

A horizontal collage of five images: a blue and white abstract pattern resembling water ripples, a server room with blue lighting, a colorful abstract pattern, a radio tower against a sunset sky, and a person working on a server rack.

Integrated Frequency & Packet Performance Monitoring in the Transition to Packet Networks

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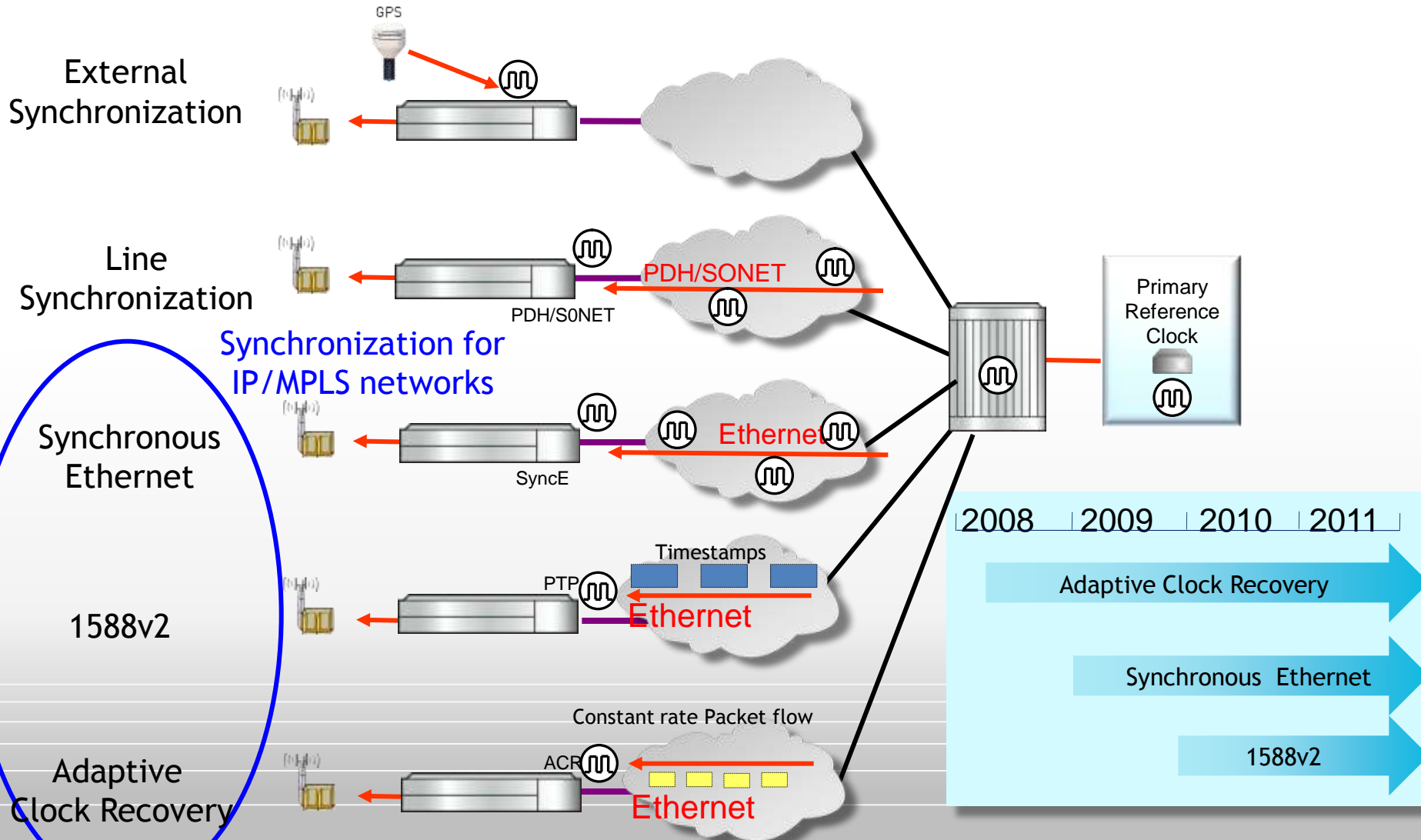
ITSF 2011



Introduction

- How did we get here?
- What is the challenge?
- Testing & monitoring compared and contrasted
- Referenced and unreferenced metrics
- Sync management
 - Building blocks
 - Deliverables
- A lesson from history

More choices than ever before...



That was then, this is now

- Past - One sync distribution network
 - PHY (SONET or SDH)
- Now - Two sync distribution networks?
 - PHY
 - Packet
- Future - Hybrid deployments
 - SyncE/PTP, GPS/PTP

Frequency Domain



Packet Domain



Definitions: testing & monitoring

- ***Testing:***
 - A procedure for **critical evaluation**; a means of determining the presence, quality, or truth of something;

- ***Monitoring:***
 - To keep close **watch over**; supervise
 - To test or **sample**, especially on a regular or **ongoing basis**
 - To keep track of systematically with a view to **collecting information**

Sync. testing & monitoring

- Network sync, testing is usually;
 - Short term (hours/days)
 - Engineer typically on-site with tester
 - OPEX heavy
 - Directed to fault investigation

- Network sync. monitoring is usually;
 - Conducted over the longer term (many days/weeks/months)
 - Engineer typically not on-site for duration of monitoring
 - OPEX light
 - Directed towards characterisation, Revenue Assurance and SLAs



On-site testing



Centralised monitoring

The sync. monitoring dilemma

- Monitor everywhere, all the time (ideal)
 - \$\$\$\$\$\$ / €€€€€€€€
 - Needs intelligent strategy to be cost-effective
 - But accurate Monitors need a reference...
 - Putting a reference everywhere removes the need for sync distribution!!!



“Telecom Guys” testing & monitoring

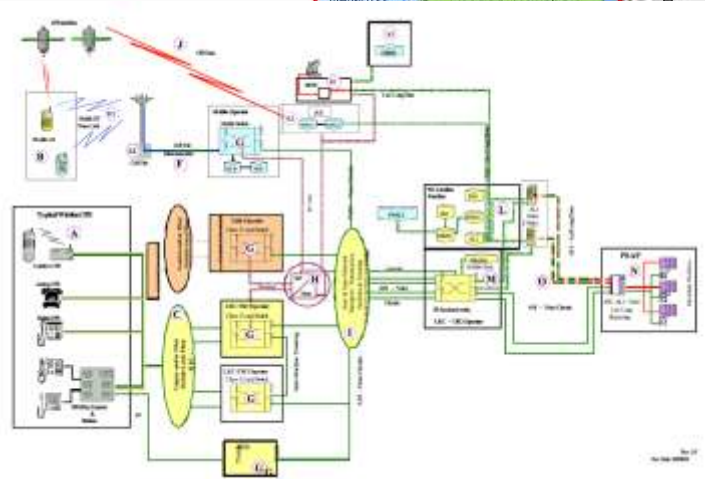
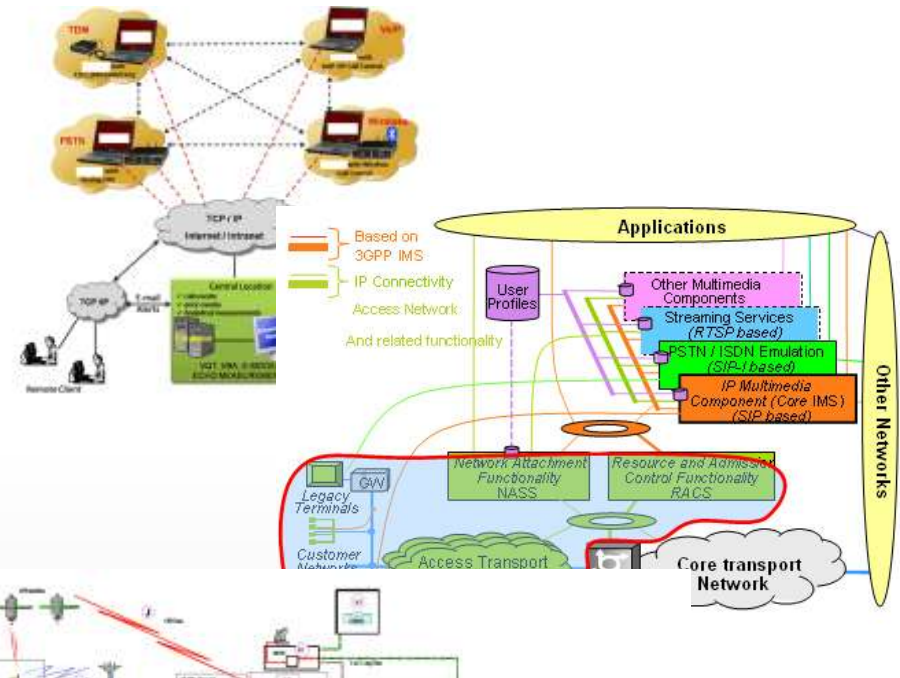
- Monitor PHY layer only
 - PTP client does the heavy lifting
 - Source, network & osc+algorithm = end-to-end (closed) system
 - Metrics well defined & understood
 - TIE, MTIE, TDEV
 - Tried & tested - Well engineered
 - Since 1980s!

“Packet Guys” testing & monitoring

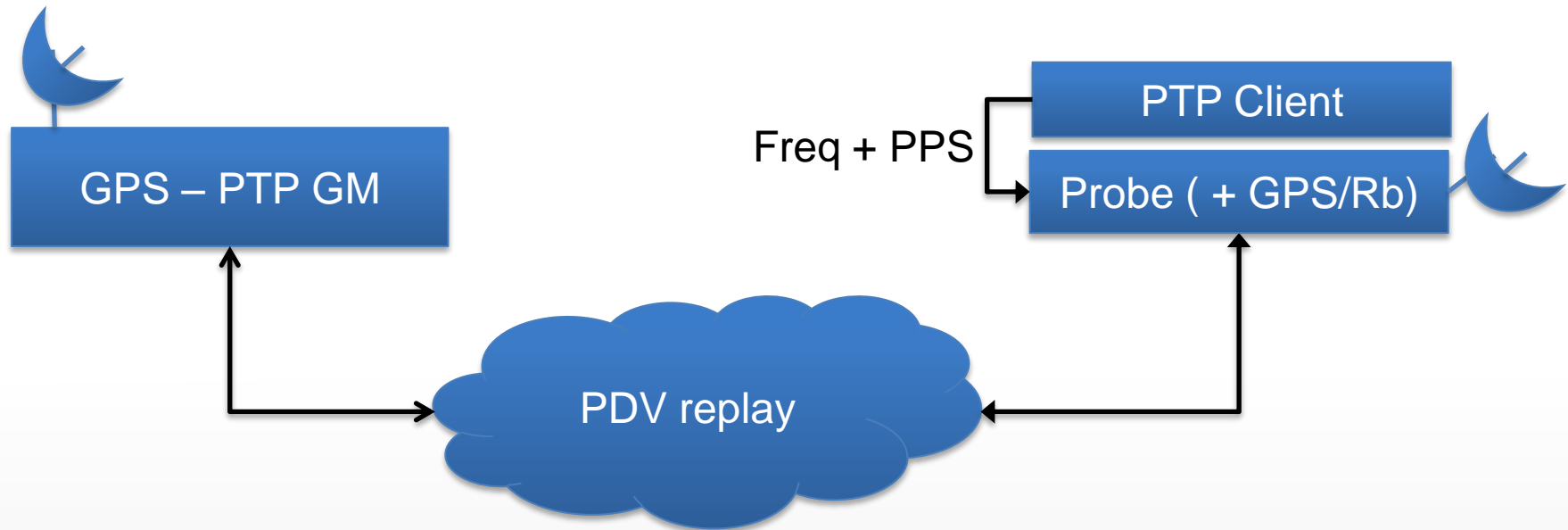
- Packets stats will tell you everything
 - Early warning of failure of “filter” or “algorithm”
 - If the client is doing its job it will filter out (smooth) network events
(PDV changes, step changes of delay etc.)
 - Needs processing power, huge amounts of data
 - Engineering resource (L2/L3)
 - False positives?
 - Which network events to ignore (filter/algorithm doing its job)
 - Which network events to watch (filter/algorithm can't cope)

The challenge is what to measure and where?

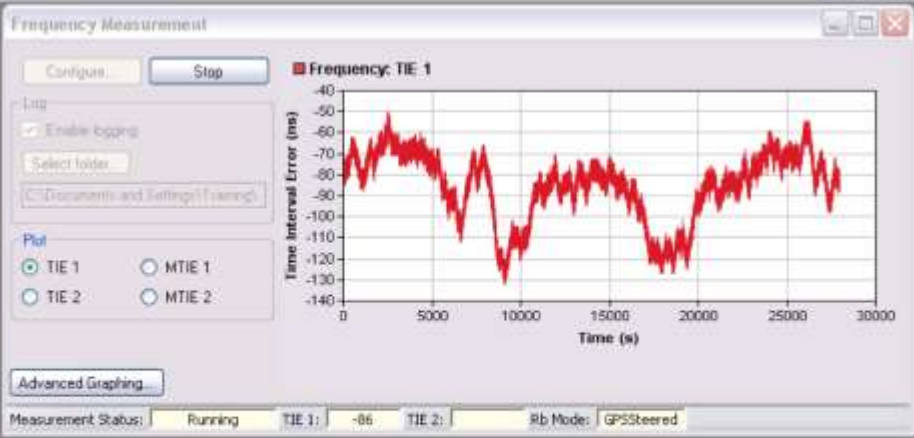
- At the boundary of technologies?
- At Hub / Concentrator sites?
- Important service access points?
- All or nothing?
- Costs to implement?
- Costs if we don't implement?



What data is available? Test set up



- GPS ref'd PTP GM
- Real World μ Wave PDV capture/replay
- Probe has packet & physical layer measurement capability
GPS/Rb ref



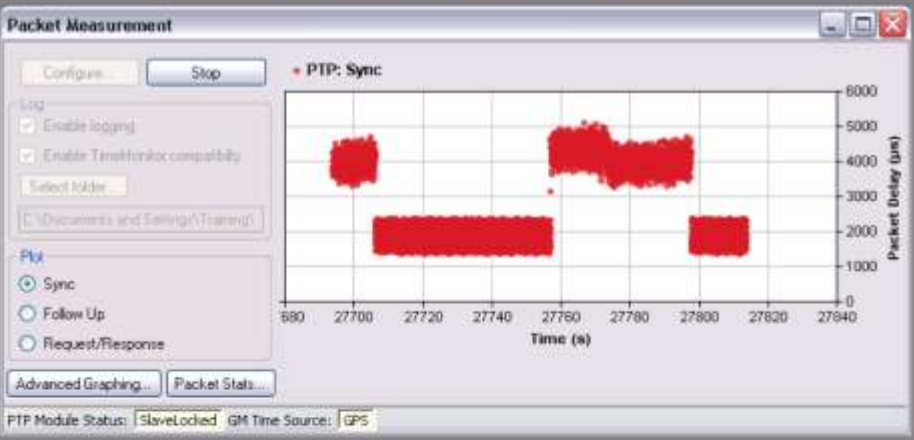
Probe Info

Serial number: sw200090
 IP Address: 172.31.90.209
 Firmware version: disconnect_test

Installed Modules

Module	Description
1	CTL-611 PTP
2	-
3	CTL-431 Rb w/ GPS

OK



Packet Stats

	Sync	Follow Up	Request/Response
	Unicast	Multicast	
Total Packets:	909543		
Out of Sequence:	0		
Lost Packets:	272		
Max Flight Time (µs):	5917.322		
Min Flight Time (µs):	1416.946		



Live Measurement

Information

Live measurement

Probe Serial: sw200090

IP Address: 172.31.90.209

Start Date: 01/11/2011

Start Time: 09:29:35

More...

Frequency

TIE MTIE

Input F 1PPS

NOT CONFIGURED

Ref: GPS 2.048MHz

Packet

Sync

Follow Up

Delay Request/Response

Masks

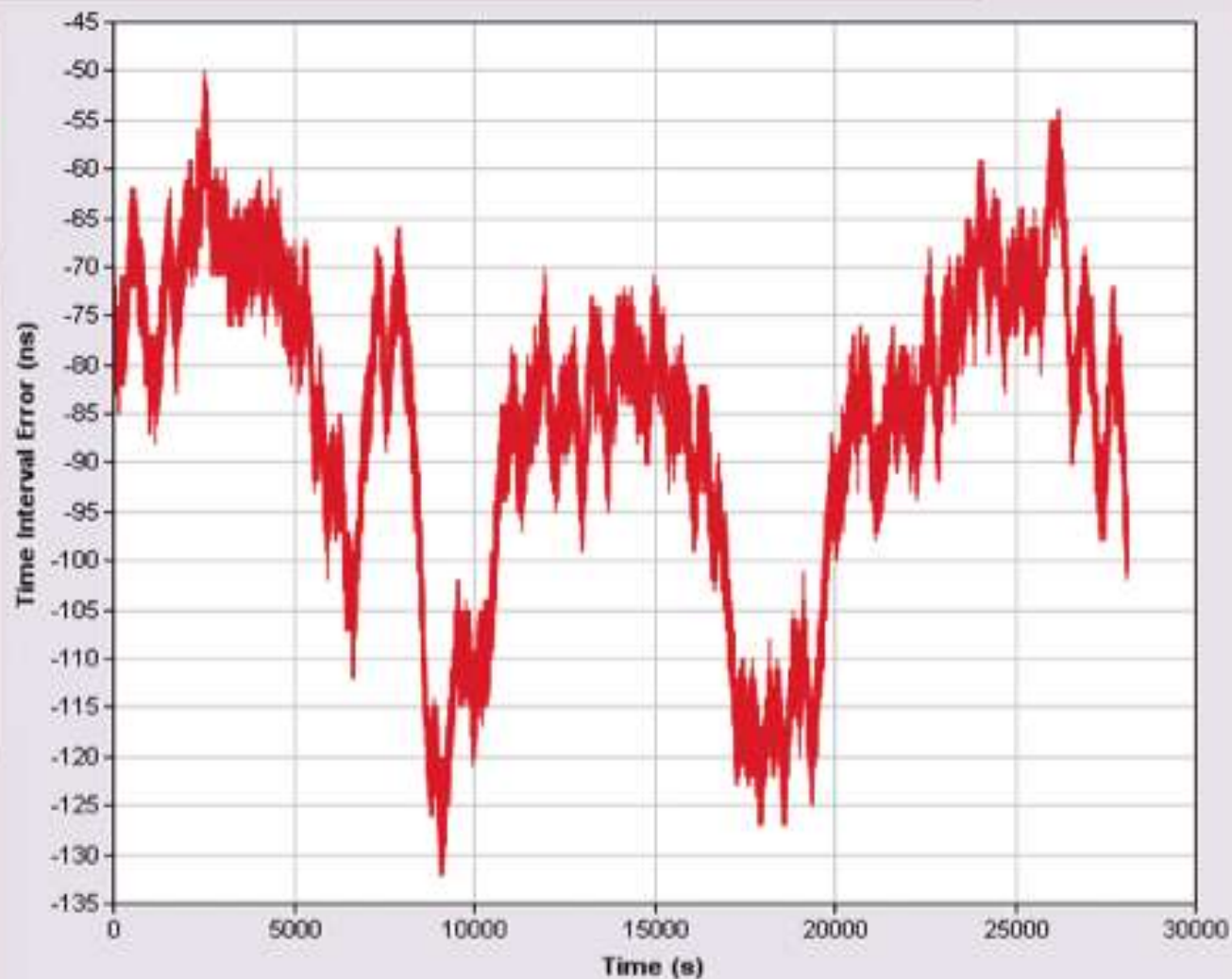
ETSI EN 300 462-3-1 PRC

ETSI EN 300 462-3-1 Network SEC

ETSI EN 300 462-3-2 Network SSU

ETSI EN 300 462-4-1 Locked SSU

ETSI EN 300 462-5-1 Locked SEC



Live Measurement

Information

Live measurement
Probe Serial: sw200090 IP Address: 172.31.90.209 Start Date: 01/11/2011 Start Time: 09:31:45 More...

Frequency

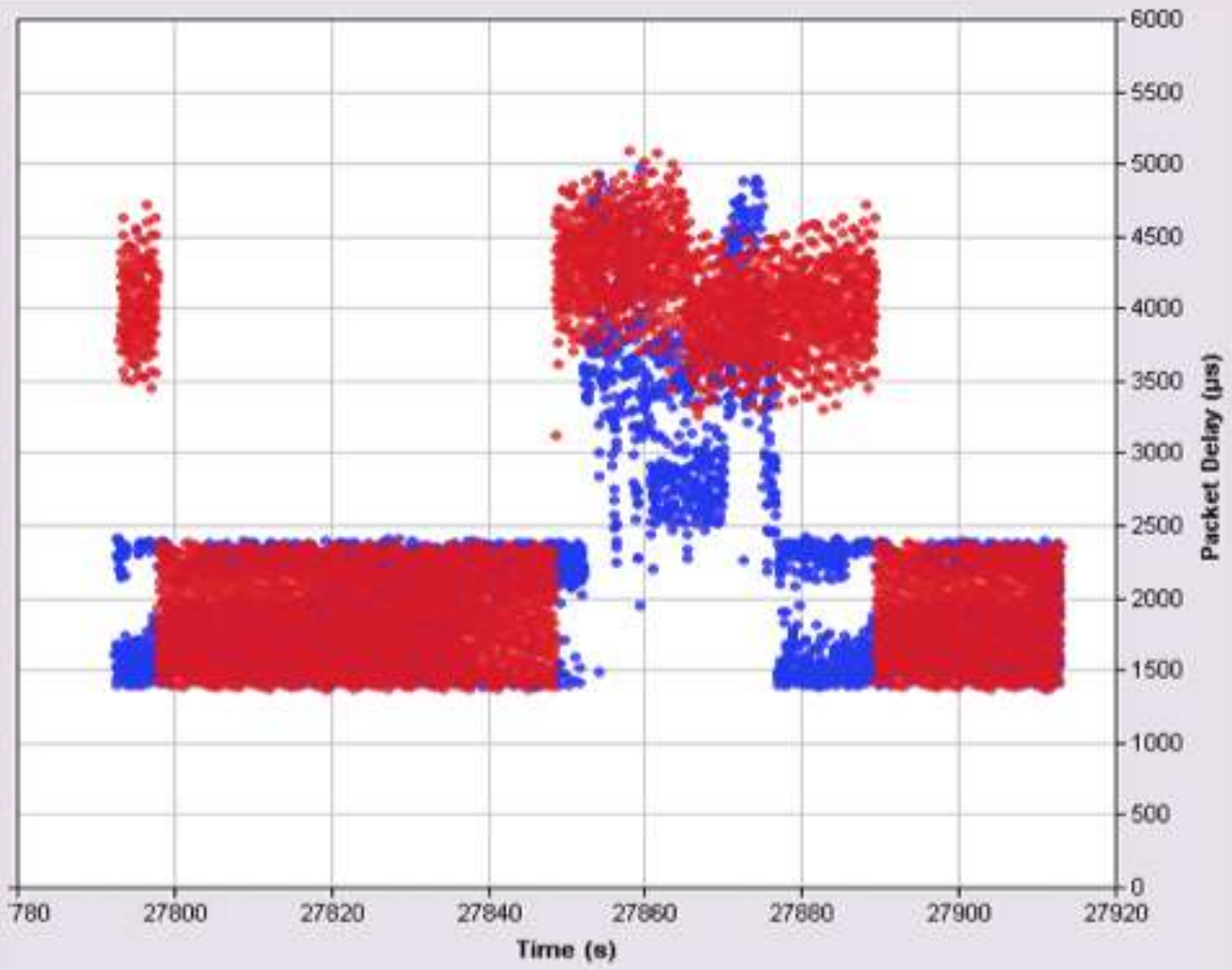
- TIE MTIE
- Input F.1PPS
- NOT CONFIGURED
- Ref: GPS 2.048MHz

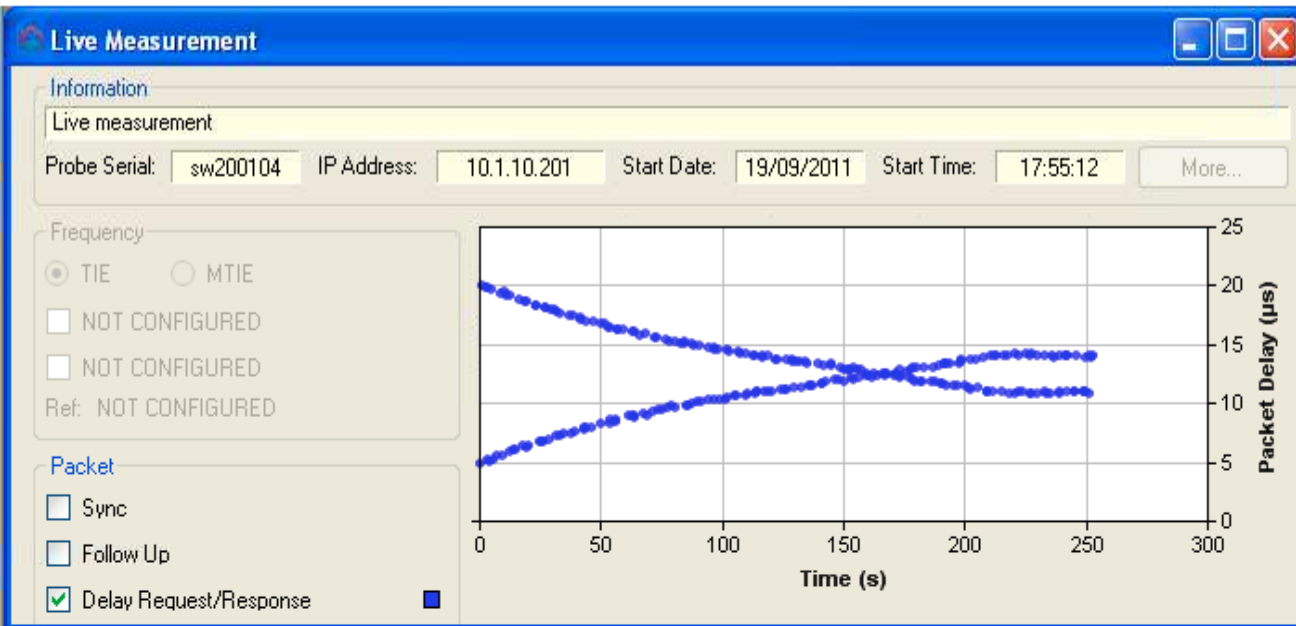
Packet

- Sync ■
- Follow Up
- Delay Request/Response ■

Masks

- ETSI EN 300 462-3-1 PRC
- ETSI EN 300 462-3-1 Network SEC
- ETSI EN 300 462-3-2 Network SSU
- ETSI EN 300 462-4-1 Locked SSU
- ETSI EN 300 462-5-1 Locked SEC

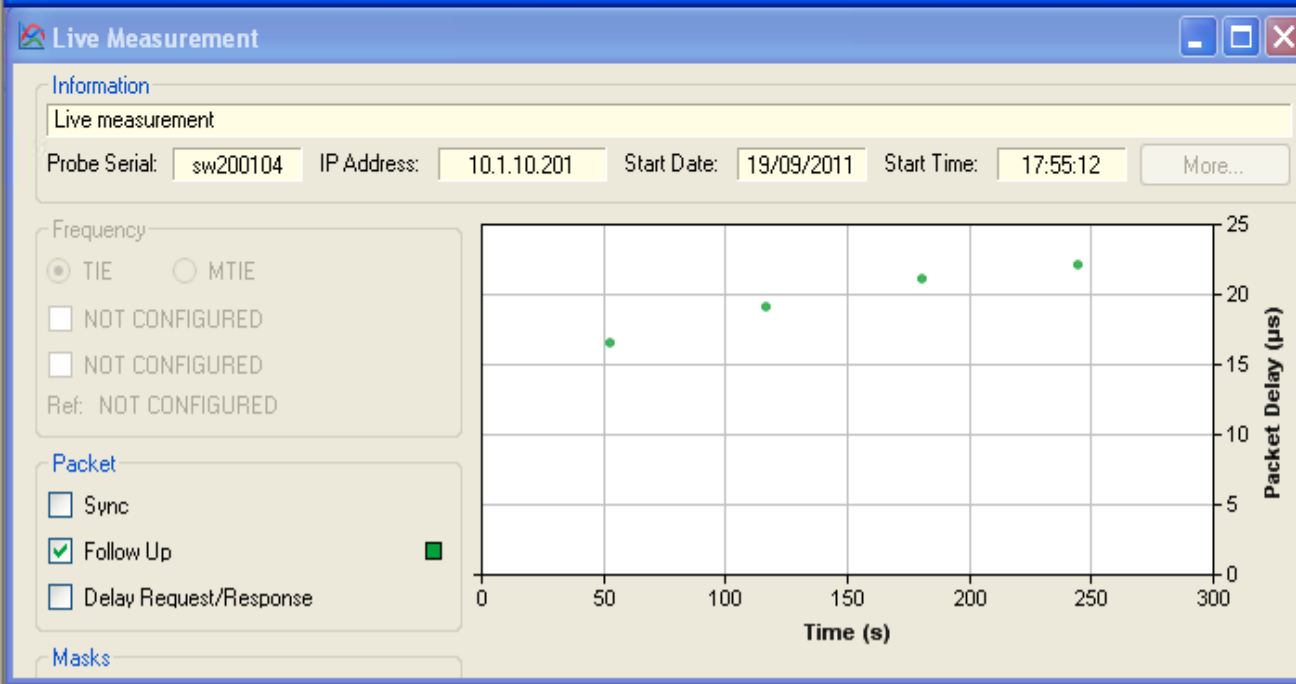




Packet Stats

Sync Follow Up **Request/Response** Announce

	Unicast	Multicast
Total Packets:	-	256
Out of Sequence:	-	127
Lost Packets:	-	820
Max Flight Time (µs):	-	20.057
Min Flight Time (µs):	-	4.887



Packet Stats

Sync **Follow Up** Request/Response Announce

	Unicast	Multicast
Total Packets:	-	4
Out of Sequence:	-	0
Lost Packets:	-	0
Max Flight Time (µs):	-	22.158
Min Flight Time (µs):	-	16.63

What data is available?

- When you begin to see all the data, you begin to see:
 - Correlations between Packet/Physical layer performance & events
 - Spot trends – early warnings
 - Benchmarks and real-world performance limits

“Early Warning debate”

- What are we actually delivering?
 - Freq. & phase to an application
 - The sync. service quality as delivered to the end point
 - Freq & phase are the **new** network services
- What provides early warning of service quality?
 - Monitoring of frequency and UTC alignment perf.
 - You see things “early enough” in the PHY layer domain
 - If you set the SLA’s appropriately.
 - What packet measures really indicate Frequency & UTC alignment performance?

Sync Management – Can this help?

- Synchronisation problems can be caused by sources, network impairments, configurations, or other causes
- Synchronisation problems need to be rapidly indentified and repaired to maintain service levels
- Appropriate sync. testing and monitoring systems and tools can prevent history repeating itself!



Sync Management – The scope

- Sync management can benefit from a holistic view of problems suggesting that both independent probes and network management have a legitimate role

- Sync management in the NMS/OSS in a converged network focuses on the new problems – “sync over packet”, SyncE and IEEE 1588 and addresses problems like ...
 - What is the health of sources or the sync paths?
 - What events are impacting what sync paths and what services?
 - What changed? When did it change?
 - What were the resources in the path at the time; eg. queues & QoS

What might the high level solution look like?



■ Network Management Systems

- Sync tree 'service' & 'paths' relate network events and status to the sync infrastructure
- Sync tree health within the network; e.g. hop-by-hop failures, changes, oam probes...
- Sync alarms from network events; e.g. sync counter violations, path faults, service connectivity...
- Sync tree topology visualization, trouble shooting & auditing

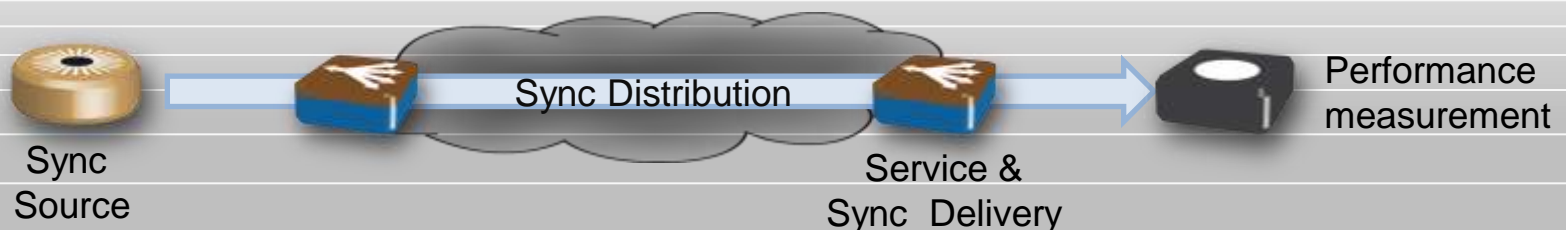
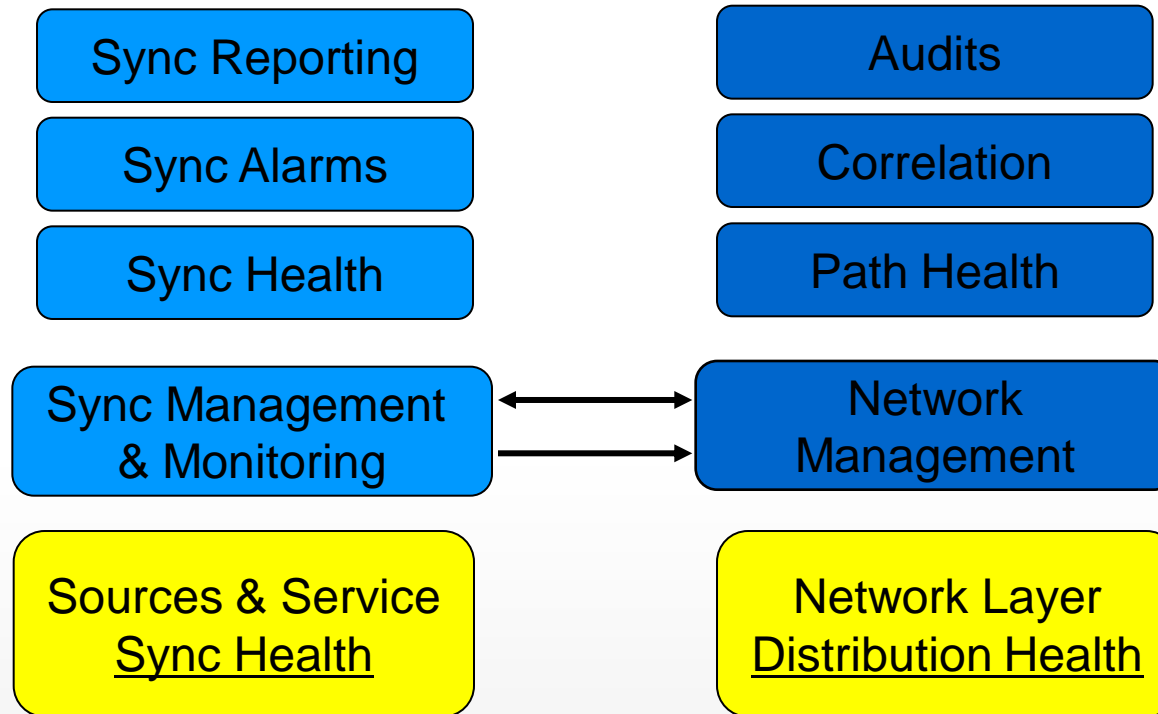
■ Sync Management and Independent Performance Monitoring

- Sync dynamics like wander, lost packets, mis-ordered packets etc.
- Service performance – in spec. or out of spec. / trends up or down
- Sync events, alarms and reporting

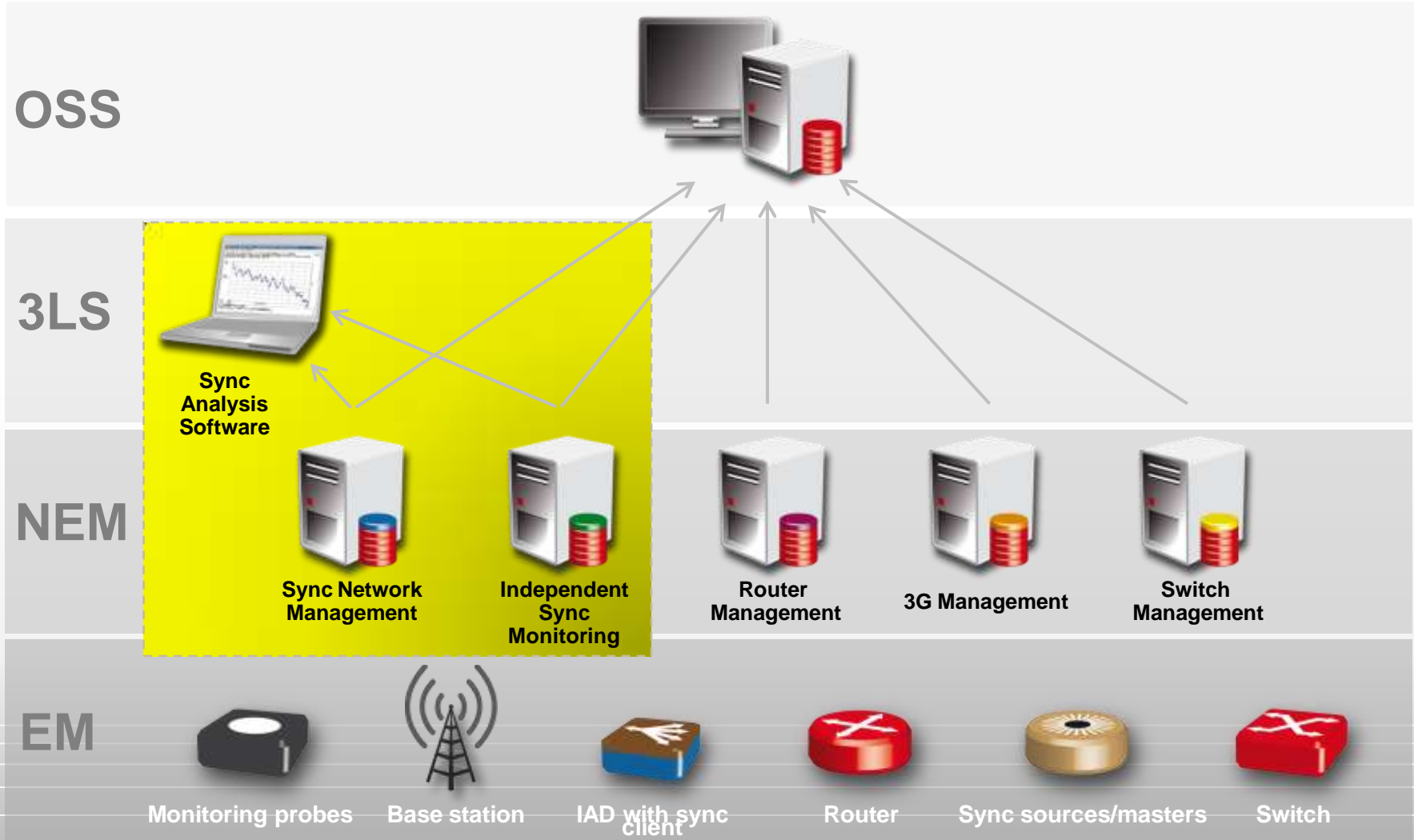
What might the high level solution look like?

- Fully Integrated Network & Sync Management/Sync Monitoring
 - Probes / Sources are represented (provisioned) on “sync service” within the NMS vendor platform
 - Probes can be auto-discovered via LLDP/SNMP – topology built – measurement capability/ports learned
 - Sync performance & alarms propagate to NMS and are correlated to the sync service
 - NMS <> Sync Mgmt/Monitoring GUI & Db integration (GUI cross-launching and Db import/export)

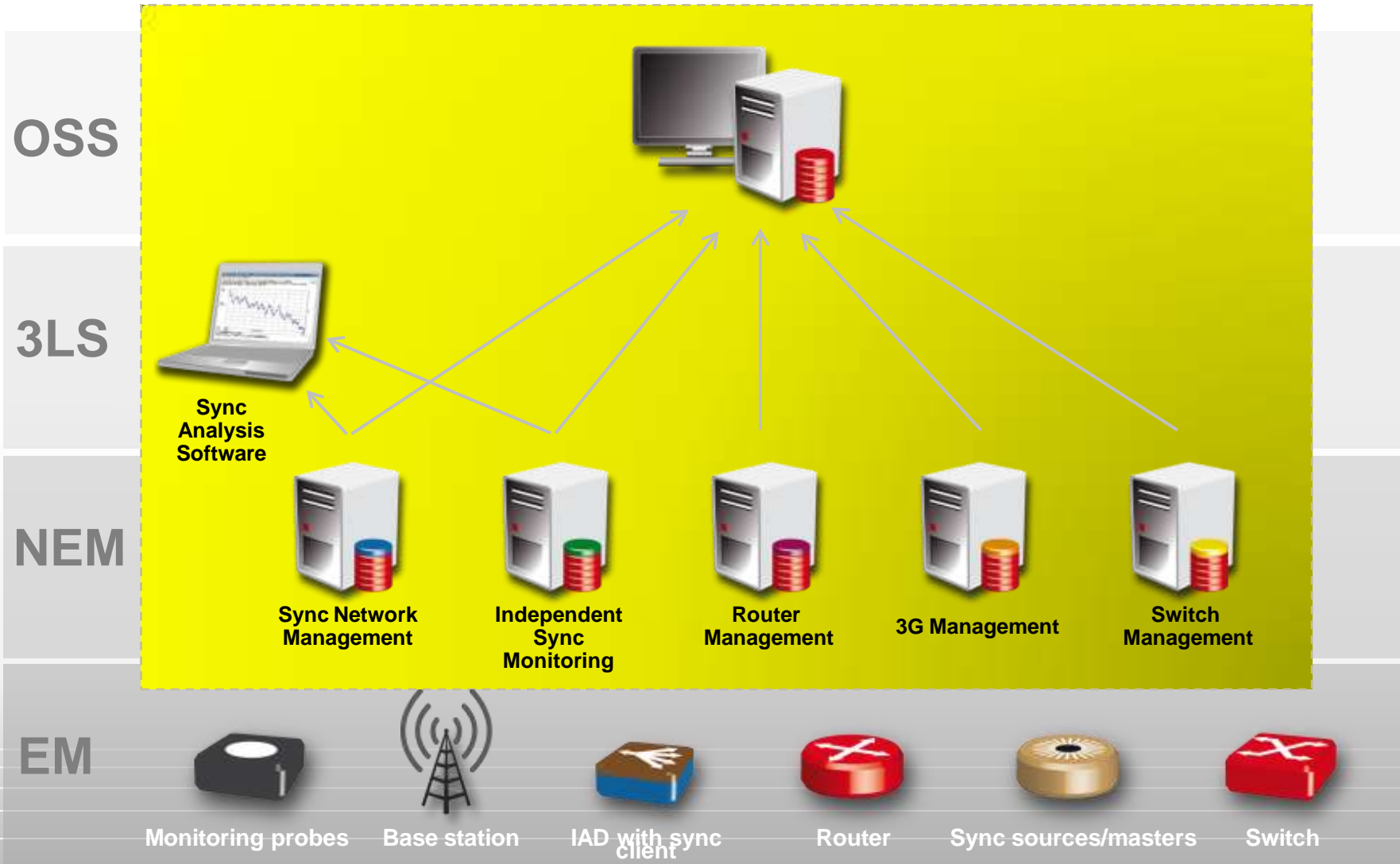
Sync health & distribution health



The building blocks of the solution - Past



The building blocks of the solution - Future



What should the solution deliver?

- Sync management is assurance focused upon managing sync. in multiple layers of the network along with pro-active notification and troubleshooting
- Managing the Synchronisation Distribution Tree
 - End-to-End topology visualization to validate maximum spans, redundancy, loop avoidance, etc.
 - End-to-End status visualization (free running, selected source, etc)
 - End-to-End sync 'service' integrates sync sources/ measurement probes in the NMS topology
- Managing Synchronisation faults pro-actively
 - Monitoring the current distribution; e.g. probe detected events or network layer impairments
 - Correlation of faults to the sync 'service' and impacted circuits
 - Analysis of configurations and resources to avoid or understand faults
- Managing Synchronisation efficiently within operations
 - React quickly to events because of early detection of problems
 - Repair problems quickly though integrated correlation, topology maps and trouble shooting

Testing and monitoring throughout the life of the network



Packet network “project”

“Technology Selection”

“Network Characterisation”

“Benchmarking”

Proving it works in practice

“Field Evaluation”

“Construction”

“Service Turn-up & Burn In”

Early adoption & roll out

Monitoring & Management

“Construction”

Service Monitoring

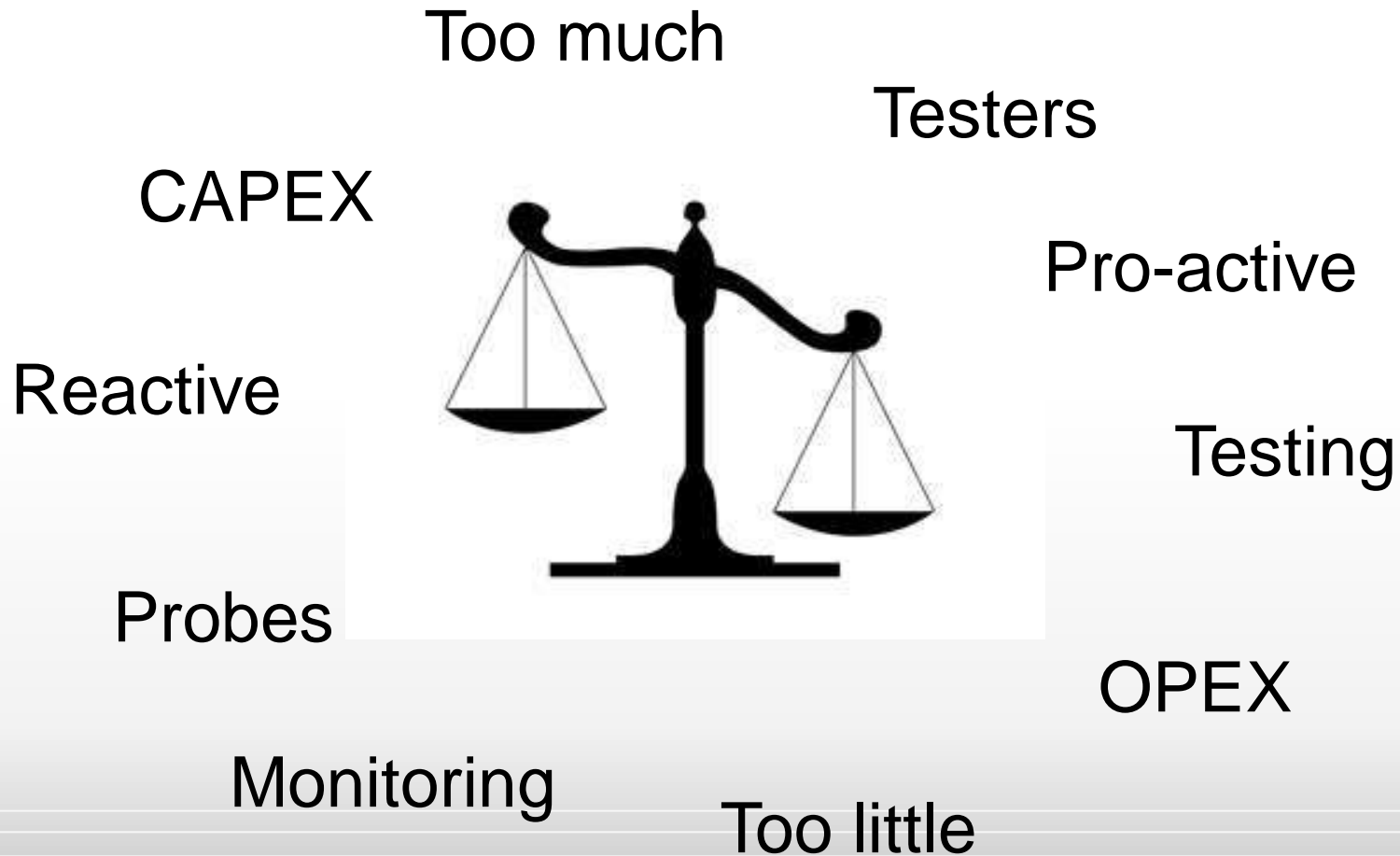
Business as usual

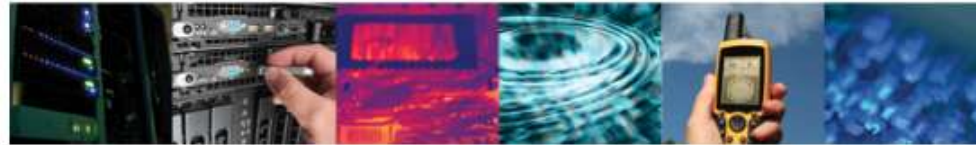
Diagnosis & Troubleshooting

Maintenance

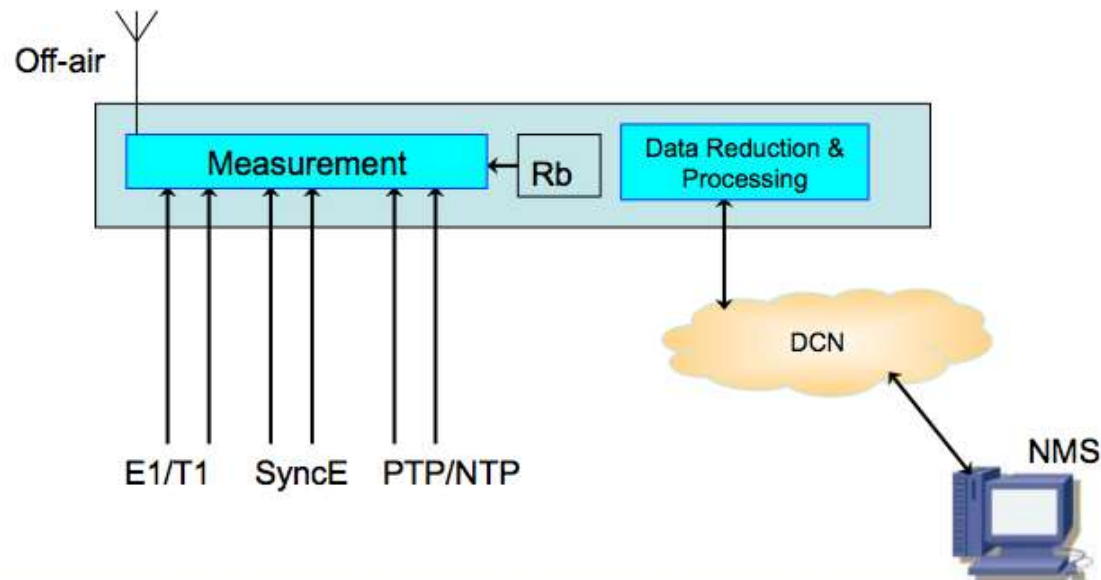
Service Troubleshooting

It's all about getting the balance right





Global Probe for SLA measurement



- *“Measurement nodes either integrated into NEs (e.g. SSU, routers/switches with PDV monitoring) or standalone probes.”*

Conclusions

- Monitoring hits the mainstream
- The “Sync Monitoring Appliance” – built on open standards & protocols can be integrated into existing sync distribution architecture & NMS/OSS
- Complete network monitoring needs to be in **both** Physical & Packet layers
- Sync. performance strategy needs to cover both long-term monitoring & short-term testing
- Different tools for different teams/functions

Get the balance right!

Thank you for listening



Any questions?



Chronos Technology Ltd

With thanks to:
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Greg Soprovich

