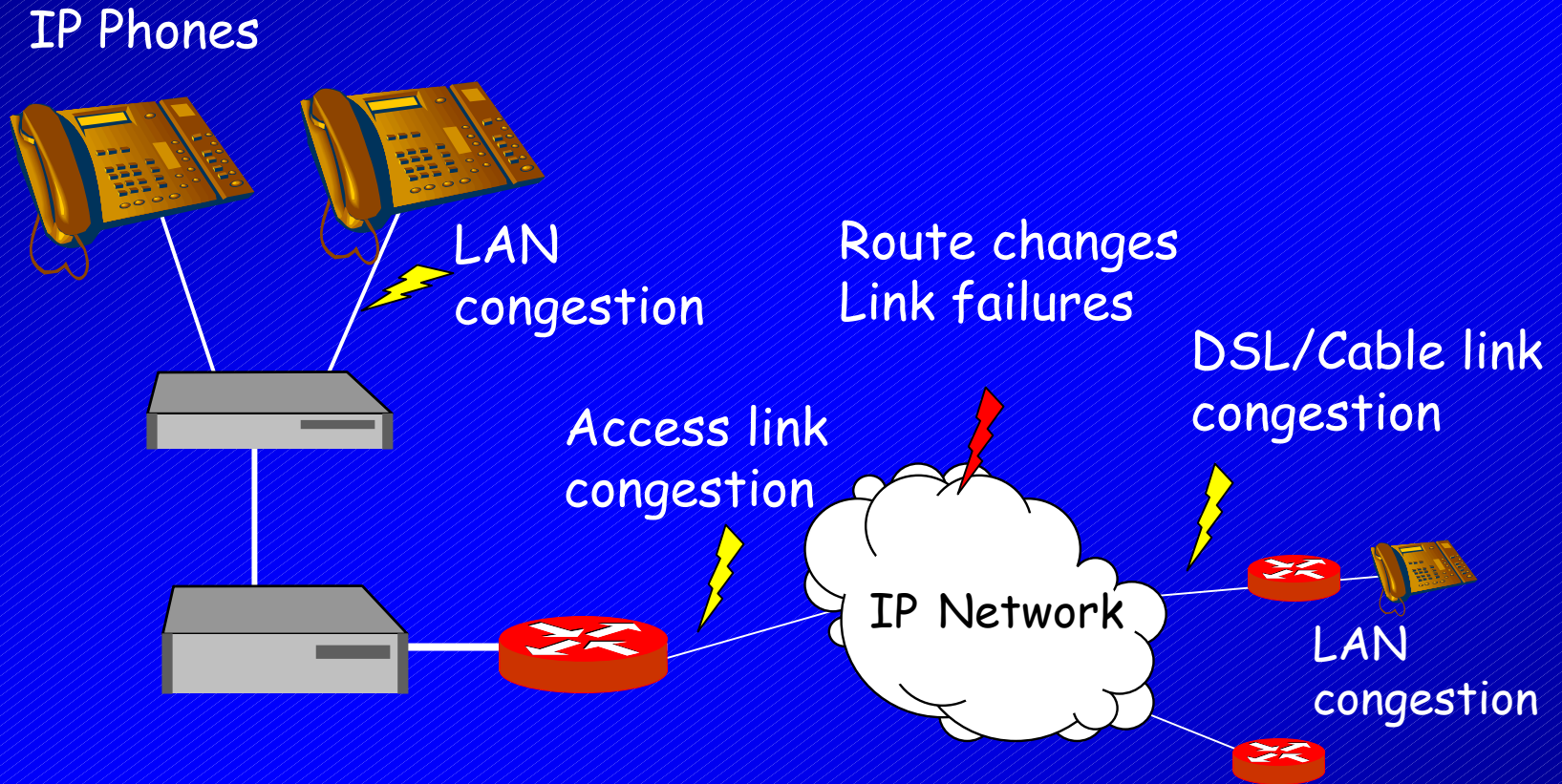# Monitoring Voice Quality

Alan Clark
alan@telchemy.com
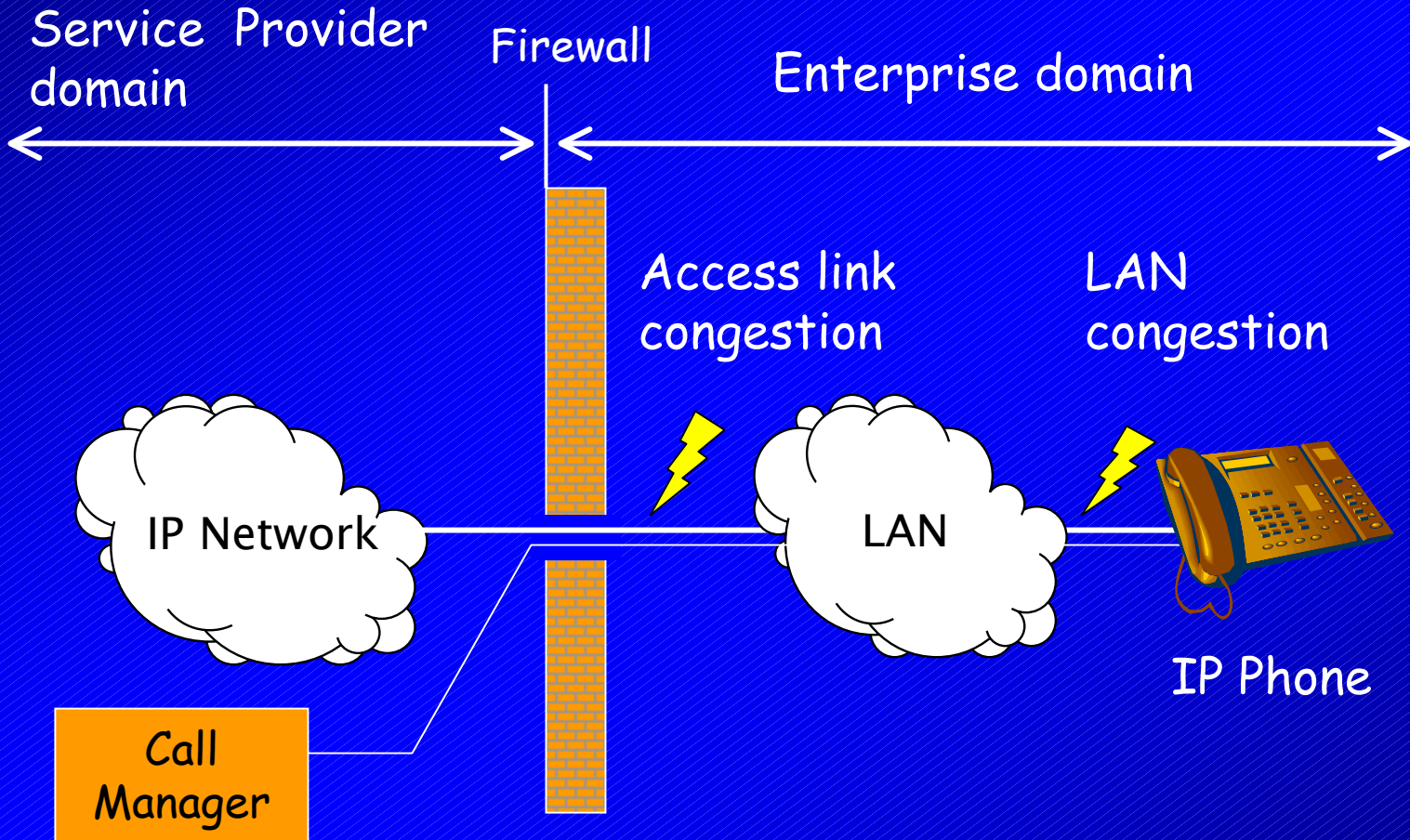
Monitoring Voice Quality

- Why measure voice quality?
- Typical problems affecting call quality
- Non-intrusive measurement of call quality
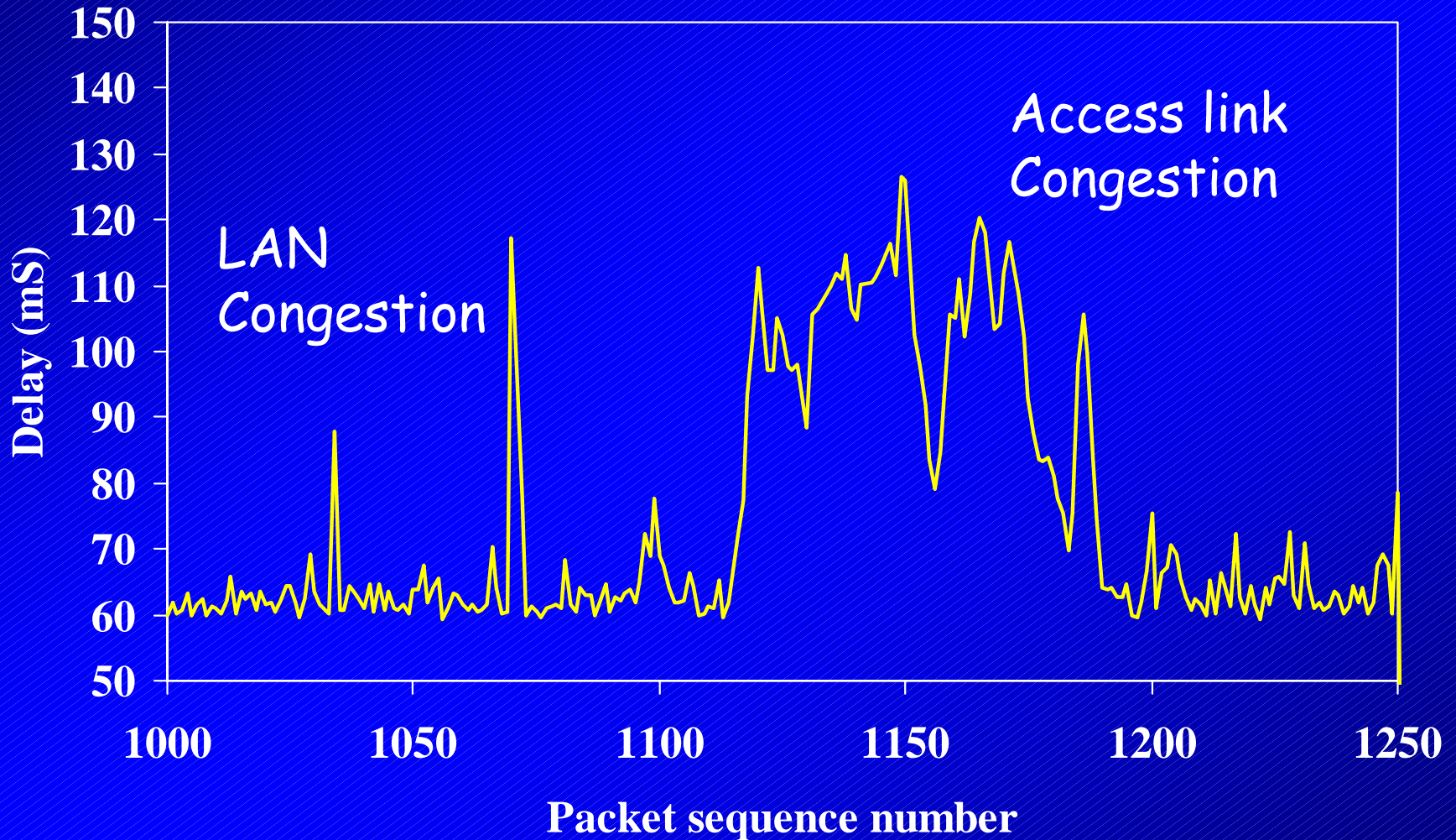- Diagnosing call quality problems
- Applications

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Enterprise VoIP

IP Phones

LAN congestion

Route changes
Link failures

DSL/Cable link congestion

Access link congestion

IP Network

LAN congestion

Transient problems

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IP Centrex

Service Provider domain

Firewall

Enterprise domain

Access link congestion

LAN congestion

IP Network

LAN

IP Phone

Call Manager

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Impact on packet stream

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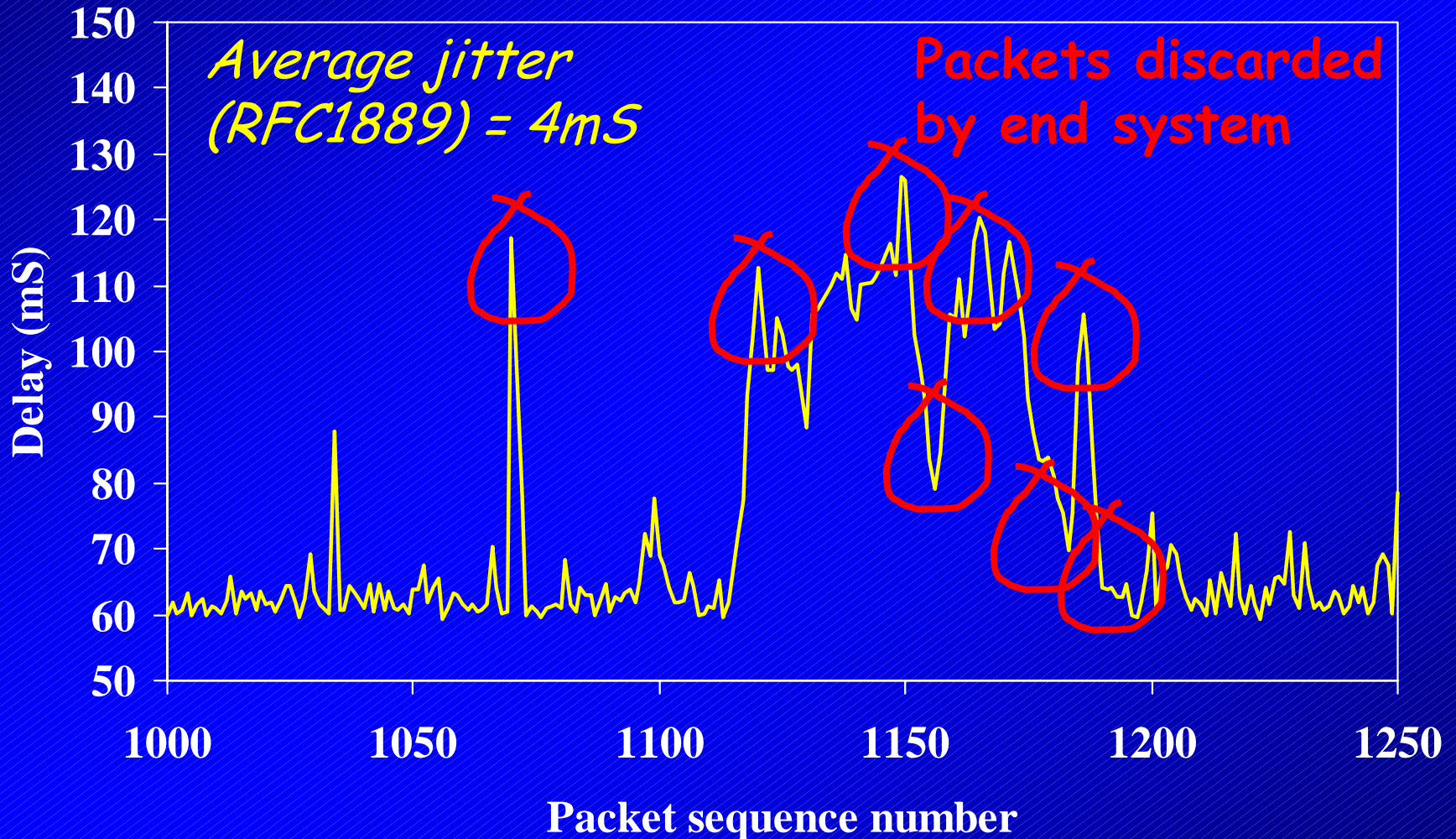
Impact on packet stream


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Key message

- Average LAN utilization may be low BUT short periods of high congestion CAN occur

- Access links are *bottlenecks*, congestion causes short term delay variations

- Packet loss/discard is BURSTY – you can have significant quality problems even with low average packet loss rates
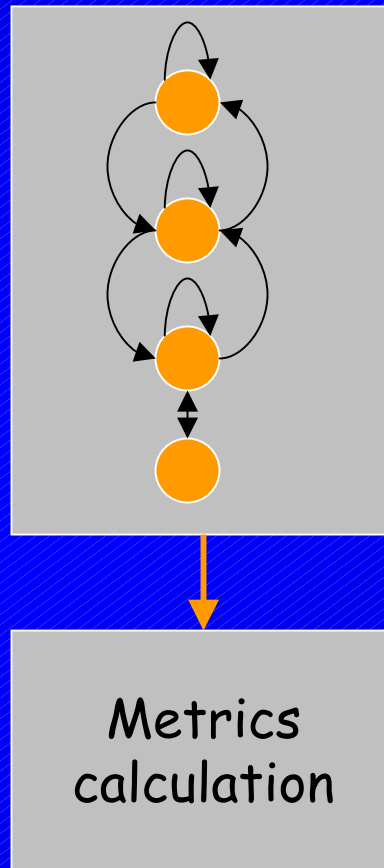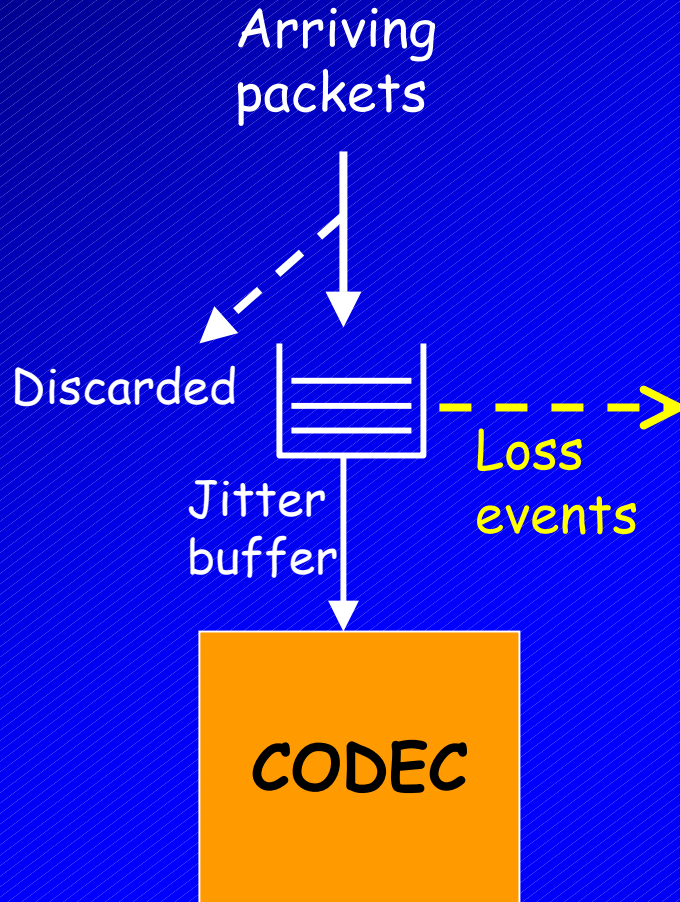
- So ….

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Effects of Burstiness

Packet Loss Concealment works well for isolated lost packets
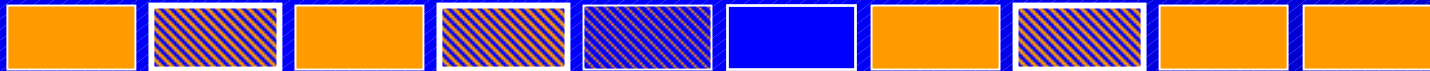
Periods of high packet loss result in audible sound Quality degradation

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Capturing time varying QoS

Arriving packets

Discarded

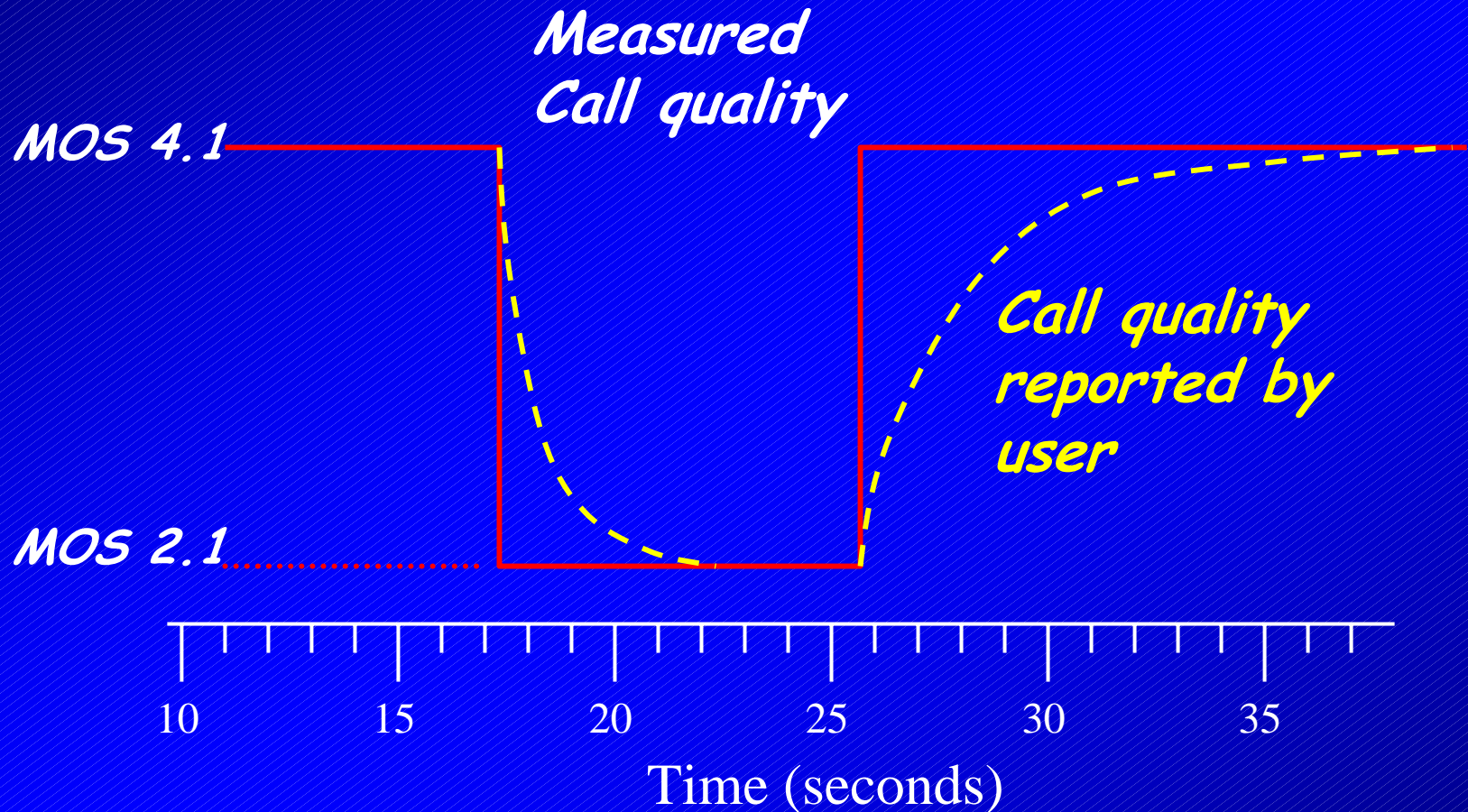Jitter buffer

Loss events

CODEC

Metrics calculation

4-state Markov Model
Gather detailed packet loss info in real time

Captures data on burstiness

Calculate call quality metrics at end of call Using extended E Model

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Measured vs Reported Quality

Measured Call quality

MOS 4.1

MOS 2.1

Call quality reported by user

Time (seconds)

10   15   20   25   30   35

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Output metrics

End Point →
- X-RTCP
- End-of call
- History/ average

Mid-Stream →
- User, Network R Factor
- MOS-LQ, MOS-CQ
- Loss, Discard, Delay,
- Burst statistics

→
- Detailed diagnostics
- Root cause analysis
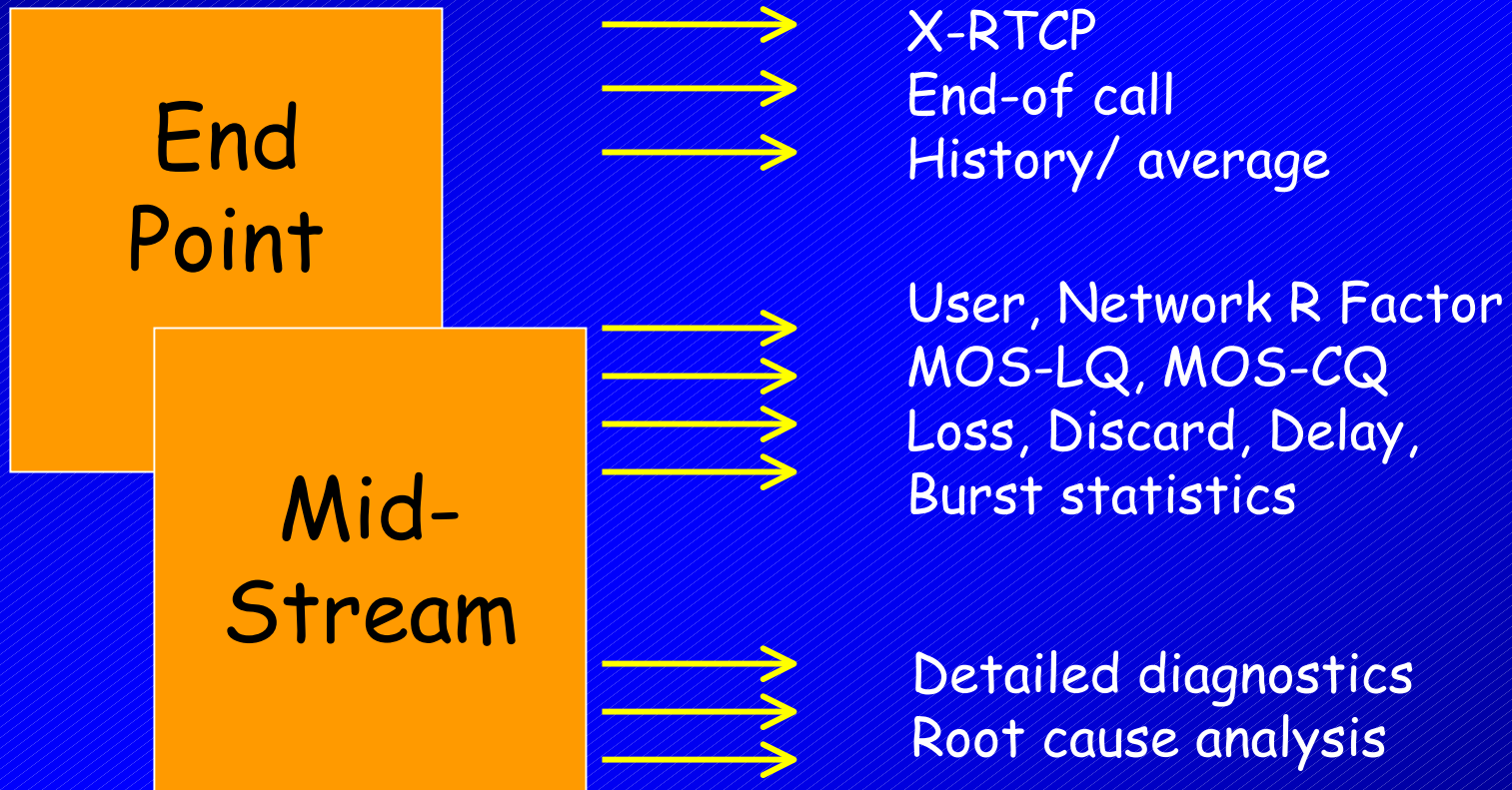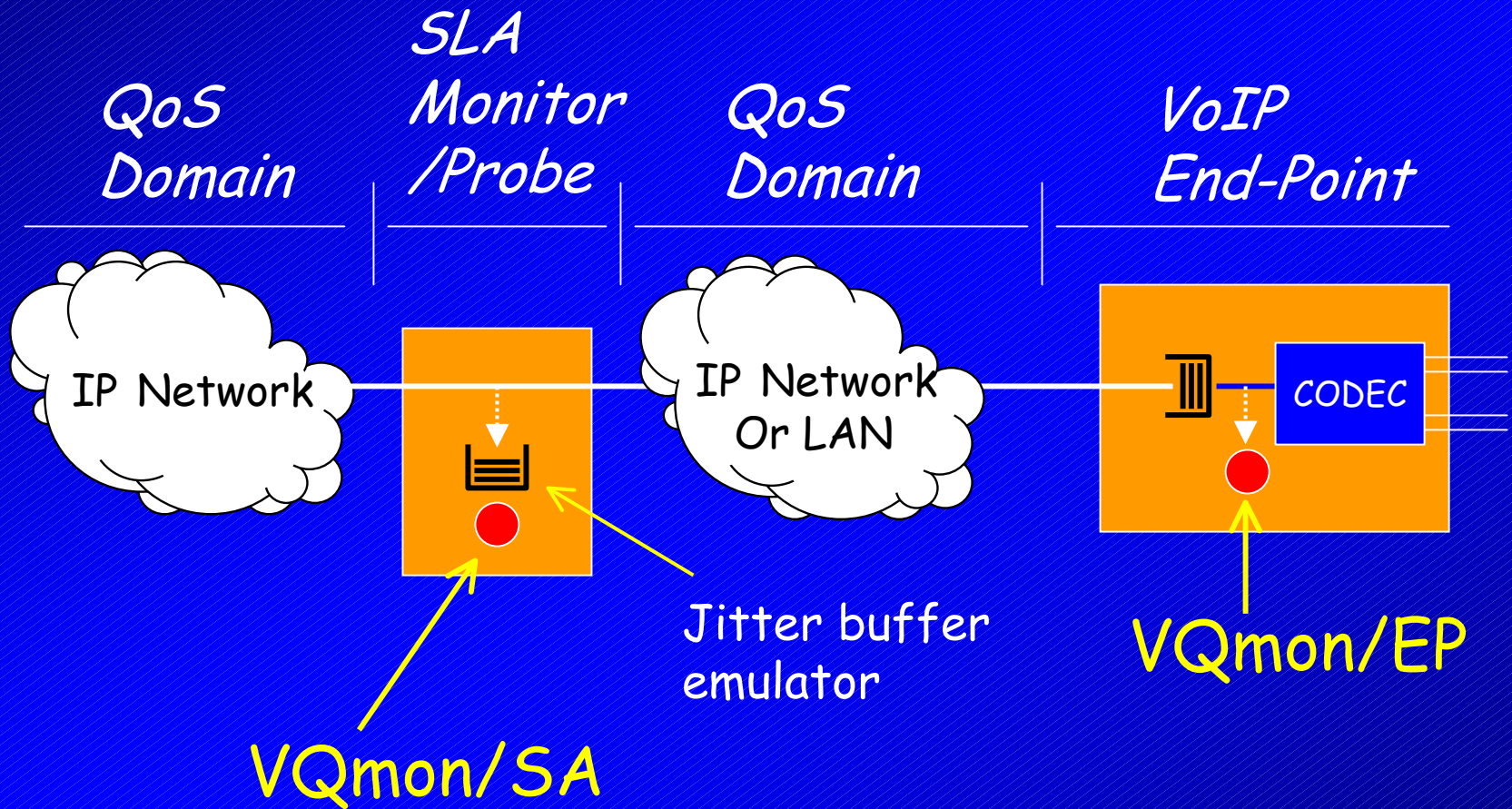
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VQmon MOS-LQ vs MOS
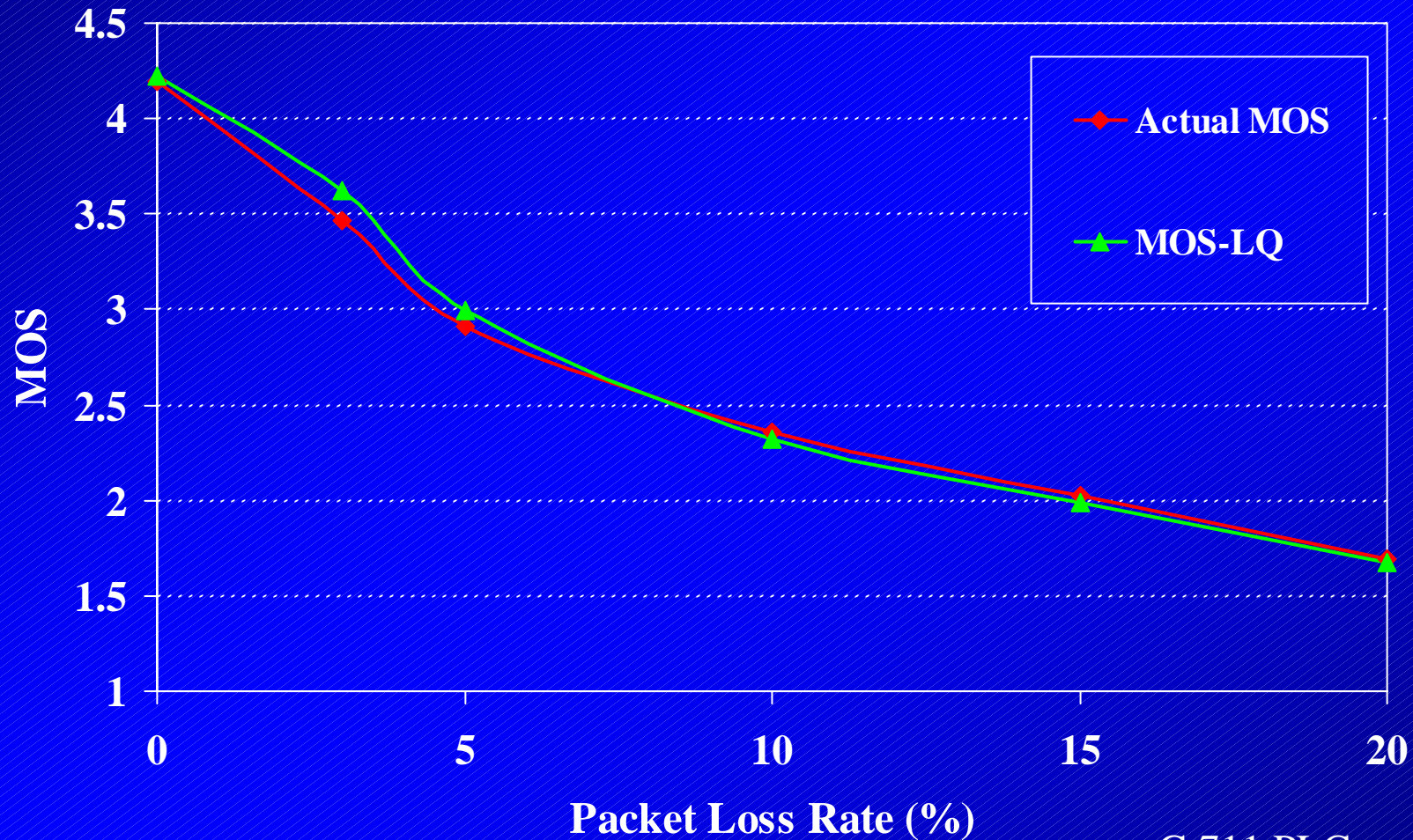
Subjective data from COMSAT

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G.711 PLC

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Where to measure?

QoS
Domain

SLA
Monitor
/Probe

QoS
Domain

VoIP
End-Point

IP Network

IP Network
Or LAN

CODEC

Jitter buffer
emulator

VQmon/SA

VQmon/EP

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Reporting via RTCP

IP Phone
Or
Gateway

Embedded
Agent

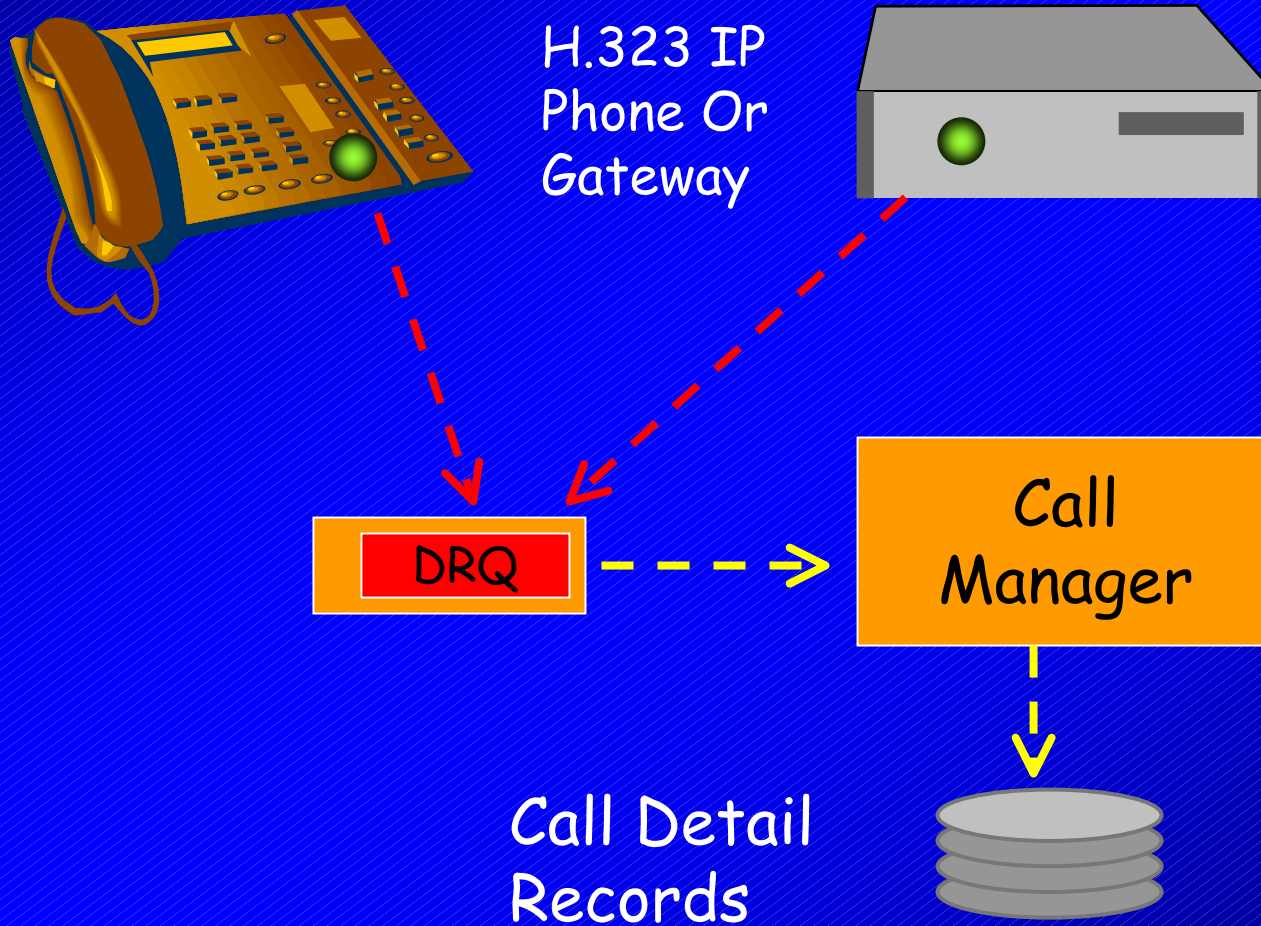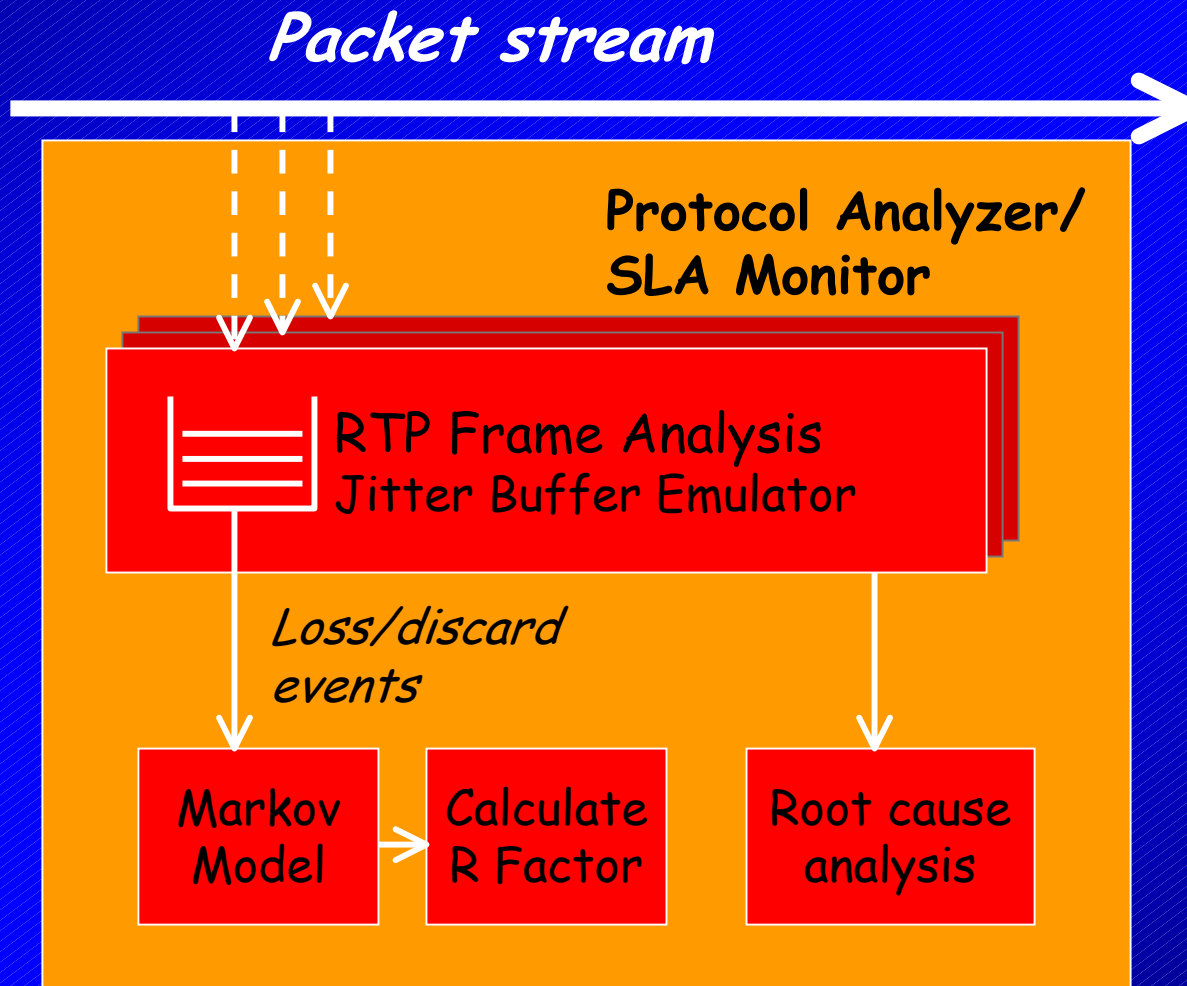| RTP | X-RTCP | RTP | RTP stream → | RTP |
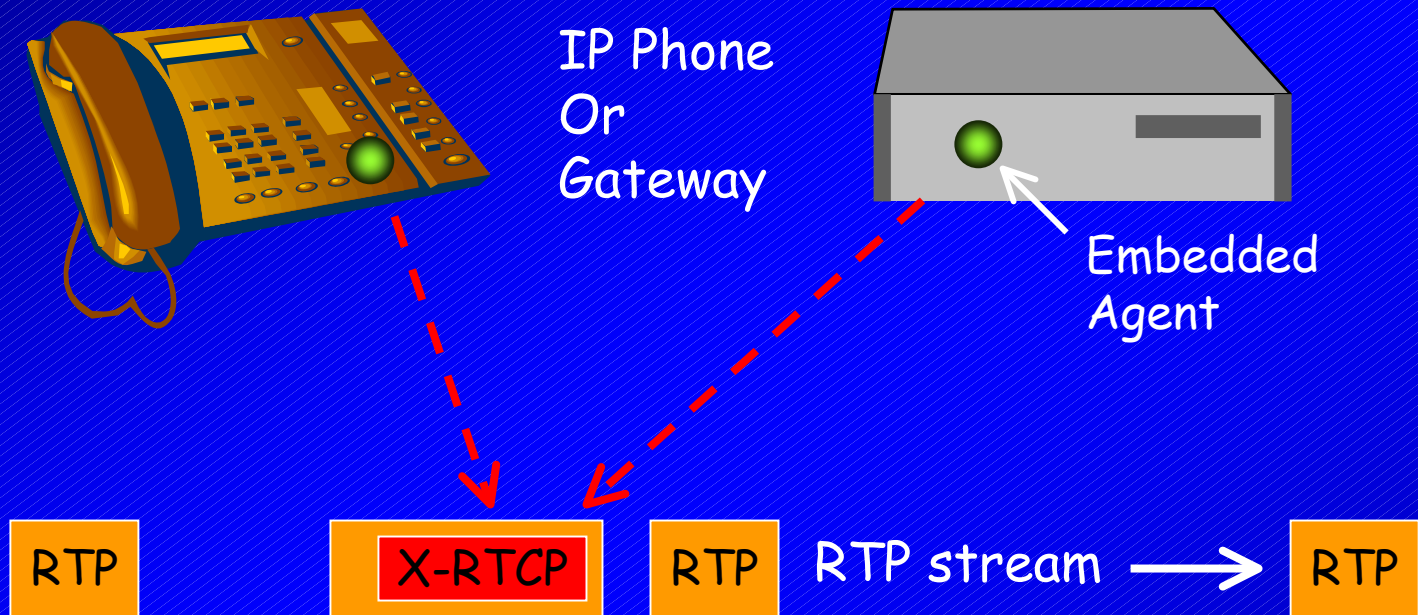
Extended RTCP – loss, discards, burst metrics, delay, signal levels, doubletalk, jitter buffer settings, call quality metrics

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End of Call Reporting

H.323 IP Phone Or Gateway

DRQ

Call Manager

Call Detail Records

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Mid-stream monitoring

Packet stream

→

**Protocol Analyzer/
SLA Monitor**

RTP Frame Analysis
Jitter Buffer Emulator

*Loss/discard
events*

Markov Model	→	Calculate R Factor

Root cause
analysis

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Enterprise VoIP solution

IP Phones/
Gateways

Embedded
Monitor

Probe/
Analyzer

IP Network

IP Phone
Small Office/
Residential
Gateway

Switch

SLA monitor

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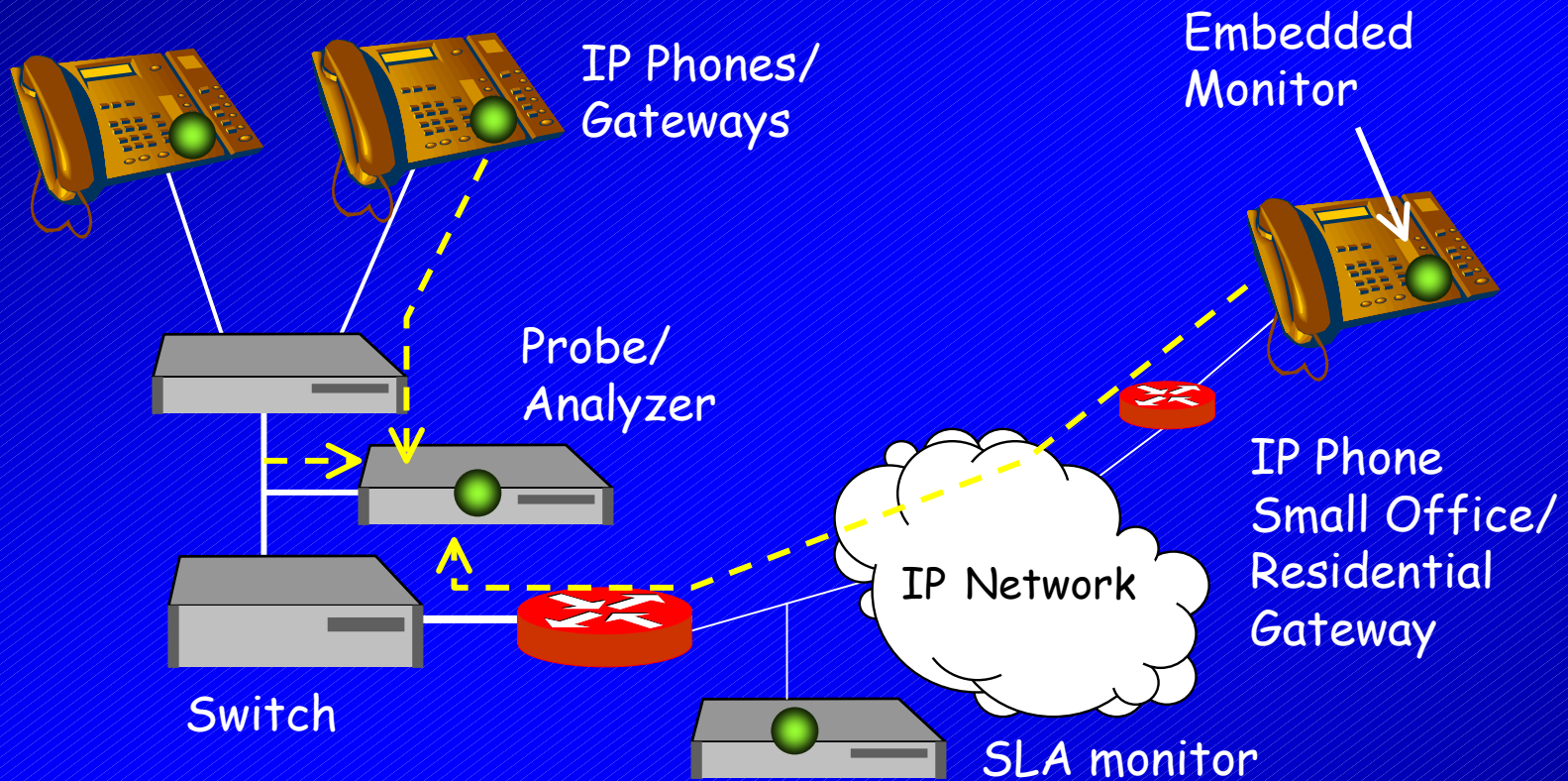
Key Points

- Many problems are transient
- Call Quality is Time Varying
- For accurate results on live calls must consider time varying impairments
- Best to use the same algorithm at different locations in the network to monitor SLAs, isolate problems
- RTCP extensions provide a practical way to get data from desktops /remote workers

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About Telchemy

- Founded in August 1999
- Develops technology for managing quality of service for Voice over IP and Video
- Goal to be a key technology source for the industry – leading edge, innovative products
- VQmon technology
  - Partners include Acetronics, Artiza, Brix Networks. Brooktrout, Finisar, Macnica, Sightsys, Texas Instruments, Trinity Convergence

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