Synchronized Network Analytics and Real-Time Performance Optimization - II

Synchronized Network Analytics as a:

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Scanning Electron Microscope

for your network:

identify latency, jitter, loss and other hard-to-find problems and enable new, high margin revenue services

Features

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Network Performance Analytics:

- Synchronization of Observation Points to ~10μs
- End-to-end, hop-by-hop metrics
- Fine-grain resolution of observation windows
  - 100ms, 10ms and 1ms
- Real-time visualization/alerts (<5 seconds)
- Database with Rest API for historical analysis
- Software based, runs on industry standard HW
  - Embedded in network nodes
    Alongside nodes in legacy networks

Use Case: Mobile Backhaul Latency Monitoring

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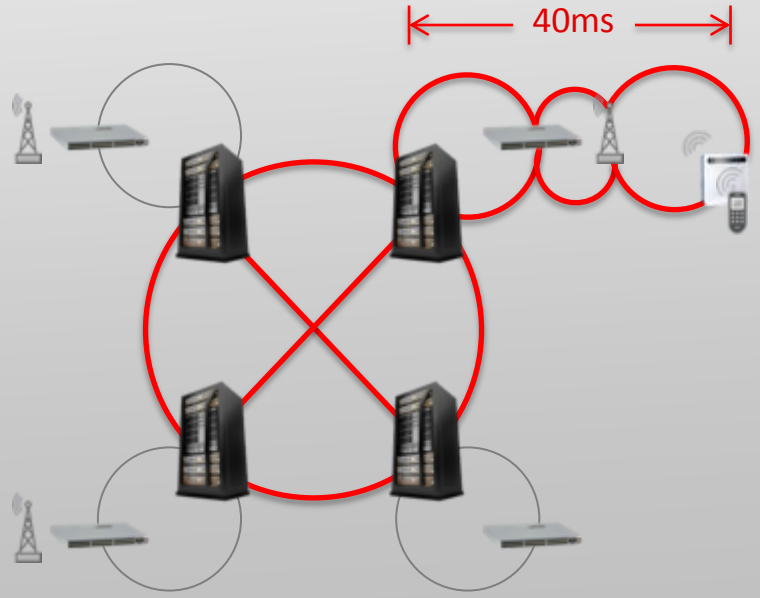
- 30-50 Evolved Packet Cores
- End-to-end visibility
- 40ms latency requirement
- 700ms actual round trip latency

$150K

Per **Each** Major Incident



Use Case: MSO System-Wide Monitoring

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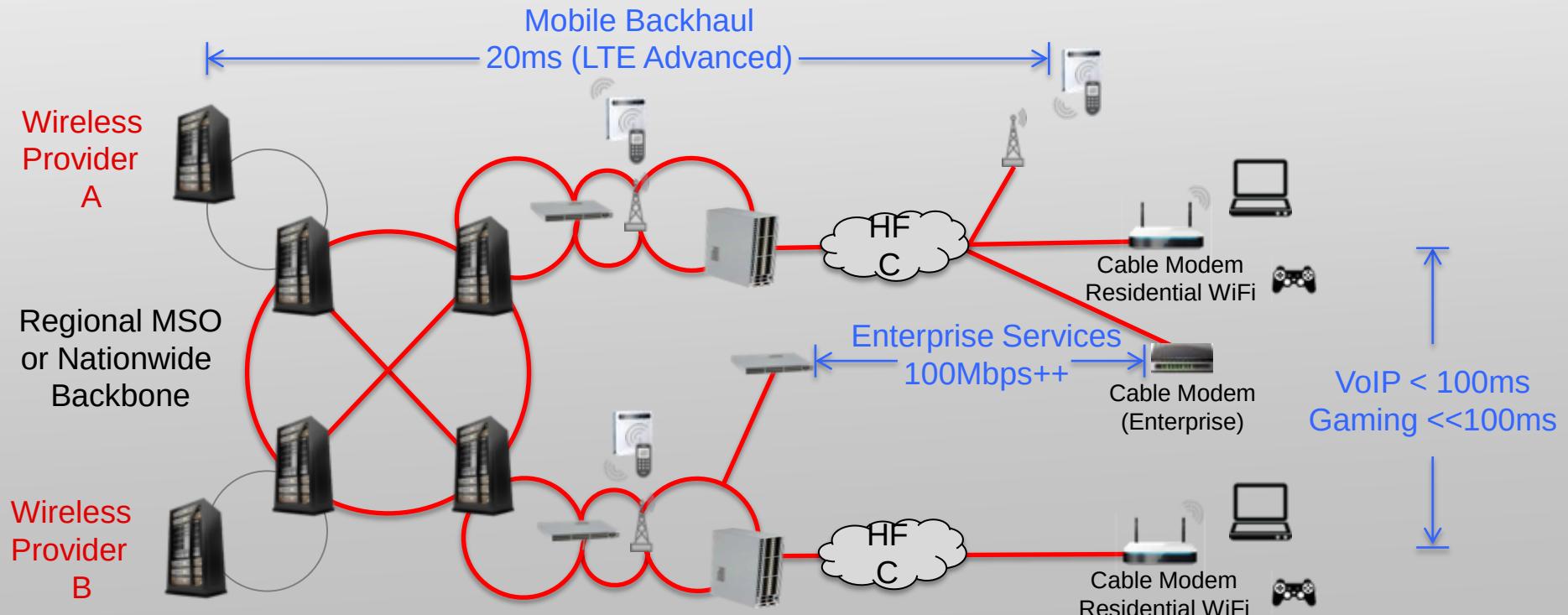
- System-wide visibility
- MSO must deliver E2E experience with disparate QoS/SLAs
  - Continuously optimized, in real-time, using real-time feedback



How?

1. Capture, fingerprint, timestamp packets, and create metadata
2. Calculate and store granular flow statistics (100ms, 10ms, 1ms)
3. Visualize detailed performance metrics (<5 sec)
4. Provide API to 3rd party applications
5. 4 patents submitted

3rd Party Analytics Applications

REST API

Analytics Database

OP

UE/CPE

OP

Basestation

OP

Router

OP

Gateway

AIR ACCESS CORE

OP **Observation Point**

Analytics – Real-time, Drill-Down and Post

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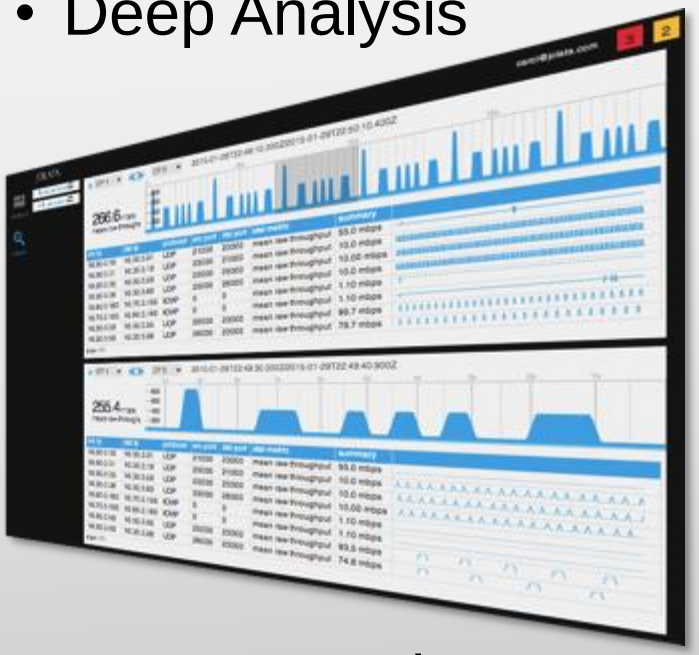
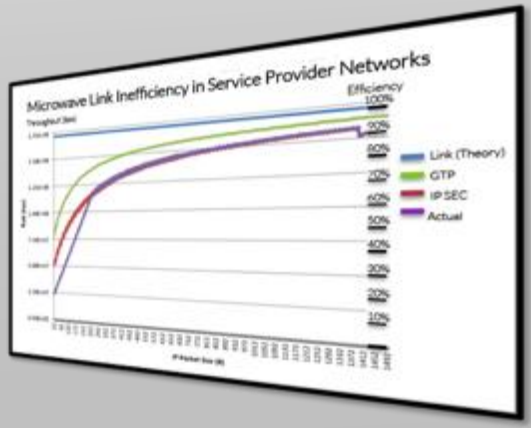
- Real-time Dashboard

- Deep Analysis



- Post Processing



No Latency Alerts When “Averaged”

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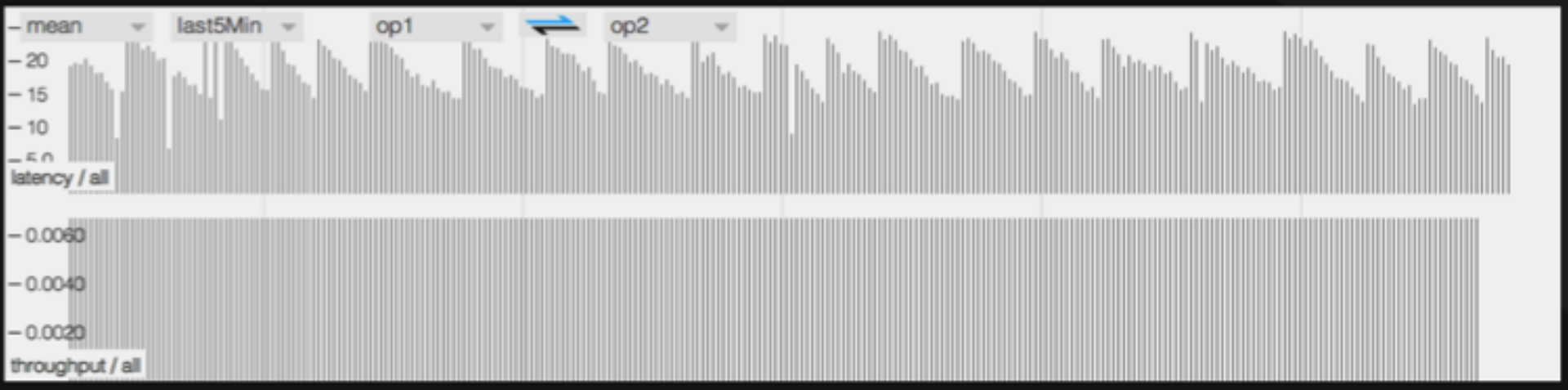

LTE Goal: <40ms roundtrip latency

Reality

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Identify the location and root cause of problem!

VoLTE Quality – Mean Opinion Score (MOS)

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Telecom Service providers care about Subscribers' quality of experience (QoE)

- Mean Opinion Score (MOS)
  - User's View of the quality of call quality on a 1-5 scale
    - MOS >4 is generally toll-quality;
    - MOS <3.5 is unacceptable to most users => "Churn" = ($$$$$$)
  - Originally subjective, now objectively computed
    - Perceptual Objective Listening Quality Assessment (POLQA/P.863), since 2011
      - Full-reference algorithm, license fees
  - MOS is impacted by a number of variables/parameters
    - Codec, handset, latency, jitter, packet loss, bit error, error correction, concealment…
    - If network impairments (latency, jitter, loss, error) are quantifiable, then
      - MOS degradation due to network impairments can be estimated.

Mean opinion score (MOS)		
MOS	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible, Not Annoying
3	Fair	Slightly Annoying
2	Poor	Annoying
1	Bad	Very Annoying

Codec	Data Rate (kbps)	MOS
AMR	12.2	4.14
G.711 (ISDN)	64.0	4.10
G.729	8.0	3.92
G.726 ADPCM	32.0	3.85
GSM EFR	12.2	3.80
G.729a	8.0	3.70

Measurement of Network QoS

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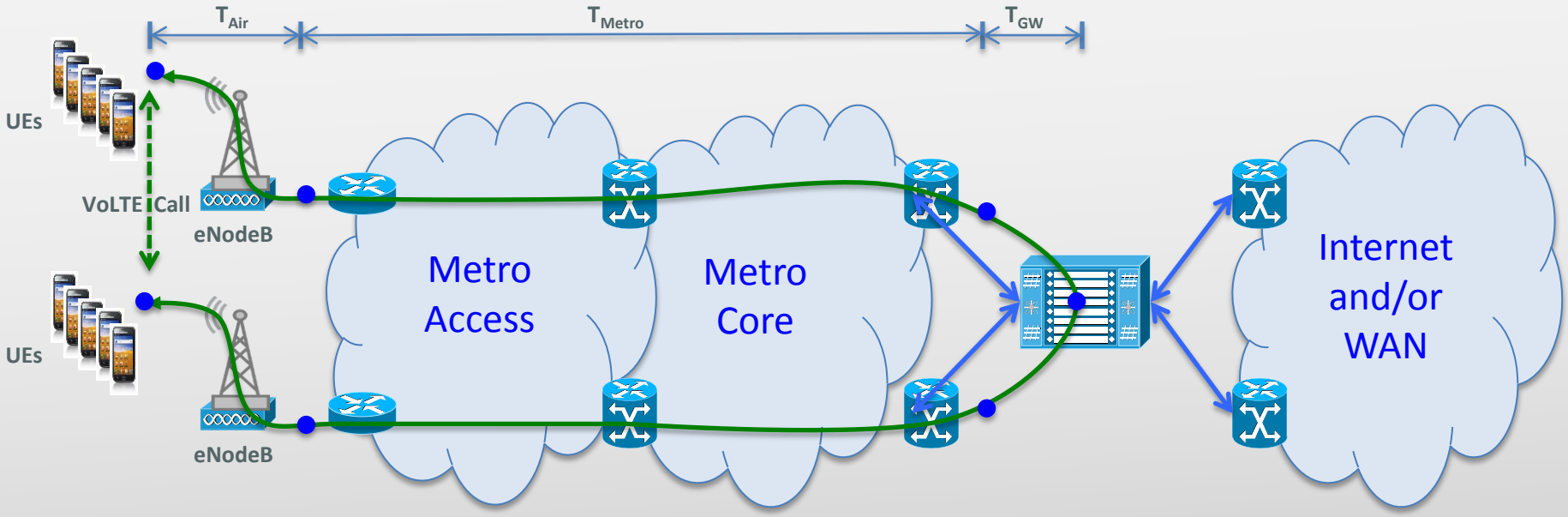

- Monitoring at Select Observation Points:
  - End-to-End and Segment by Segment Metrics based on *per packet* measurements:
    - Latency, Jitter, Loss, Error
    - Packet Rate, Throughputs, Fragmentation, etc
  - Association of individual packet point metrics to create *flow* metrics across *segments*
    - Flows based on associating (matching) packet "n-tuple" (important fields in the packet):
  - Use of flow metrics to estimate and *pinpoint* MOS degradation
    - Attribution to root cause, e.g., network congestion, processing limitations, etc.

Measurement of Emulated Network QoS

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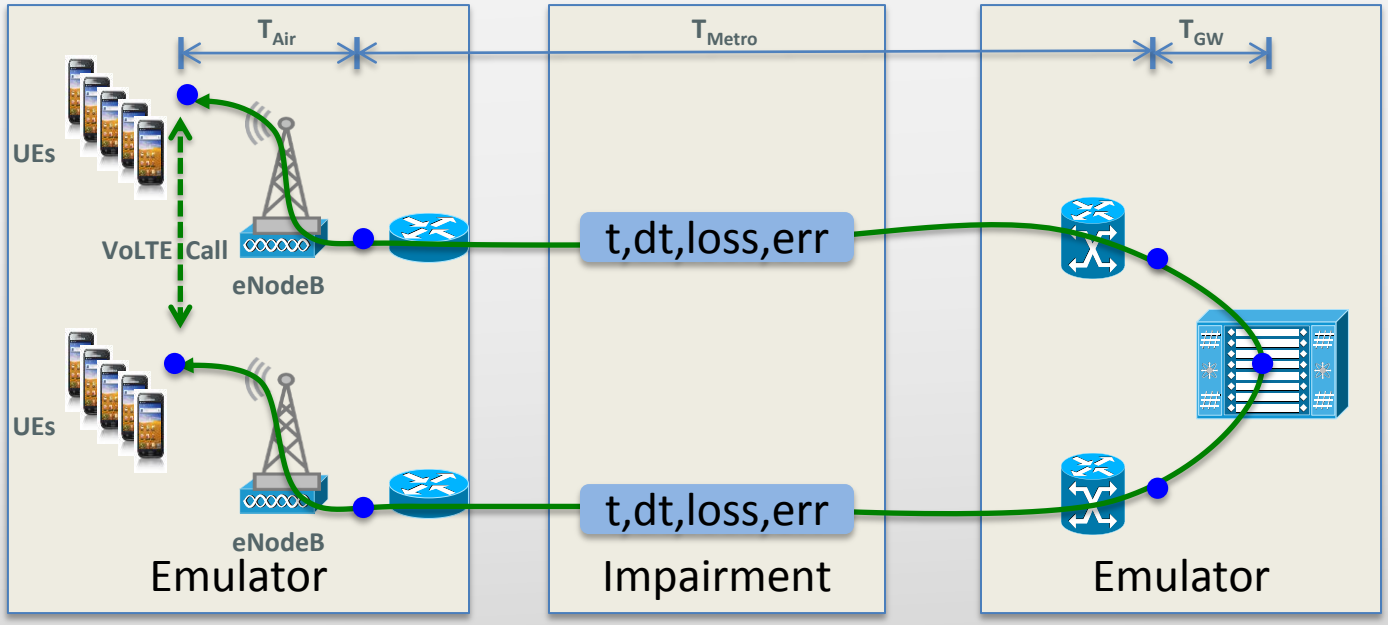
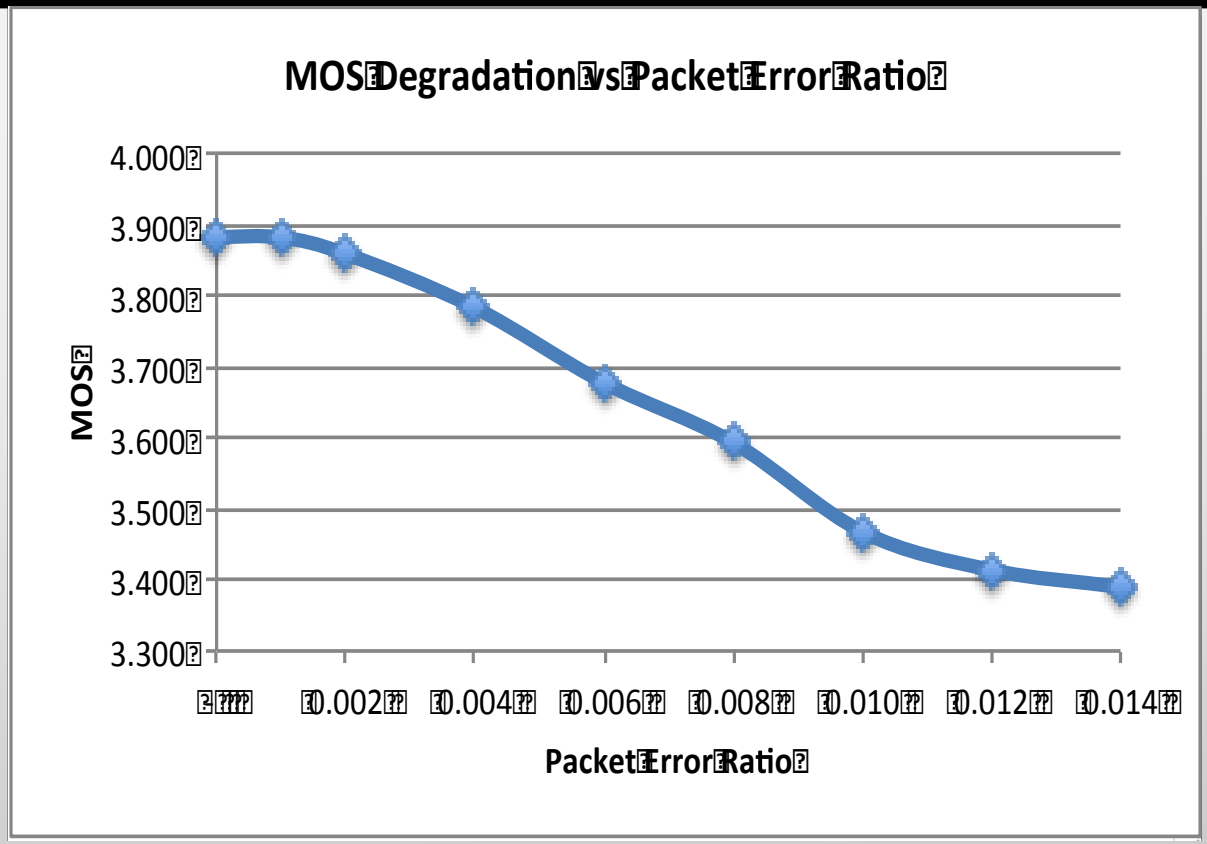


- Monitoring at Embedded or External Observation Points:
  - Larger scale than predictable in real network;
  - Controllable (error type & rates, throughput, packet rate, subscribers, etc.);
  - Evaluate QoS settings, forwarding behavior, protocols;
  - Repeatable.

Selected Post Processing Results



- MOS versus jitter, packet error ratio:
  - Repeatable, controllable impairments:
    - Latency, jitter and packet error is independently controllable in either direction, and can be tailored by Class of Service
  - Resulting in repeatable measurement of MOS Degradation

Strange, but True…

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Observation from the Telecom network:

- Most performance issues are due to packet rate (processing limited)… so…
- Uncompressed Voice may be more efficient than Compressed!
  - G.711 Uncompressed voice at 64kbps.
    - 40ms latency (per packet)
    - 104.8 kbps on the wire
    - 25 packets/second
    - 4.1 MOS
    - Open Source
    - Reduced computation - efficient use of battery

  - GSM-EFR at ”12.2kbps”…
    - 40ms latency (compute + packet)
    - 81.6kbps on the wire
      - Bandwidth savings of 22% - nowhere close to expected 81%
    - 50 packets/s => *twice* the number of packets
    - 3.9 MOS
    - Licensed
    - Significant computation – reduced battery time

Summary

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Synchronized Network Analytics:

- "Scanning Electron Microscope" for the network:
  - Identify latency, jitter, loss and other hard-to-find problems
  - Enable new, high margin revenue services
  - Wireless Service Provider and Cable and use cases
  - High resolution, precise accuracy pinpoint issues to specific areas of the network down to specific pieces of gear, or configurations
    - Improved Root Cause Analysis
  - Deployable in real, emulated and hybrid network monitoring scenarios
  - Measurement of MOS degradation for VoLTE
  - Post Processing yields many insights into the network that can be exploited for network optimization…
    - Stay tuned!