

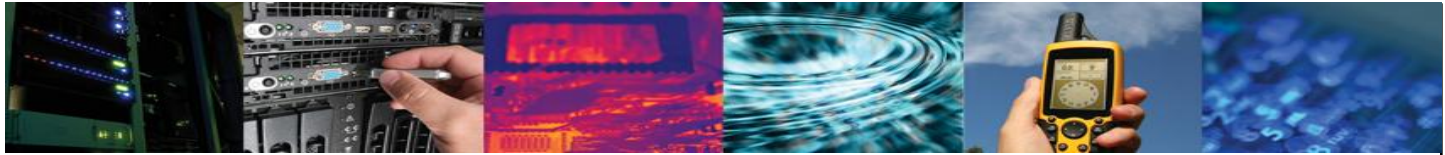
Absolute Timing Integrity Monitoring Using a Multiple Reference Mash-Up

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This presentation:

- Introduction
- Traditional testing
 - Lab based 3 channel
 - Network 2 channel
- Using Multiple References in the Network
- Conclusions



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Mashup (web application hybrid)

From Wikipedia, the free encyclopedia

In technology, a **mashup** is a [web application](#) that combines data from more than one source into a single integrated tool; an example is the use of cartographic data from [Google Maps](#) to add location information to real-estate data, thereby creating a new and distinct web service that was not originally provided by either source.

[Mashup](#) originally referred to the practice in pop music (notably hip-hop) of producing a new song by mixing two or more existing pieces.

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Overview

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Content used in mashups is typically sourced from a third party via a public interface or [API](#) ([web services](#)), although some in the community believe that cases where private interfaces are used should not count as mashups^{[\[citation needed\]](#)}. Other methods of sourcing content for mashups include [Web feeds](#) (e.g. [RSS](#) or [Atom](#)), and [screen scraping](#). Many people are experimenting with mashups using [Amazon](#), [eBay](#), [Flickr](#), [Google](#), [Microsoft](#), [Yahoo](#) and [YouTube](#) APIs.

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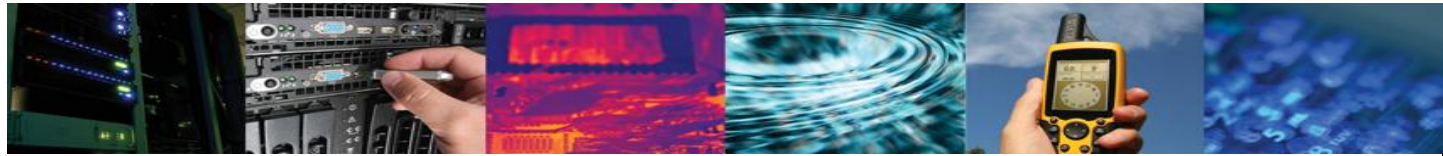
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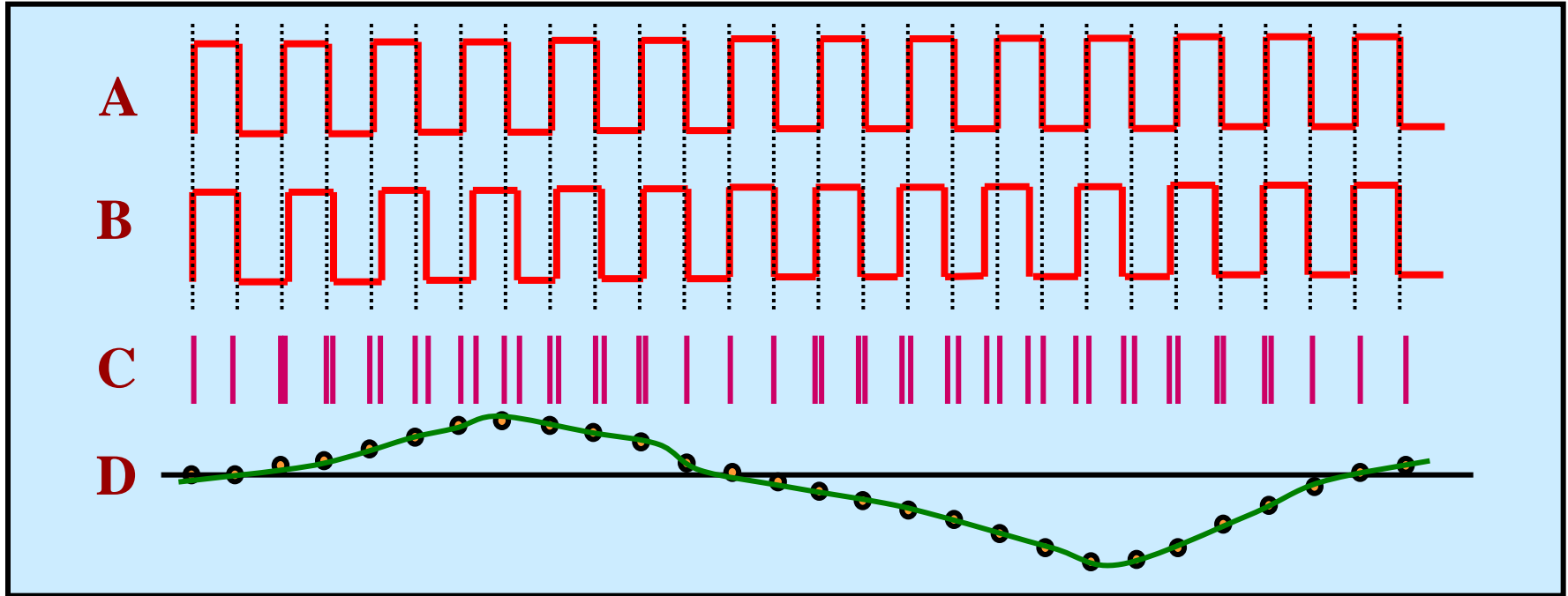
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Time Interval Error - TIE

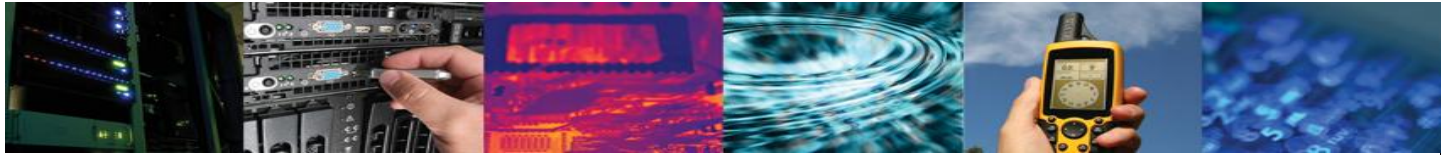


A - Ideal Clock without noise

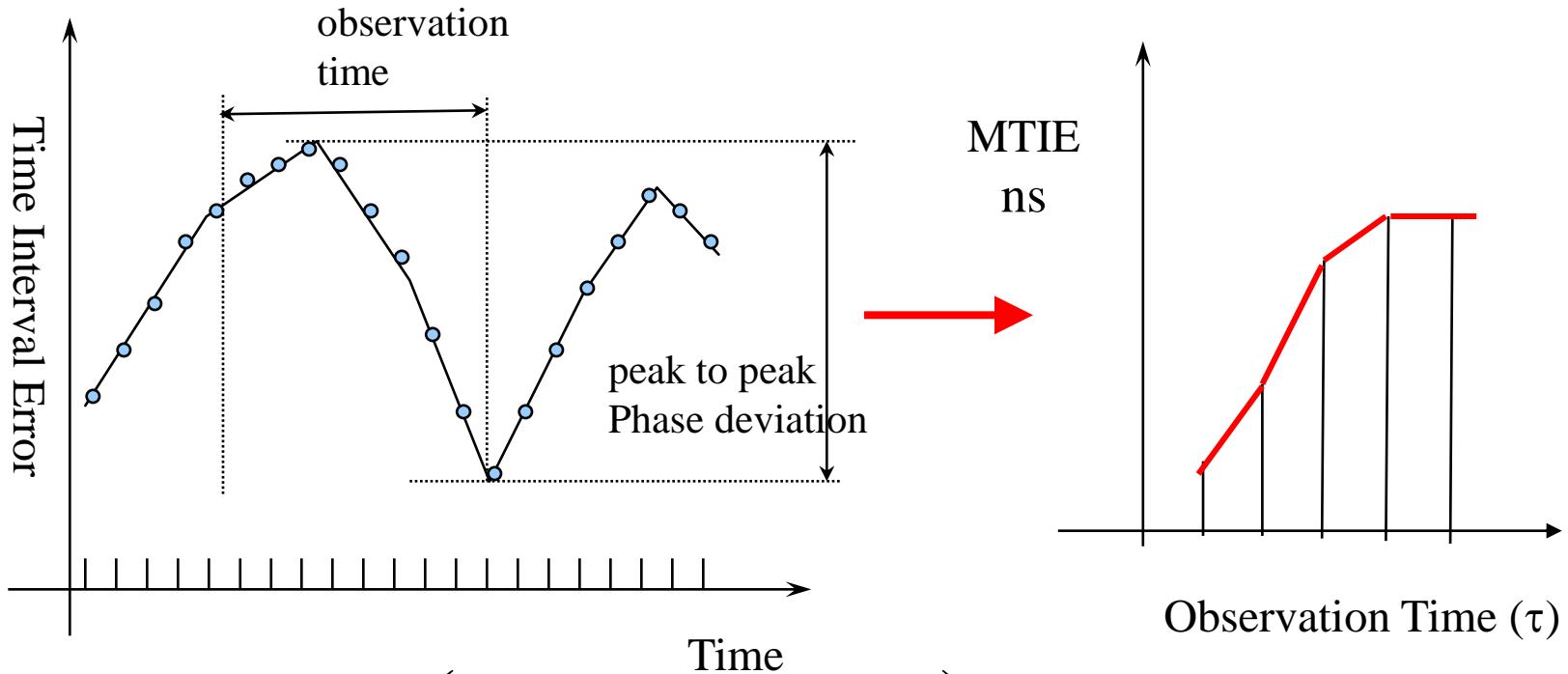
B - Stressed Clock containing noise

C - Timing Differences

D - Represents phase (ϕ) deviation or “**Time Interval Error**” (TIE)

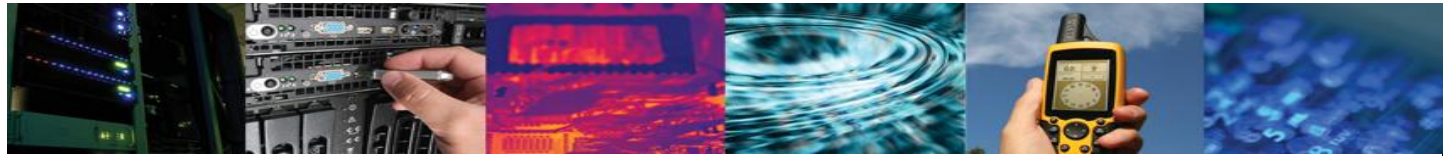


MTIE Defined



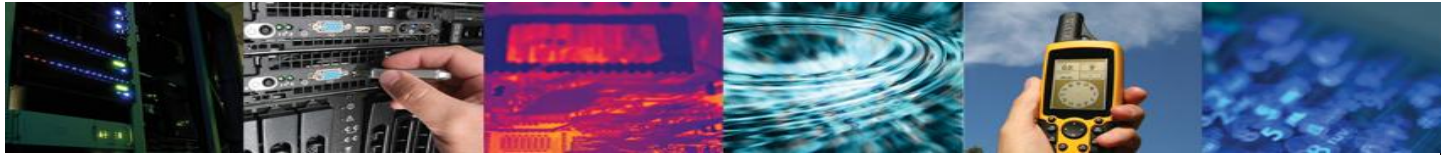
$$MTIE(\tau) = \max_{-\infty < \tau_0 < \infty} \left(\max_{-\tau_0 < t < \tau_0 + \tau} [x(t)] - \min_{-\tau_0 < t < \tau_0 + \tau} [x(t)] \right)$$

- “The maximum peak to peak delay variation of a given timing signal with respect to an ideal timing signal within an observation time (t) for all observation times of that length within a measurement period (T).”



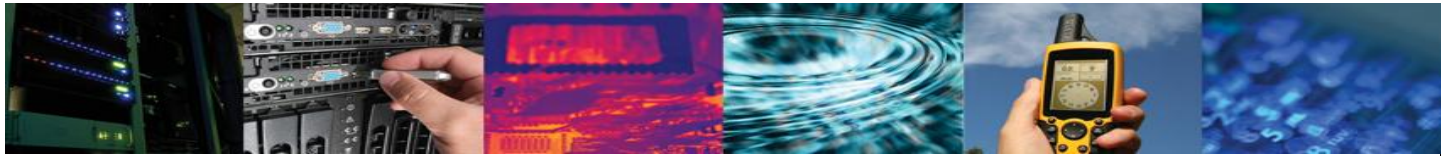
Best Practice - Typical Test/Monitoring scenarios

- Lab Based testing:
 - 2 channels – A vs. B
 - Usually your reference is well behaved/controlled
 - 3 channels – A vs C and B vs C
 - Removal of doubt!
 - Technologically different references, e.g. GPS, Rb and Network feed

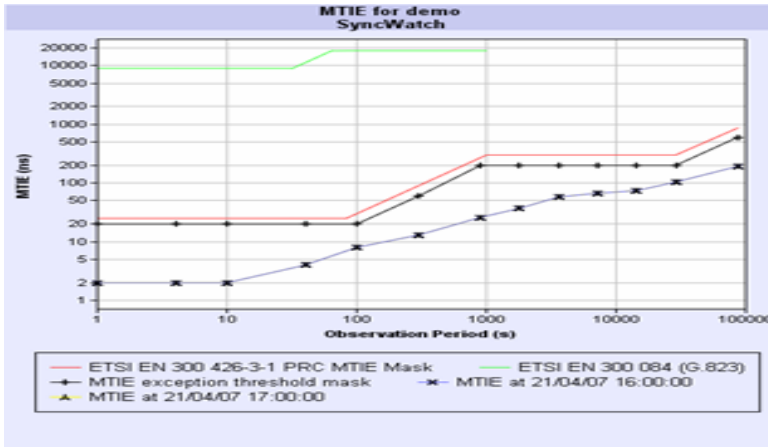


Next Generation Technologies

- Move from physical layer sync to “Packet layer” sync means new techniques need testing:
 - In the lab
 - In field trials
 - During rollout
 - ... and during “business as usual”!



Web Enabled Testing brings test capability to any network node – even right at the edge of the network

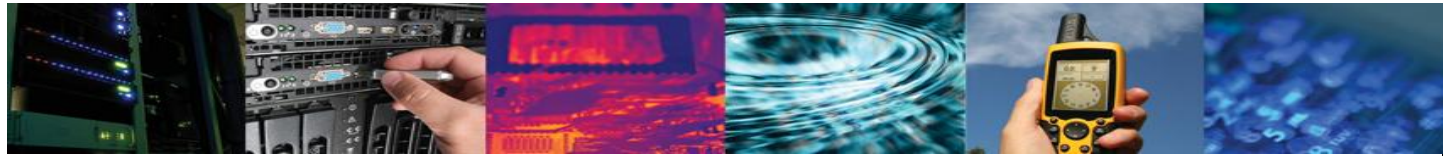


Steady State Data.

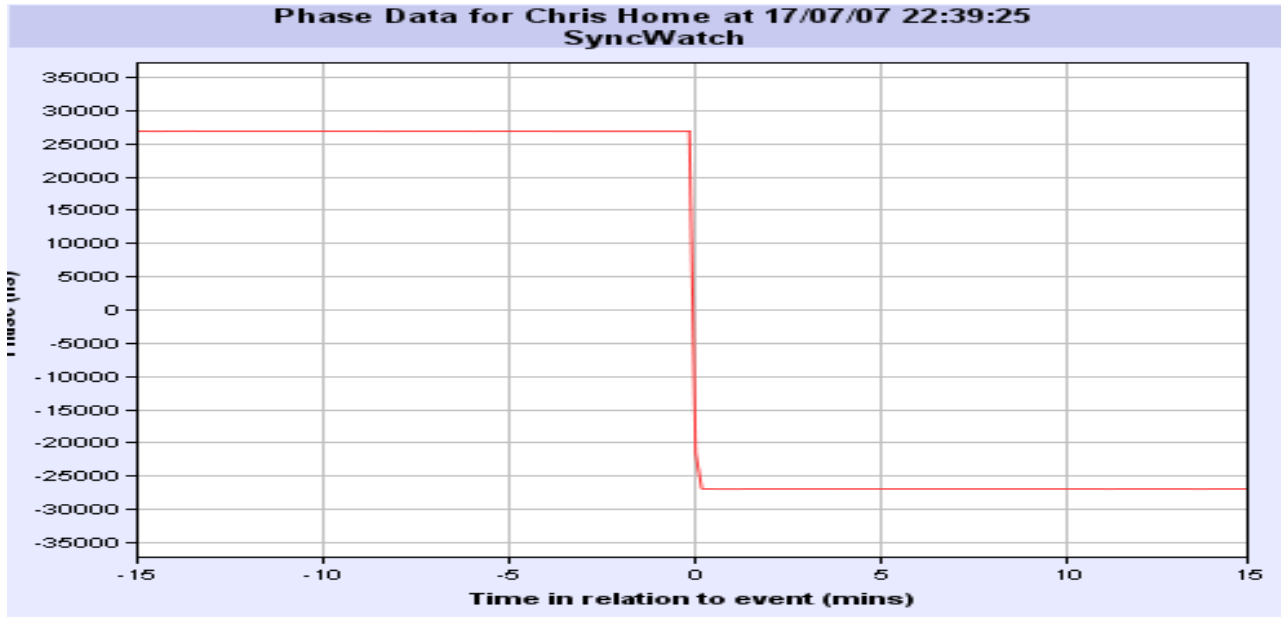
Data can be viewed on website

Catch Transients for later study, e.g. refine firmware

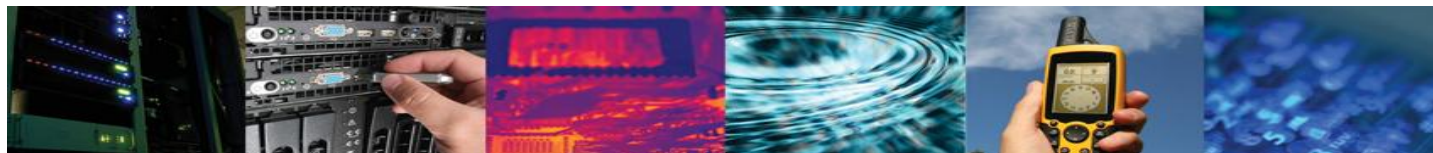




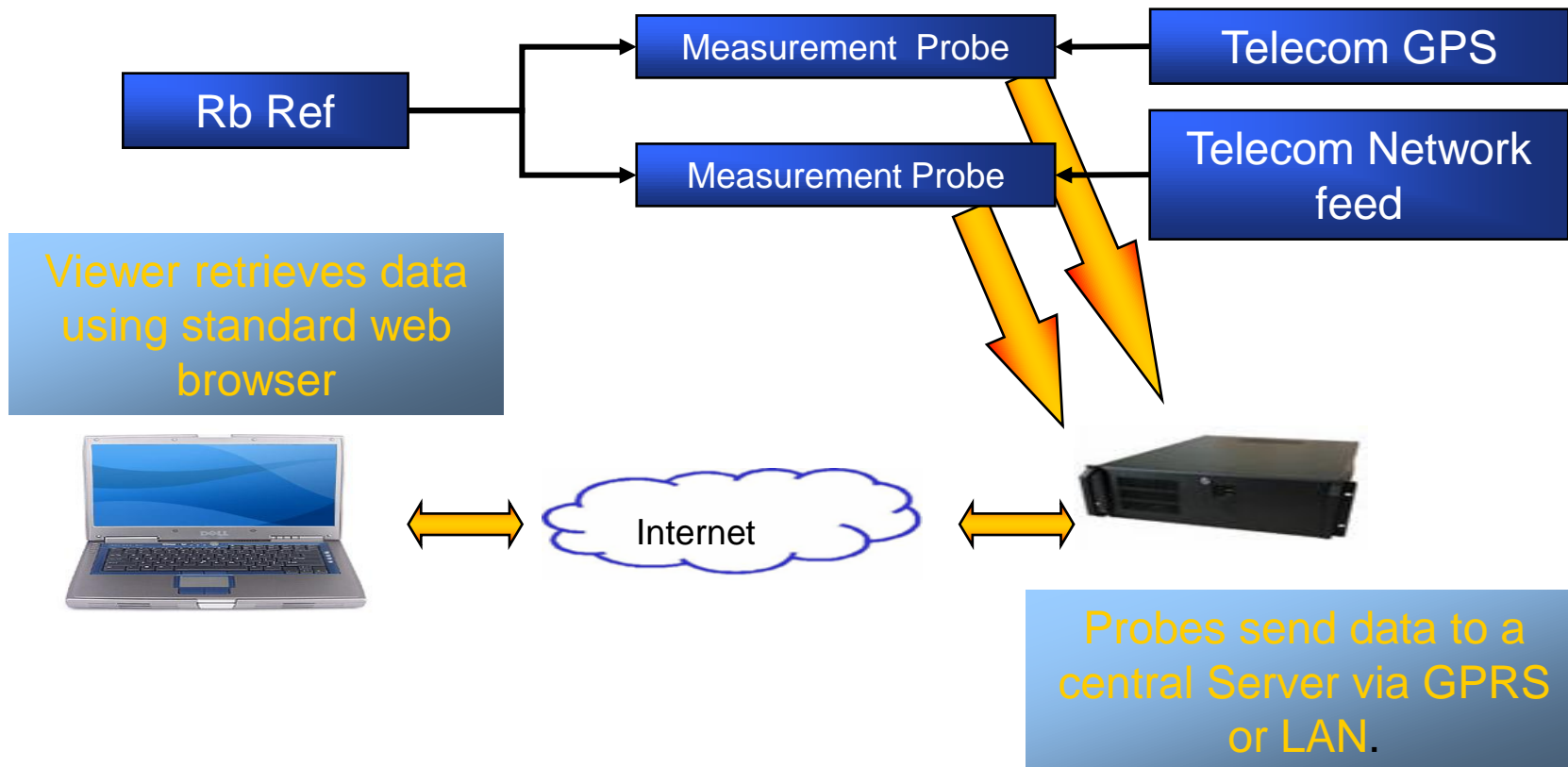
Dilemma - if A and B are different, which one is wrong?

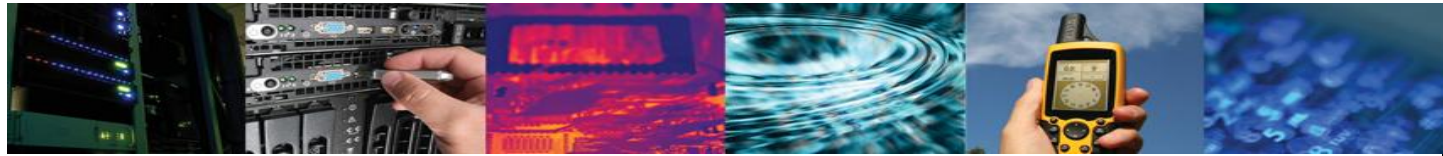


- With a traditional 2 channel A vs. B device, you can't tell!
- Technology Convergence – Next Generation Networks with all IP/Packet transport will lead to a proliferation of monitoring at the edge of the network
- Edge of the Network not the most hospitable of environments for reference integrity!



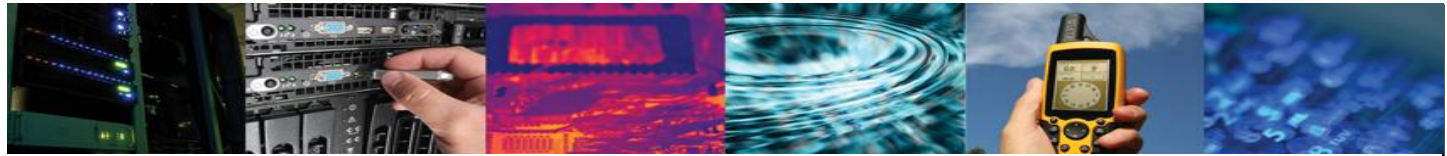
Web Enabled Testing (using traditional 2 channel testers)





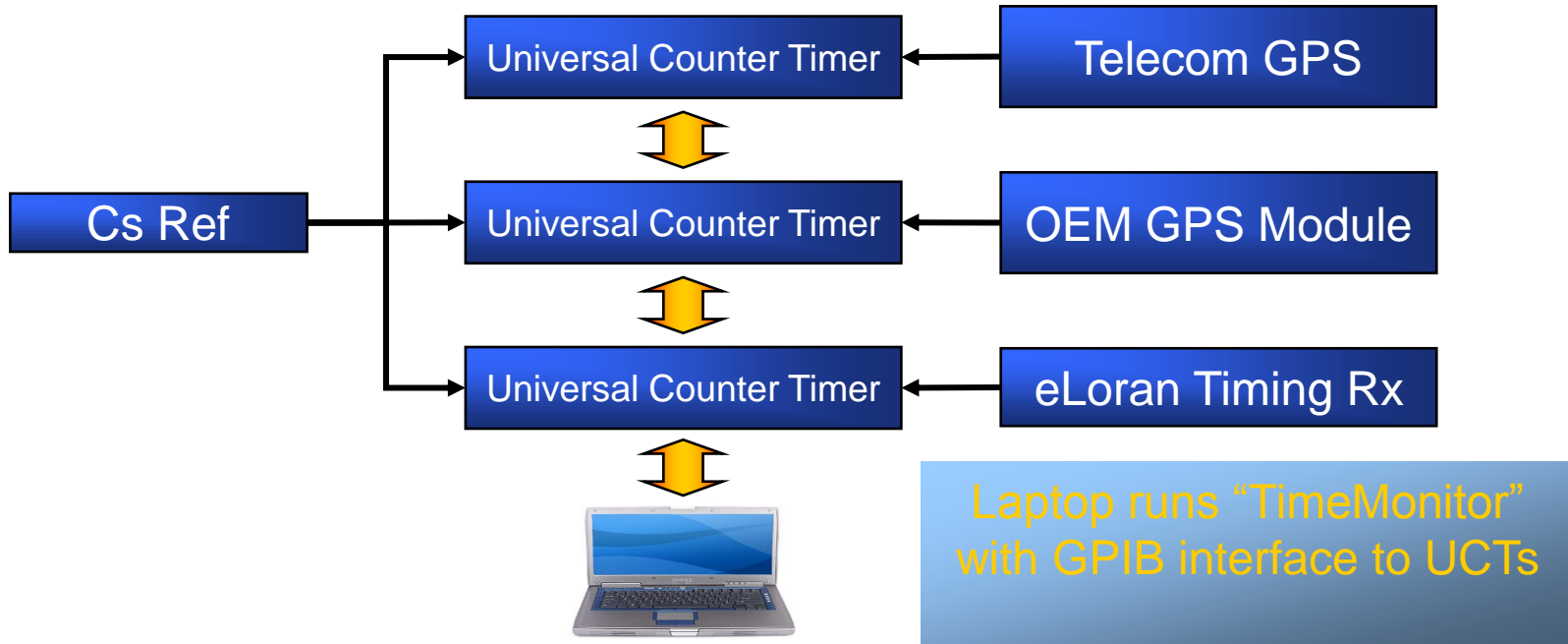
2 out of 3 – majority voting

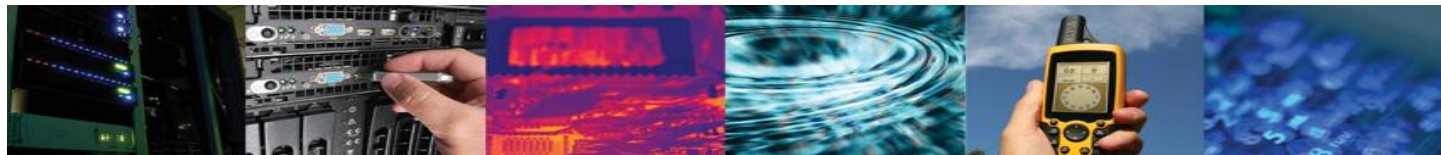
- Classic Telecom concept
 - Relative difference between 2 signals only tells you they're different
- With 3 signals if one changes and the other 2 stay the same the odd one out is likely to be in error
- Basis of fault tolerance in Telecoms/Datacomms
- Technology Enablers:
 - Small form factor Rubidium Atomic Oscillators
 - Small GPS/Galileo/eLORAN timing modules
 - Hardware time-stamping – NTP/PTP
 - Embedded Linux
- Technologically dissimilar references reduce the likelihood of common-mode failure scenarios
- New Web Enabled Testing platform with 3 channels aids integrity monitoring



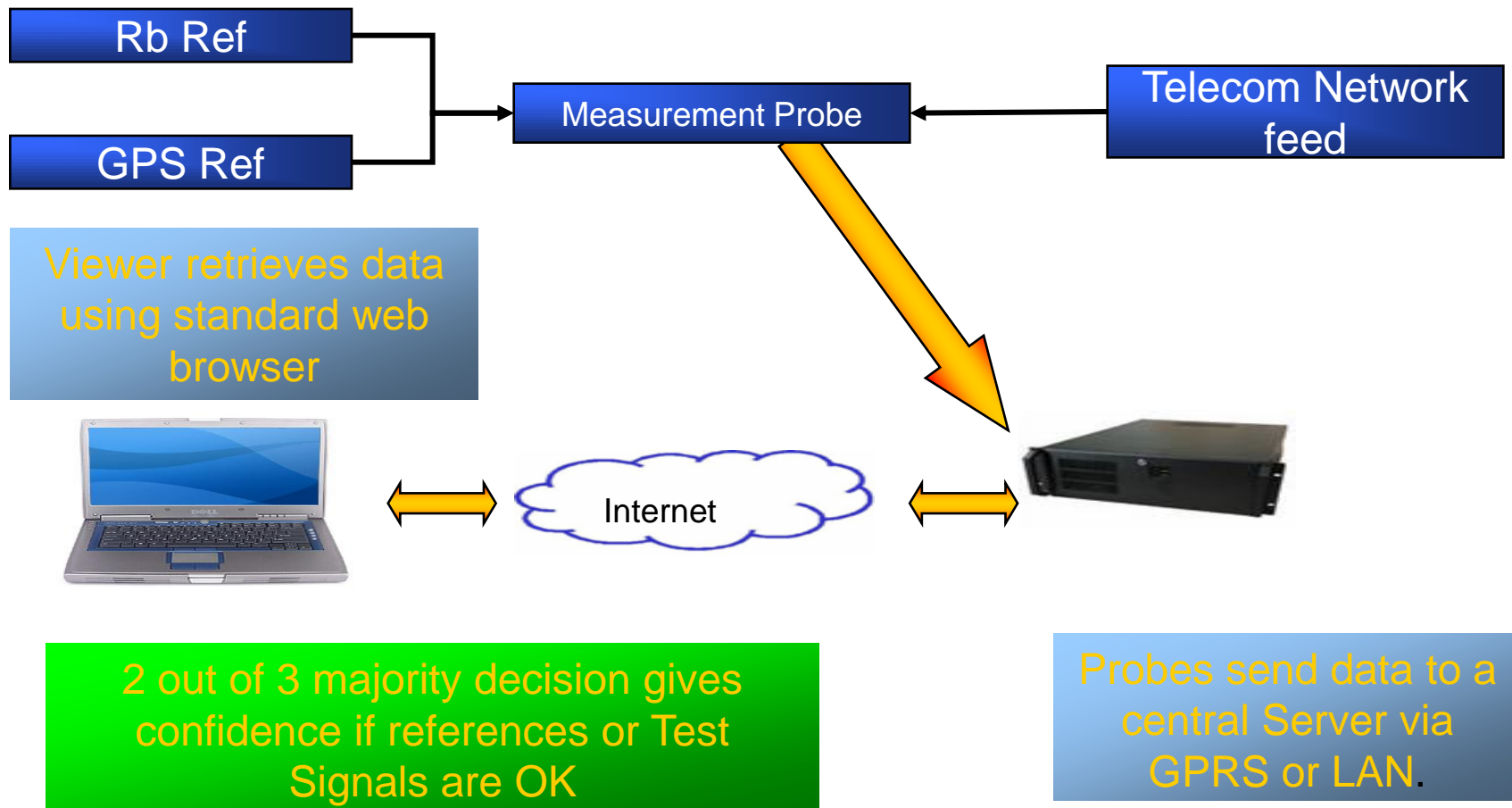
Typical Lab Bench Test

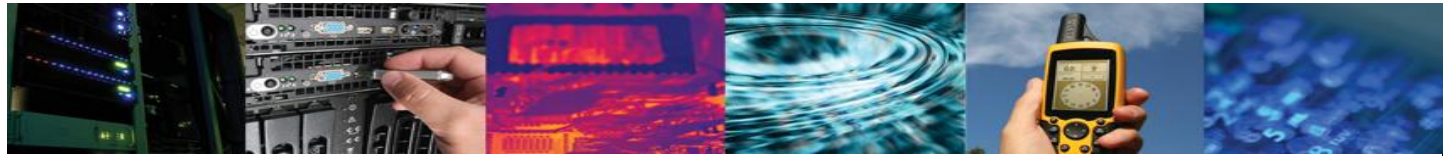
2 out of 3 majority





Web Enabled Testing (using 3 channel tester)

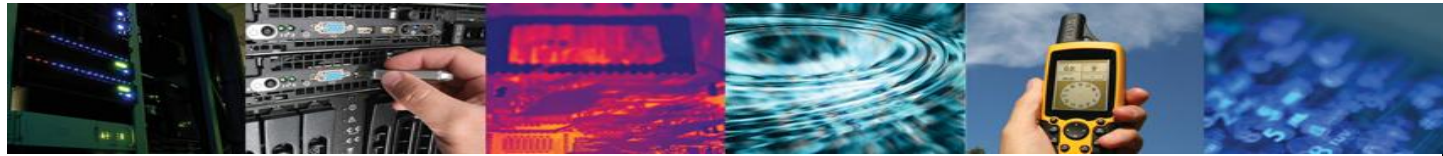




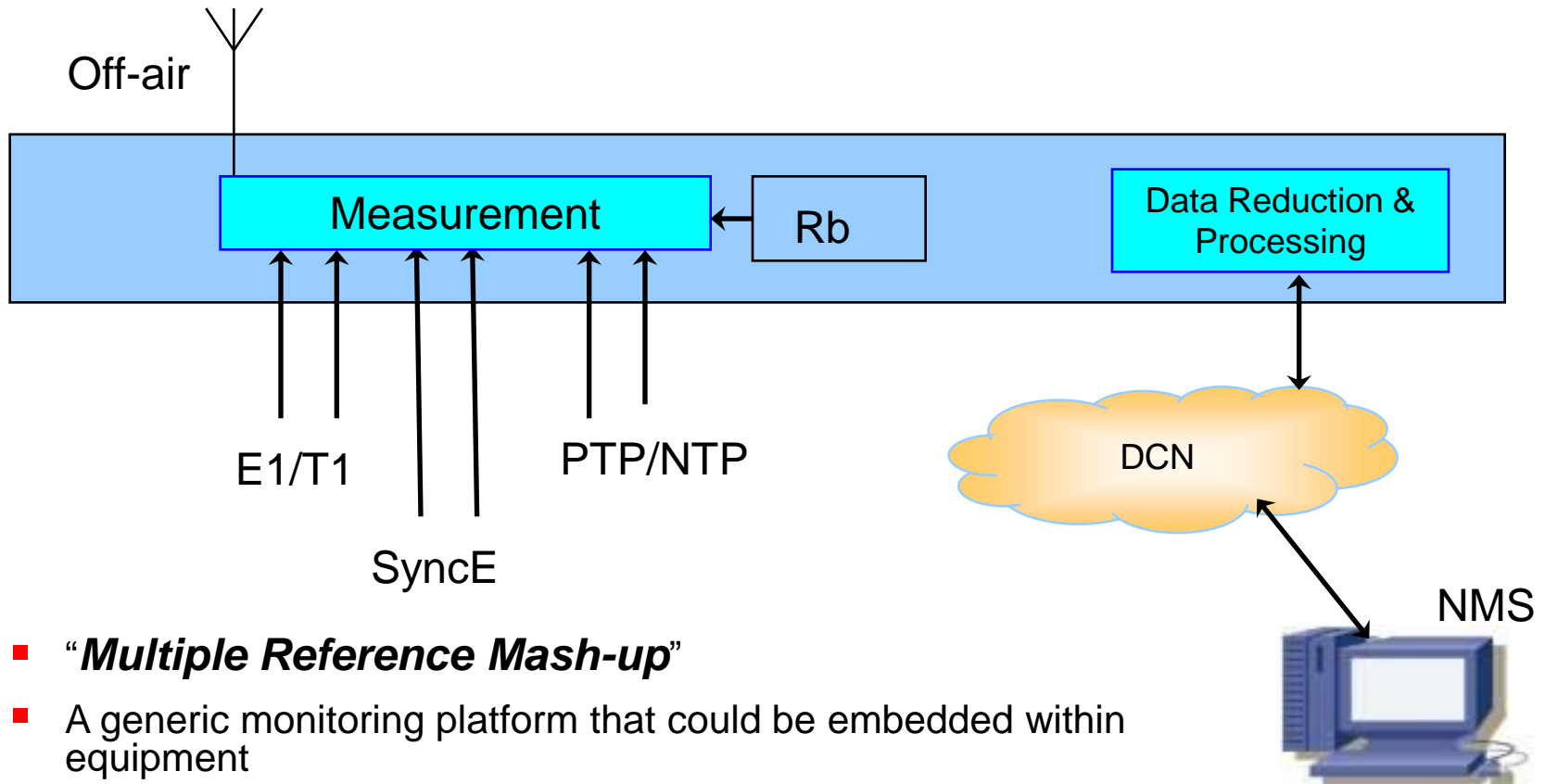
Multiple References in the Network

- 3 signals
 - Measure A vs. C and B vs. C – deduce A vs. B

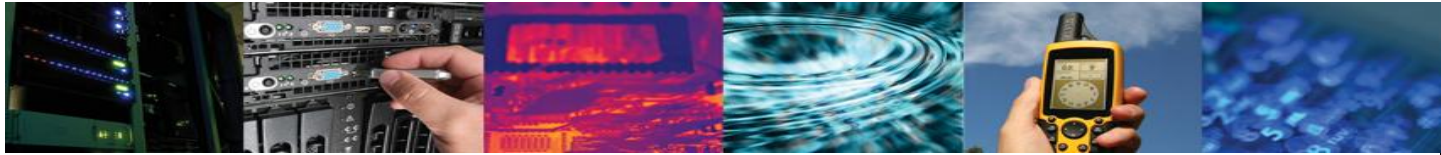
- Use Rb
 - Careful watching of behaviour could allow Rb drift to be offset by GPS once every 24 hours



Extended the concept to any available reference signal...

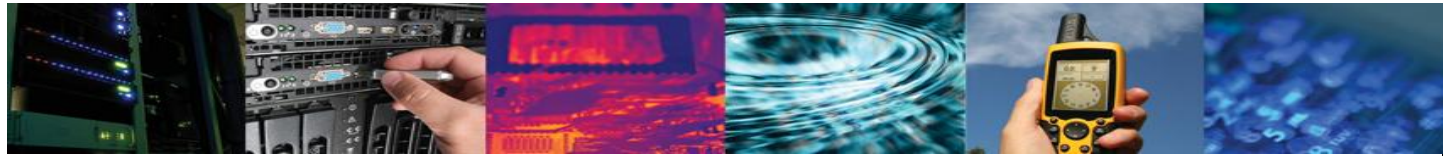


- **“Multiple Reference Mash-up”**
- A generic monitoring platform that could be embedded within equipment
- Can use any available reference for timing integrity monitoring
- Many probes – many metrics – TIE/MTIE/TDEV/minTDEV



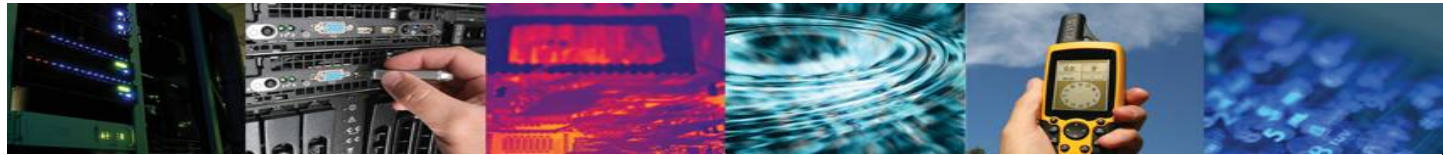
Reference choices

- Physical layer
 - BITS/TDM/SDH
 - Off-air
 - GNSS – GPS, Galileo, Compass
 - LF – WWVB, DCF77 etc. eLORAN, analogue TV spectrum?
 - Rubidium, MAC, CSAC
- Packet layer
 - PTP/NTP



Multiple references as enablers

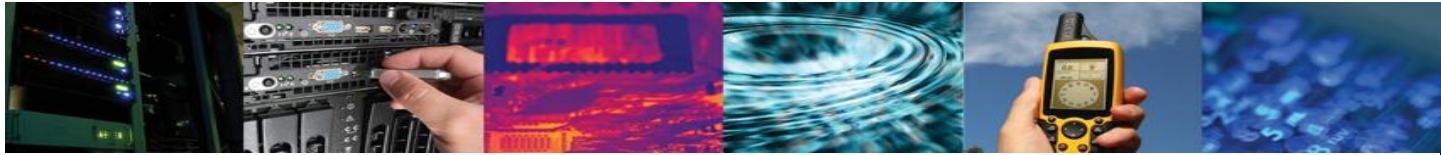
- A vs. B vs. C
 - e.g. A=GPS, B=Rb, C=eLORAN
- Miniaturisation of...
 - MAC (CSAC)
 - GNSS Rx Silicon
 - LF/eLORAN
- e.g. A=xDSL NTR, B=NTP, C=GPS
- Metrics:
 - MTIE/TIE
 - PDV/MinTDEV
 - Microbursts



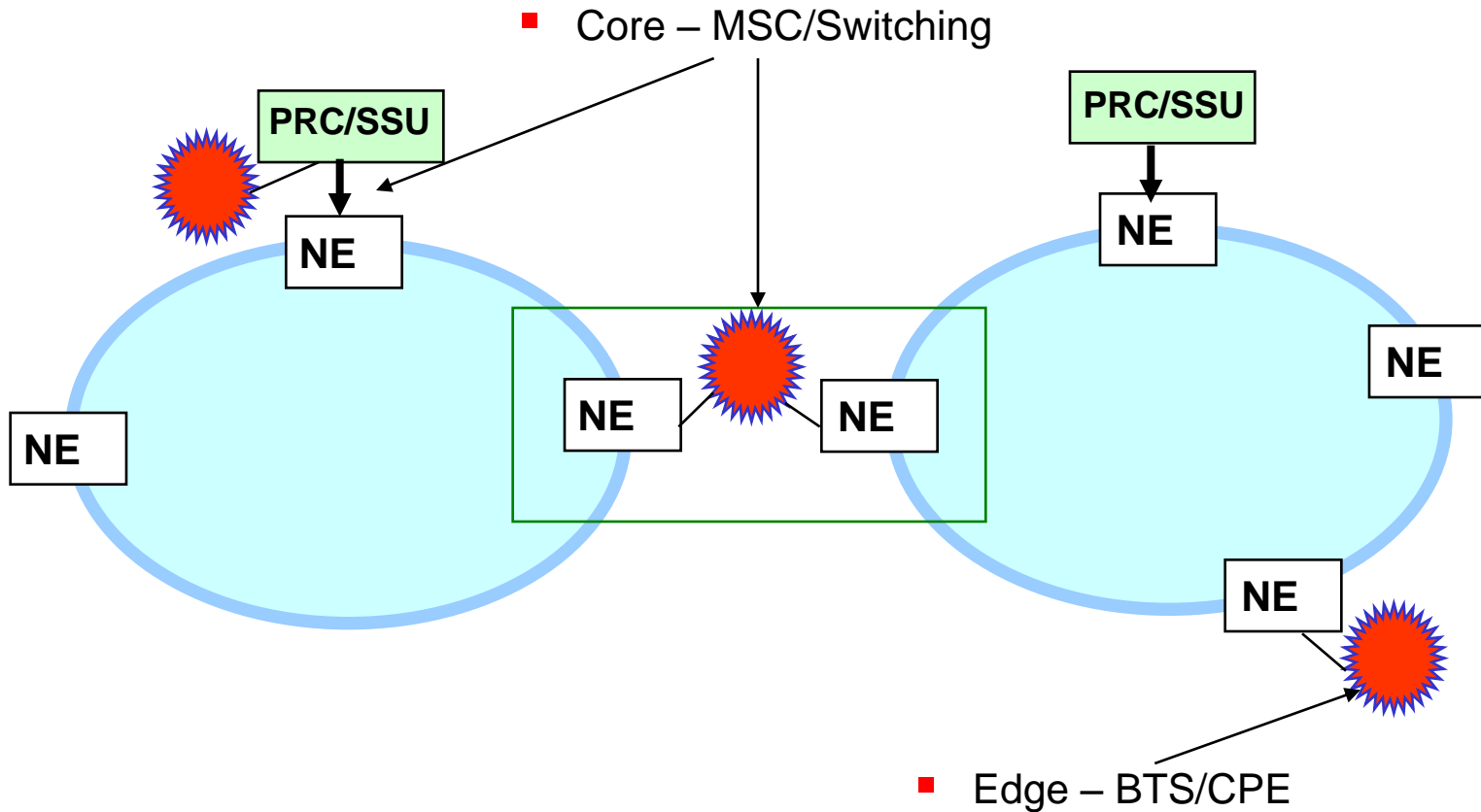
Applications – in the network

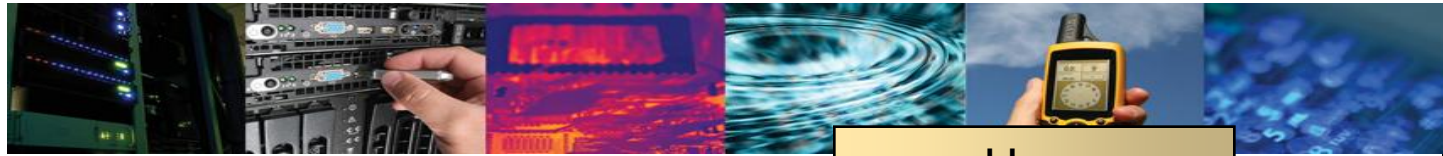
- Core – MSC/Switching
- Edge – BTS/Node B
- SLA policing/defending
 - Interconnection performance
 - Legacy/NGN boundary monitoring
- IPSLA – PDV bounding – one way delay, financial transactions

- “Timing availability monitoring”

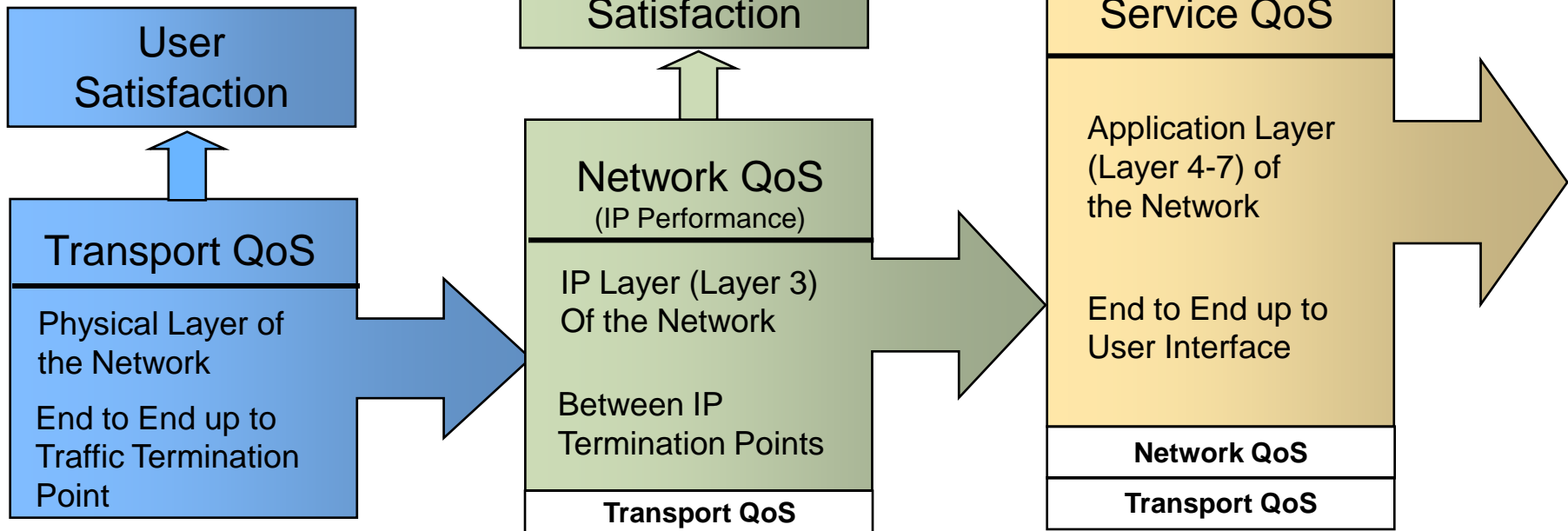


Probes to Build SLAs

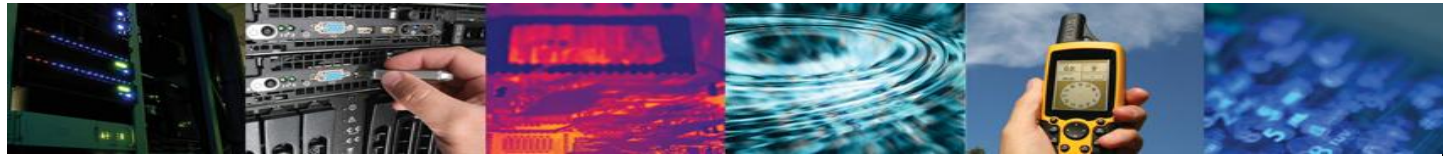




Scope of QoS is Changing



- ▶ In Next Generation Networks, QoS & QoE are the “Key Performance Indicators”
- ▶ Web Enabled Testing at the Edge of the Network will drive these KPIs
- ▶ Multiple References are key to reliable data gathering/monitoring



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