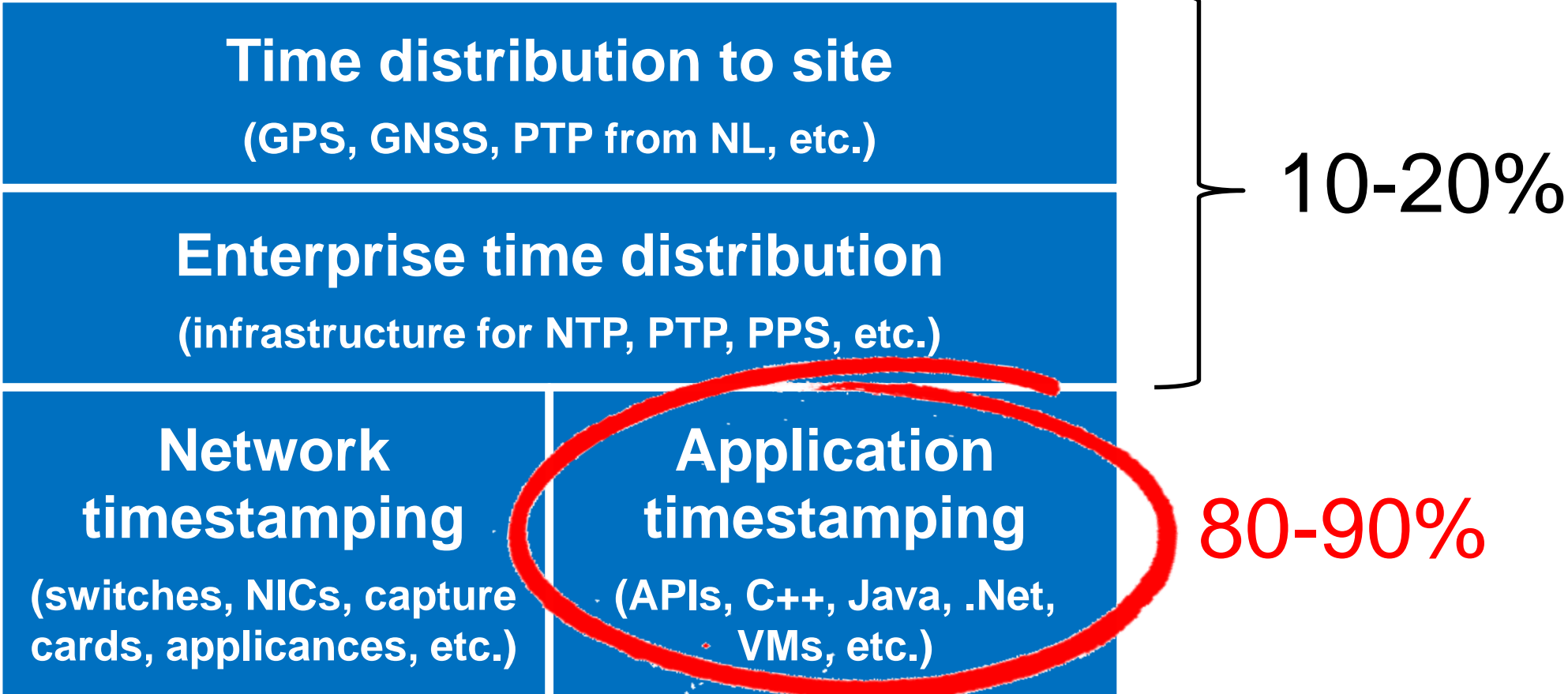
*Certain measurements apply to certain types of SUT*

# Current top priorities expressed by STAC-TS member firms

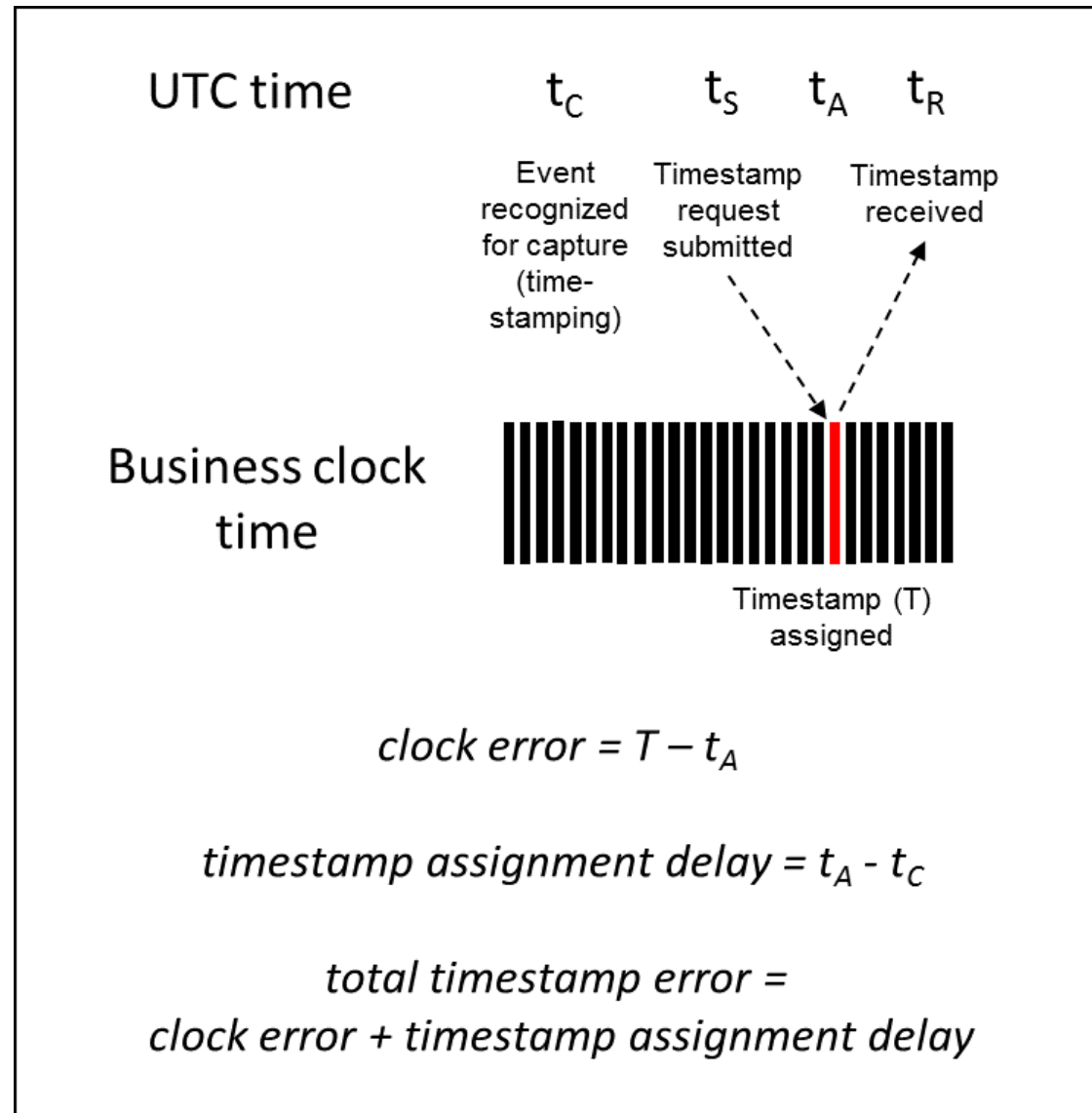
- Timestamp-assignment delay in applications
- Drift in host clocks
- Capacity of capture solutions
- Empirical proof for network timestamps



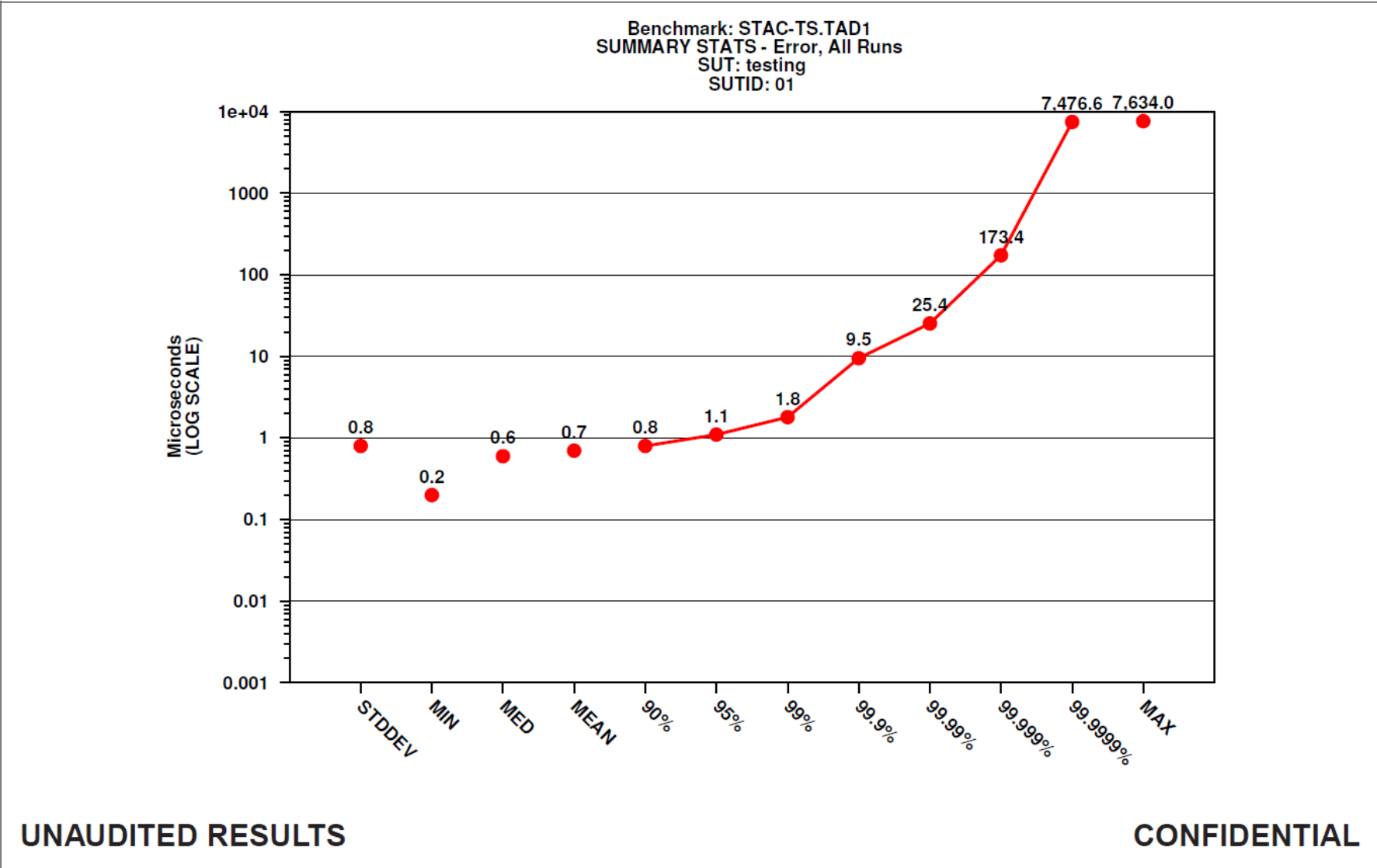
# How firms are budgeting for timestamp error (out of 100 μsec)



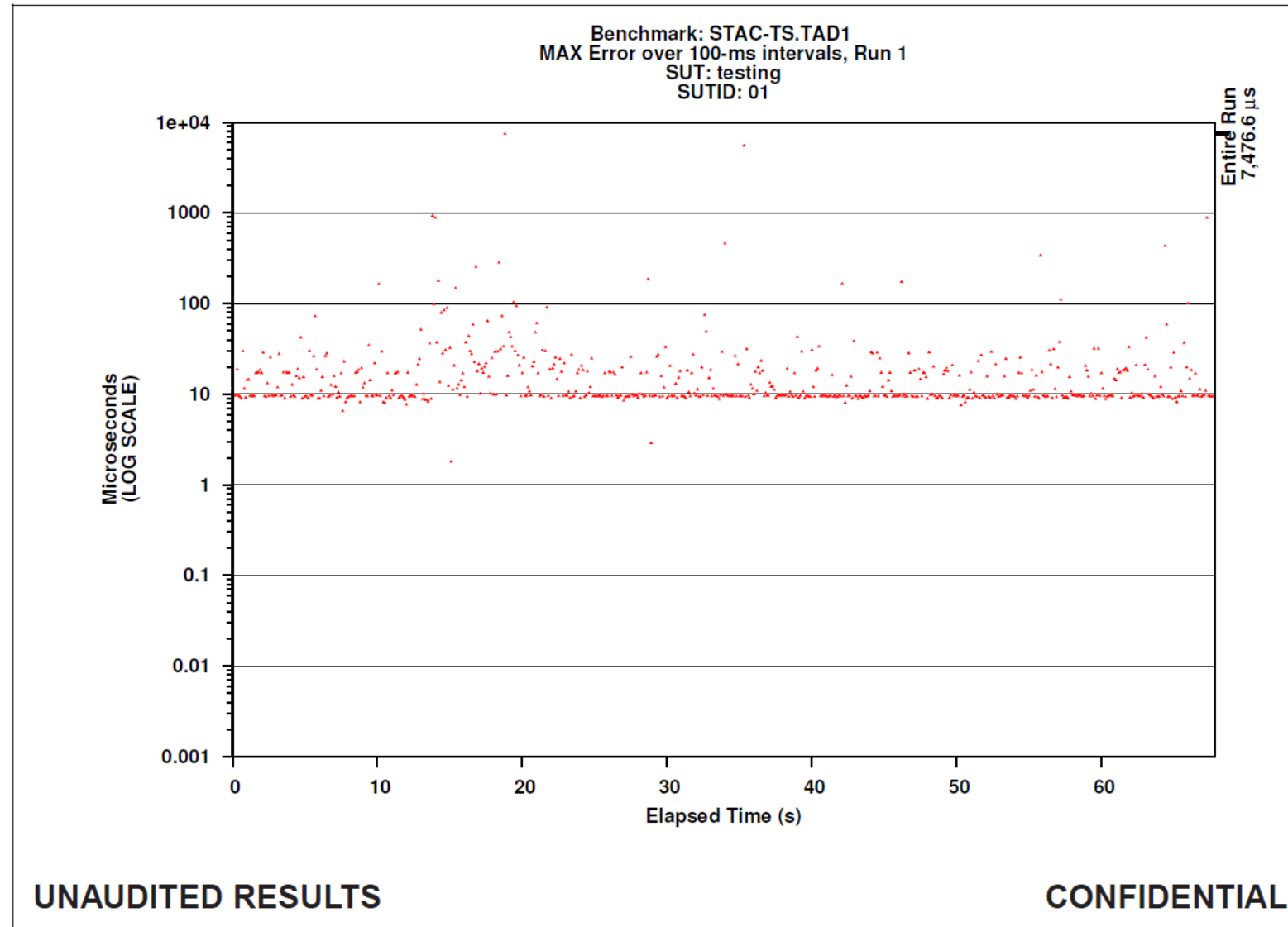
# Timestamp assignment delay



# Timestamp-assignment delays: example analysis excerpt



# Timestamp-assignment delays: example analysis excerpt



# Scenarios of interest under STAC-TS

- Realistic load extremes
- Loss of discipline (holdover)
- Interference (e.g., GPS jamming)
- Leap seconds

## Question

The NTP or PTP daemon on Host XYZ dies.

How long do you have to fix the issue before the host is out of compliance?

# Drift in host clocks

- Answer: probably not long (see below)
- STAC-TS includes holdover tests

## Initial Results (30 minutes)

Time (s)	Offset (us)	
	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



*Provided by a trading firm active in the STAC-TS Working Group*

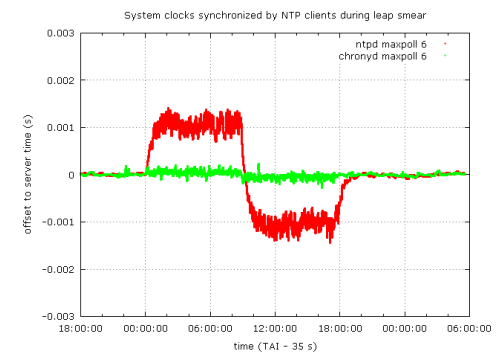
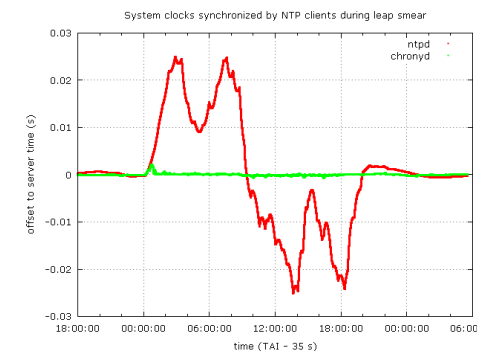
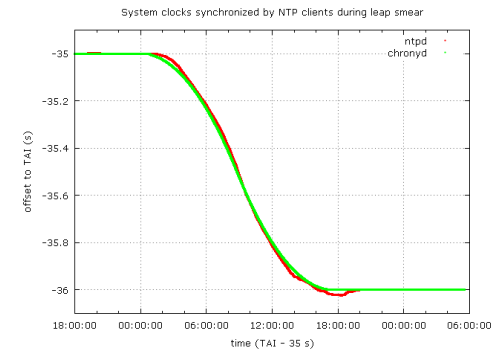
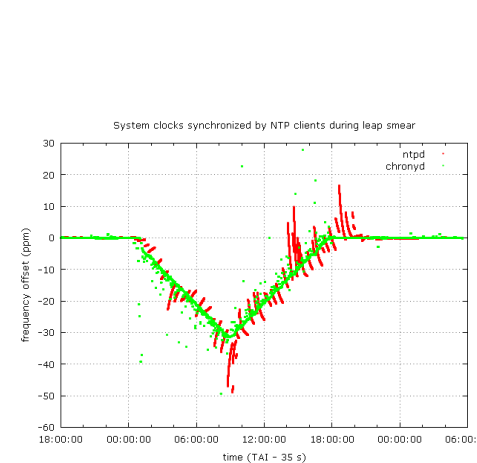
# GPS interference

- Hot topic in London right now
- Reason for concern everywhere
- Several types of interference (see John @ Spectracom's preso)
  - Environmental
  - Accidental
  - Intentional
- Important to understand how systems deal with these



# Leap seconds

- Hoping they only affect Asia isn't a strategy
- Many approaches exist
- Stepping minimizes the duration of non-compliance
- Slewing reduces the magnitude of non-compliance but increases its duration
- Some solutions claim to slew traceably
- STAC-TS tests any configured strategy



\* From [http://planet.jboss.org/post/five\\_different\\_ways\\_to\\_handle\\_leap\\_seconds\\_with\\_ntp](http://planet.jboss.org/post/five_different_ways_to_handle_leap_seconds_with_ntp)

# STAC-TS business model for vendors

## Standard STAC model

- Member vendors can use tools for their internal research
- Vendors can pay for an audit



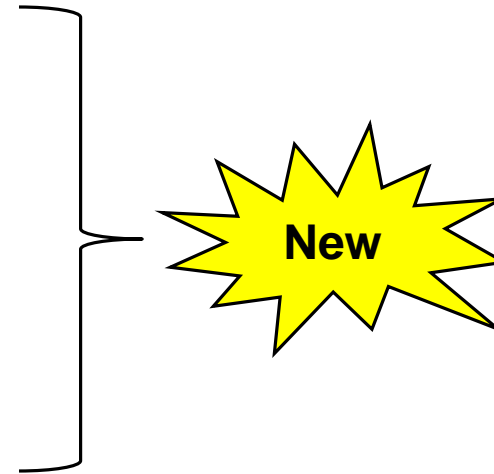
# STAC-TS business model for regulated firms

## Standard STAC model for premium subscribers:

- Use STAC Reports to vet products
  - Much of it not restricted to premium subscribers
- Use STAC-TS tools for internal research
  - Included in STAC premium subscription

## Plus extensions to the model:

- Use STAC-TS tools to provide evidence to regulators
  - Unaudited reports
- Pay for audits of existing products
- Pay for on-site audits
  - STAC partner model



# Feedback on needs (so far)

	<b>Research reports</b>	<b>Testing Tools</b>	<b>Client-funded audits</b>
Client <b>with</b> lots of time and expertise	✓	✓	
Client <b>without</b> lots of time and expertise	✓		✓

# Iterative release cycle

- Releasing the methodologies in priority order
- Community source model
- Clearly defined “Approved” releases
  - Suitable for results disclosure to regulators

# Want to get started?

- If you'd like to join the working group or get notified when methodologies are released:
- Go to [www.STACresearch.com/ts](http://www.STACresearch.com/ts)
- Click "Enable me!"