Managing the Performance of Enterprise and Residential VoIP Services

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Outline

- Problems affecting Residential VoIP and Teleworkers
- VoIP Performance and Quality Challenges
- VoIP Performance Measurement and Problem Diagnosis
- Passive Monitoring using Embedded Agents
- Active Testing using Downloadable Agents
- Looking forward to IPTV

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Problems affecting Residential VoIP and Teleworkers

- Net Neutrality issues
  - Deliberate downgrading of priority
  - Artificial congestion
- Residential gateways
  - Performance
  - Difficult to control bandwidth allocation
  - “Bugs” affecting SIP/RTP connectivity
- Home networks
  - Home environment
  - Unexpected sources of congestion

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VoIP Performance and Quality Challenges

- Lost packets and jitter due to network congestion
  - Typically time varying/ transient
- Packet loss due to layer 1-2 problems
  - Duplex mismatch, bit errors…..
- Delay
  - High delays lead to conversational problems
  - Even small delays make echo more obvious
- Echo
  - Many phone services suffer from echo
  - Not obvious if delay is very short
- Signal levels
  - High – clipping, Low – noisy speech, gaps
- Noise levels
  - Obvious but – should this be a factor in QoE metrics?

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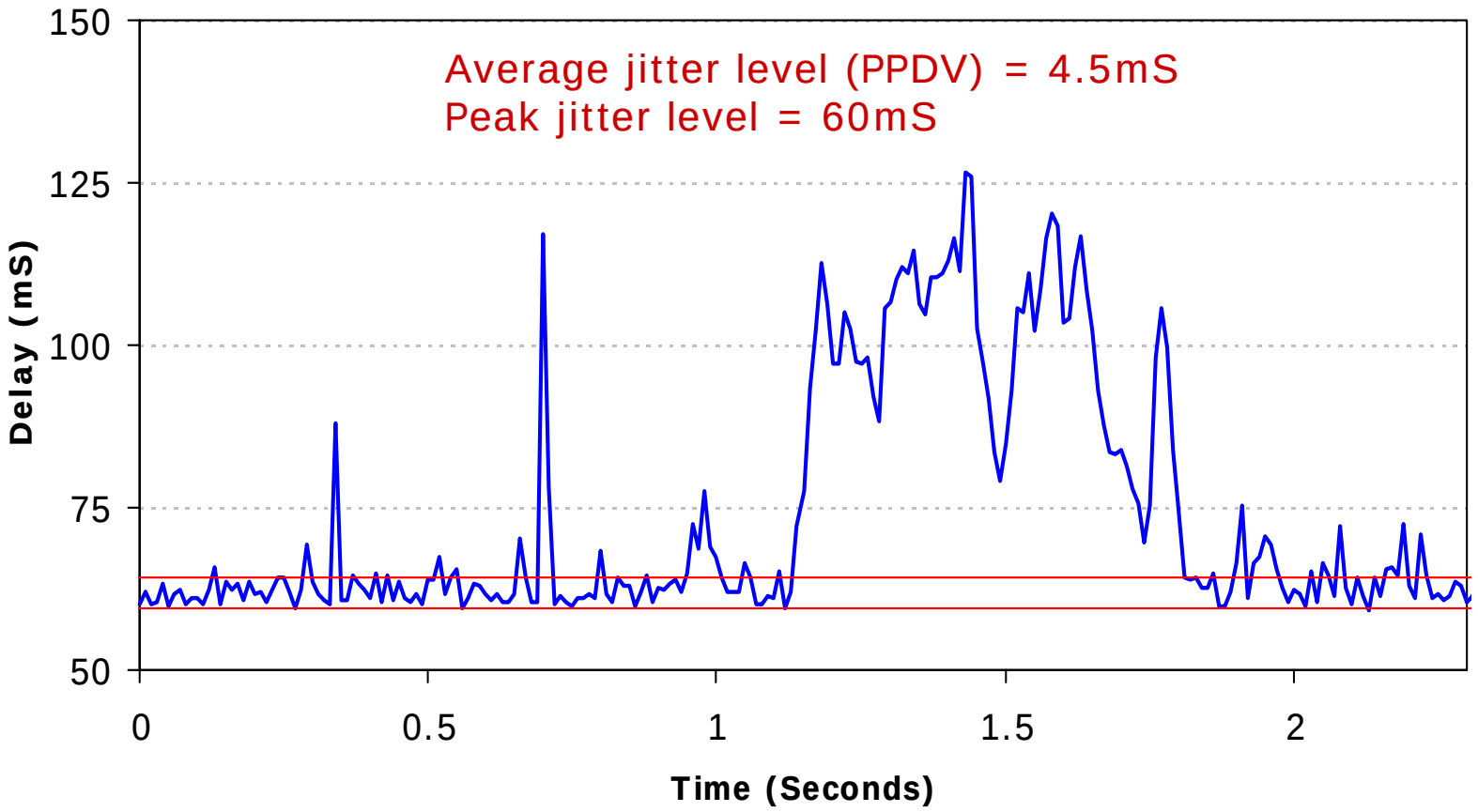
Jitter measurements can be misleading!!!



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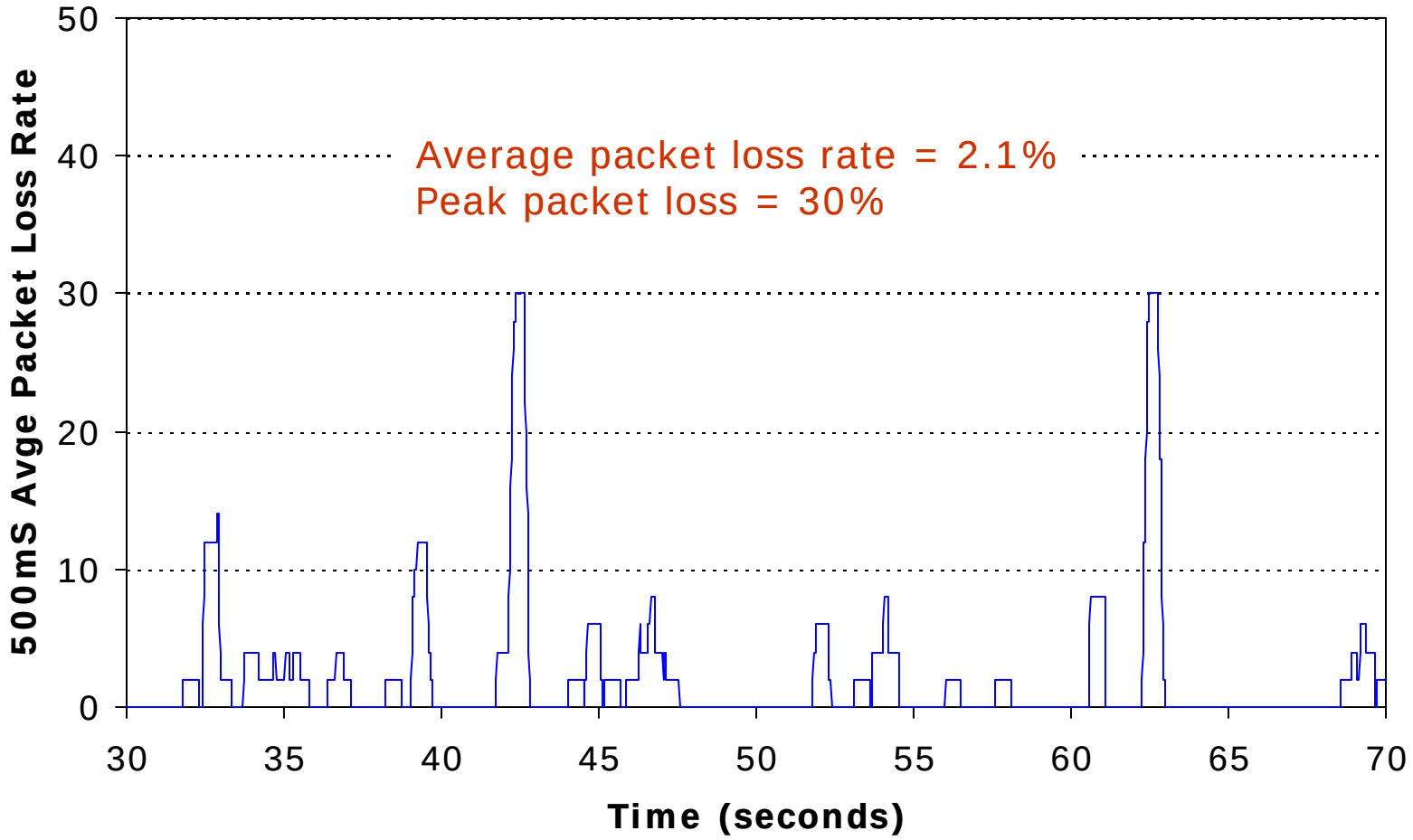
Packet Loss is time varying



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Passive Monitoring using Embedded Agents

- Basic premise
  - Measure performance close to the user
    - *Integrate a performance monitoring agent into the IP endpoint (IP phone)*
  - Send fewer but more meaningful reports
    - *Capture information and report info on transient problems*
  - Incorporate signal, noise, echo information but avoid the need to decode the signal
    - *Leverage data already available from the endpoint's codec/ echo canceller*
  - Conversational quality calculation requires some information from the remote endpoint
    - *Need combined information exchange/ reporting protocol*

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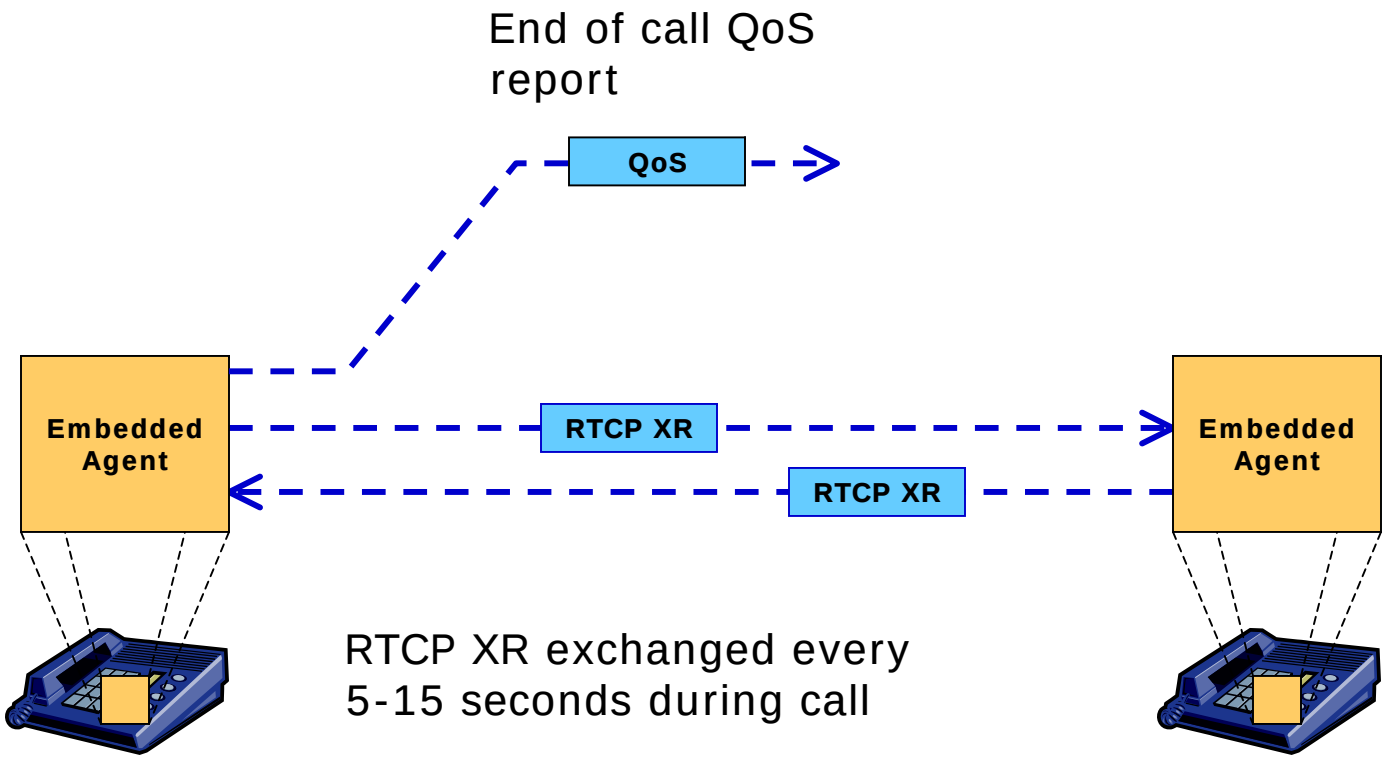
VoIP Performance Reporting Architecture



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How to measure performance?

- Subjective quality – “MOS”
  - Listening quality
  - Conversational quality
- Objective measurement

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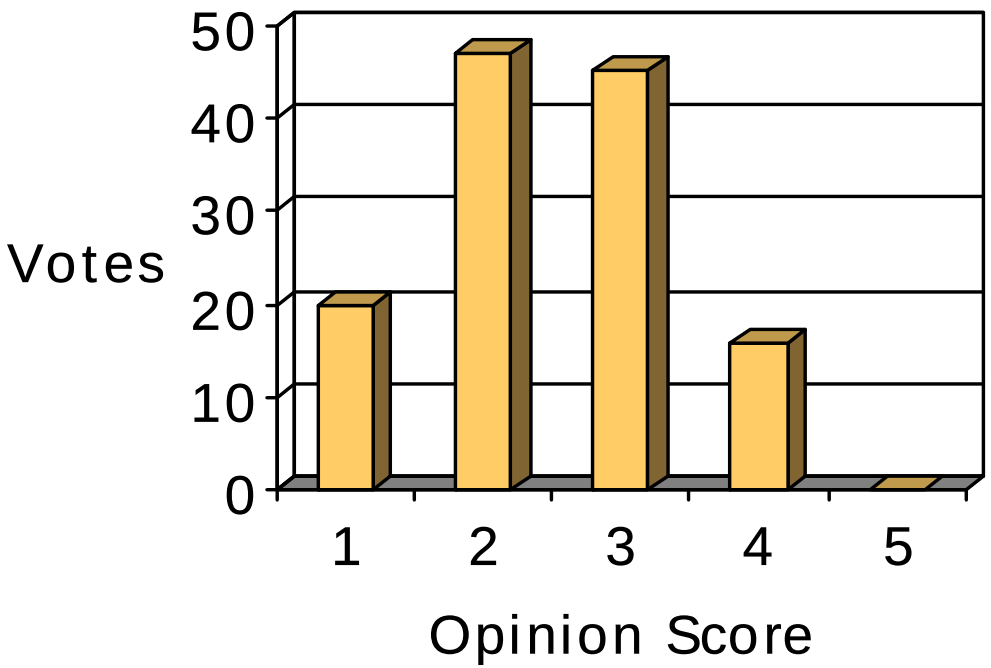
What is MOS?

- Extract from an ITU subjective test
- Mean Opinion Score (MOS) was 2.4
- 1=Unacceptable
- 2=Poor
- 3=Fair
- 4=Good
- 5=Excellent



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Objectively estimating MOS

- VQmon
  - Passive measurement algorithm, widely used in VoIP test tools and IP phones/ gateways (tested vs P.562)
- ITU G.107
  - Transmission planning model
  - Used for monitoring but does not comply with P.562
- ITU P.562
  - Standard for testing IP based passive measurement algorithms
- ITU P.563
  - Voice sample based passive measurement algorithm, very compute intensive
  - Only accurate when averaged over many calls
- ITU P.862 – PESQ
  - Full reference

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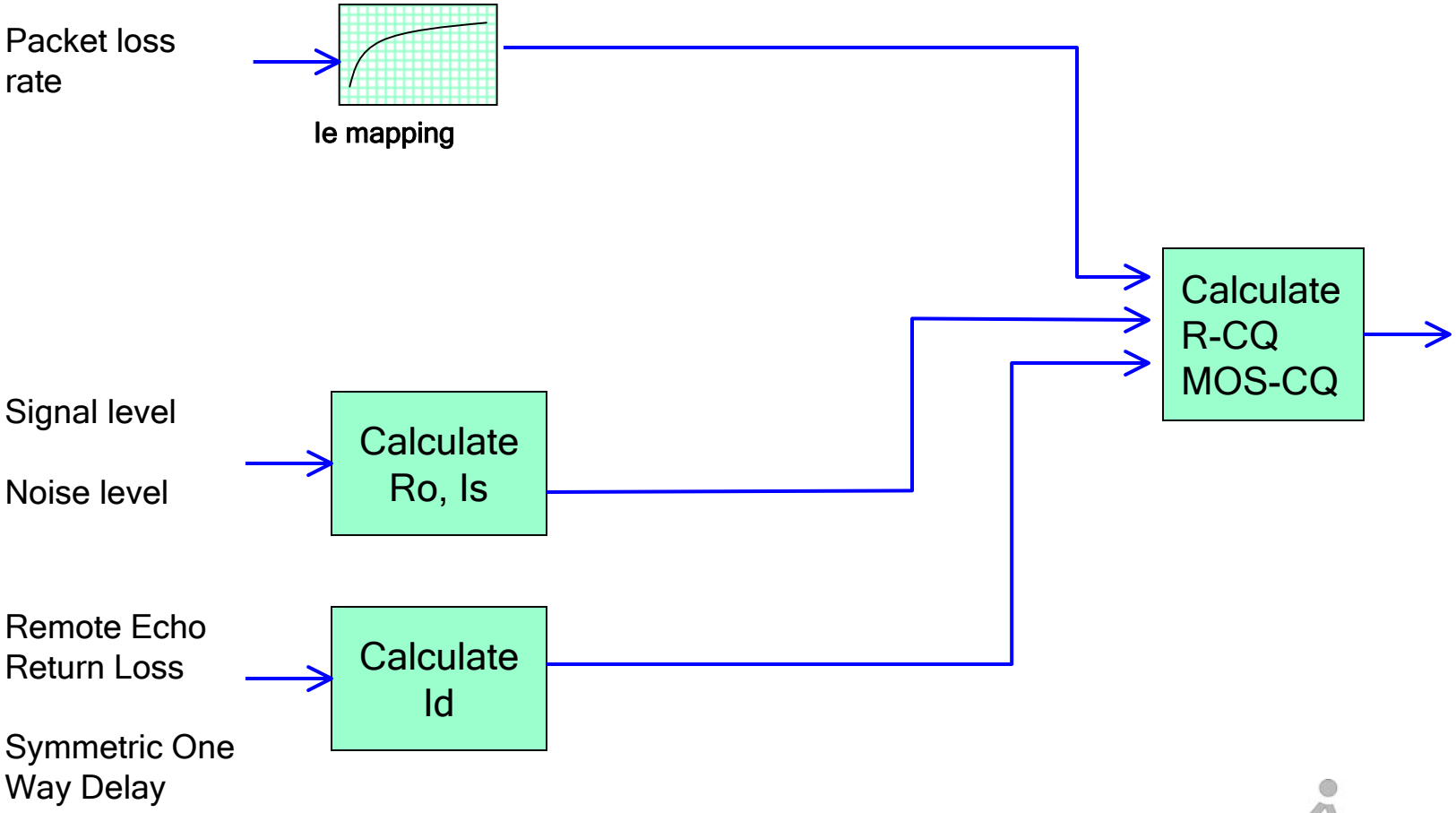
E model



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Problems with the E Model

- Additivity problem
  - Impairments aren't additive
- Inaccurate for time varying loss
- Inaccurate for consecutive loss
- Conversational quality only

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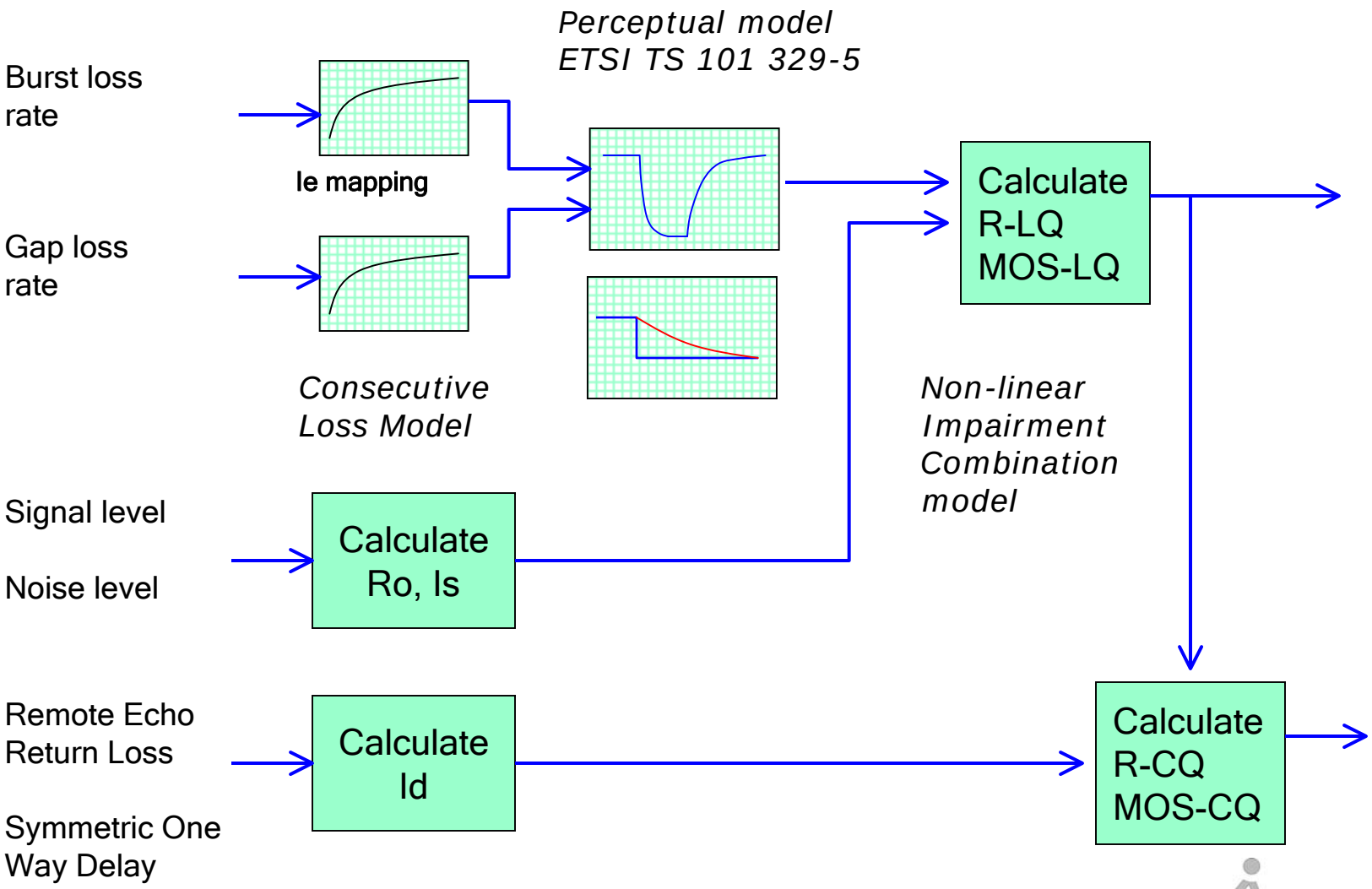
VQmon computational model



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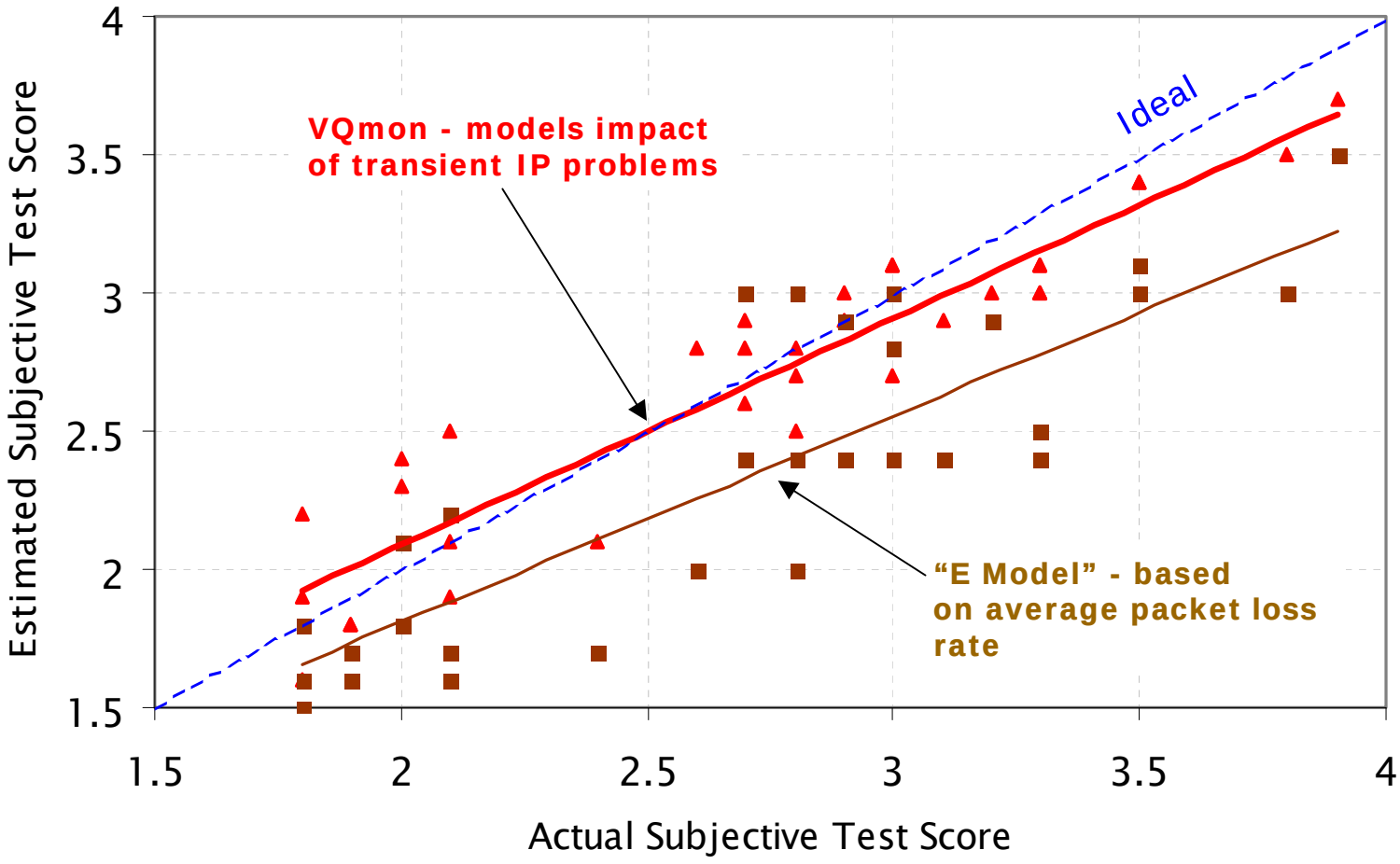
Impact of TS 101 329-5 model



Independent test by France Telecom and University of Bochum

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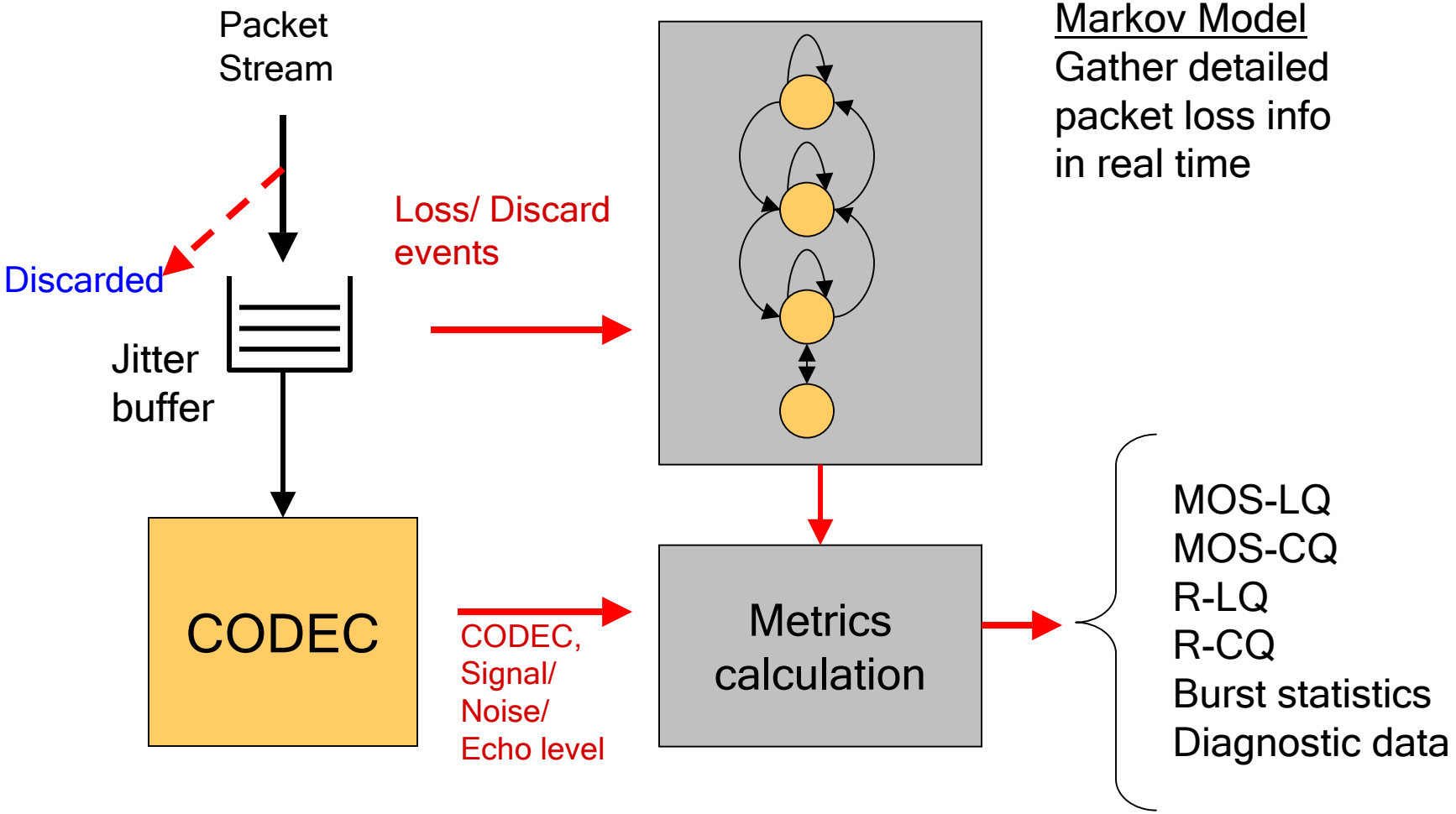
VQmon



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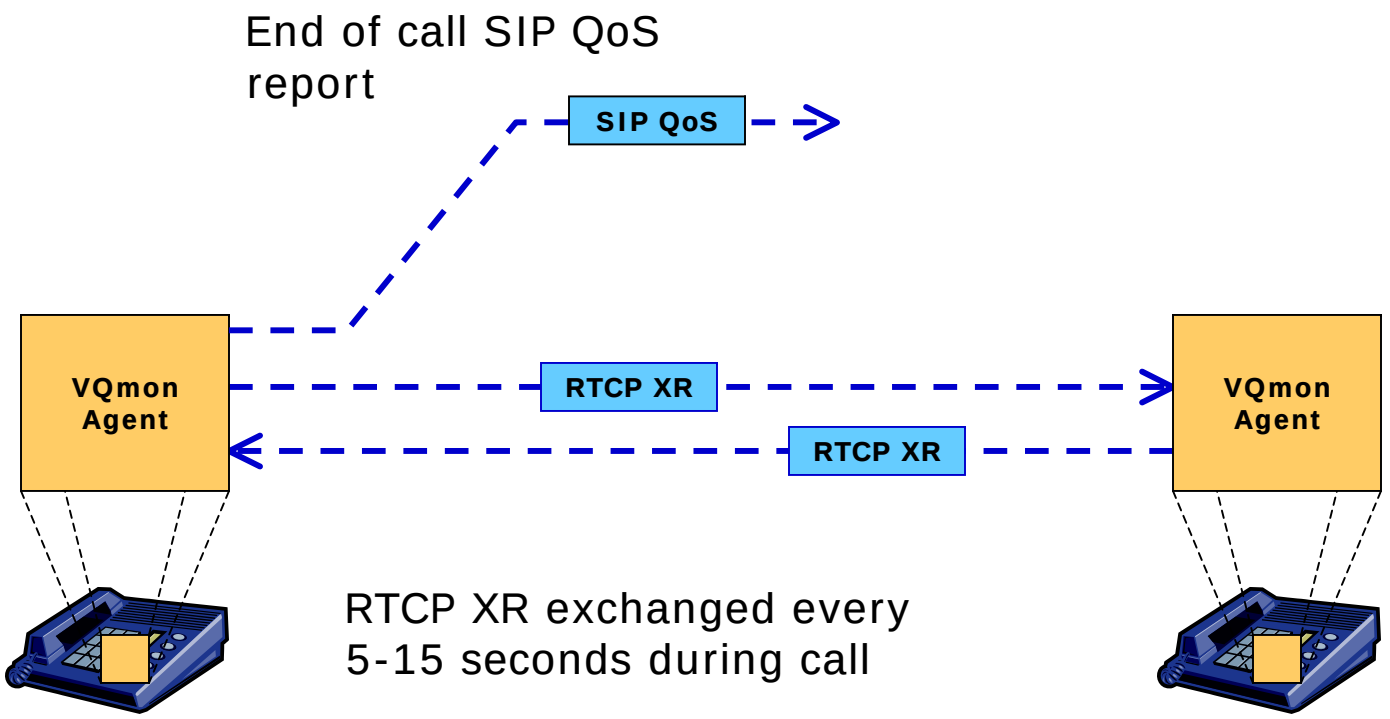
VoIP Performance Reporting Architecture



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RTCP XR Reports

Loss Rate	Discard Rate	Burst Density	Gap Density
Burst Duration (mS)		Gap Duration (mS)	
Round Trip Delay (mS)		End System Delay (mS)	
Signal level	RERL	Noise Level	Gmin
R Factor	Ext R	MOS-LQ	MOS-CQ
Rx Config	-	Jitter Buffer Nominal	
Jitter Buffer Max		Jitter Buffer Abs Max	

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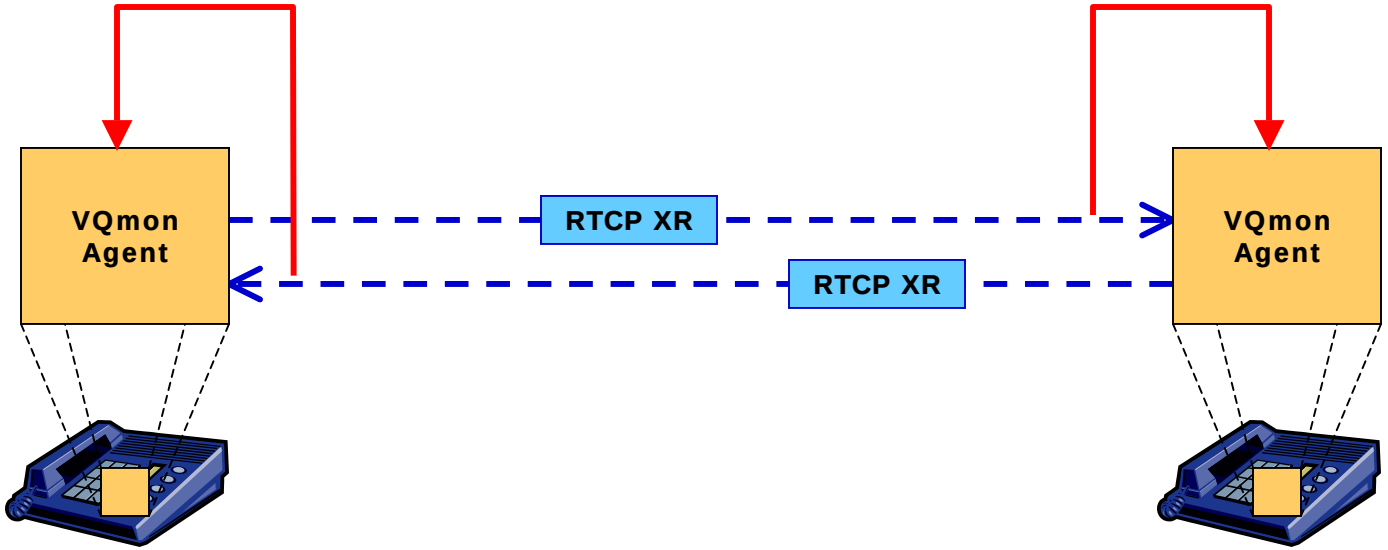
Information exchange using RTCP XR

Remote Echo Return Loss
Remote End System Delay
Remote Signal Level



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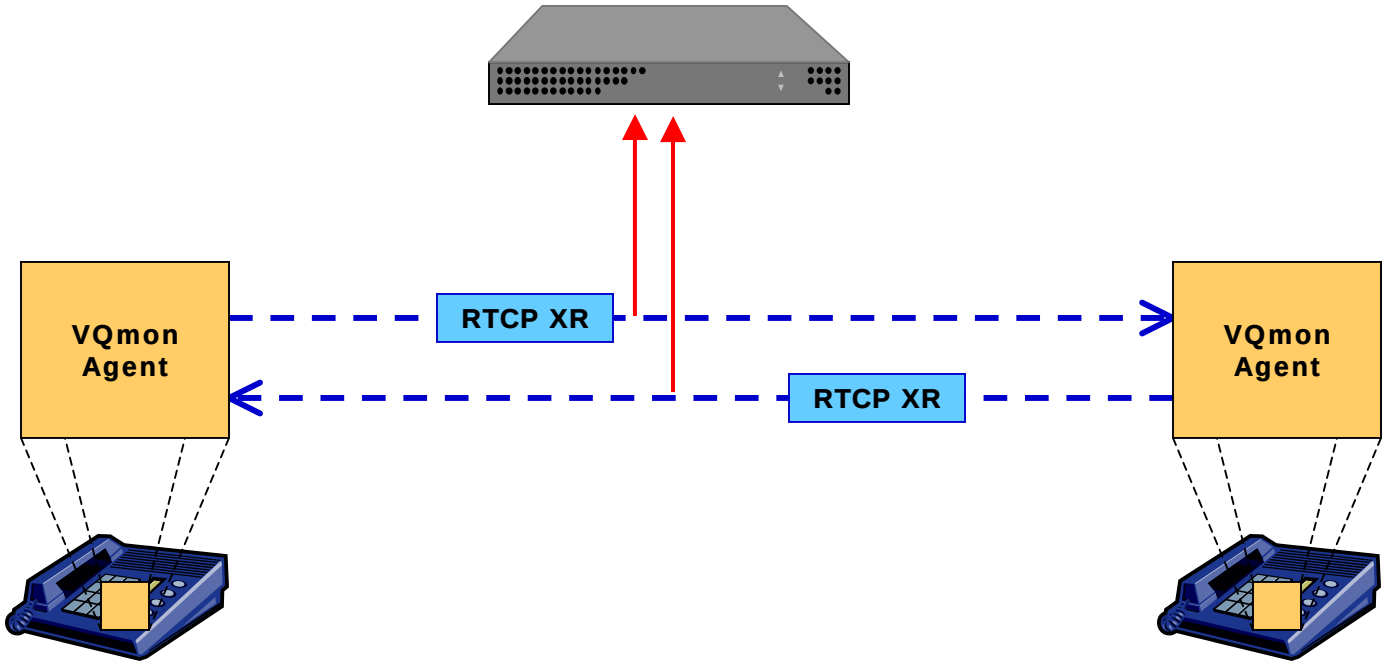
RTCP XR as a reporting protocol

Probe or Analyzer

-can incorporate signal, noise, echo, delay from XR reports

- Can report for both midpoints and endpoints



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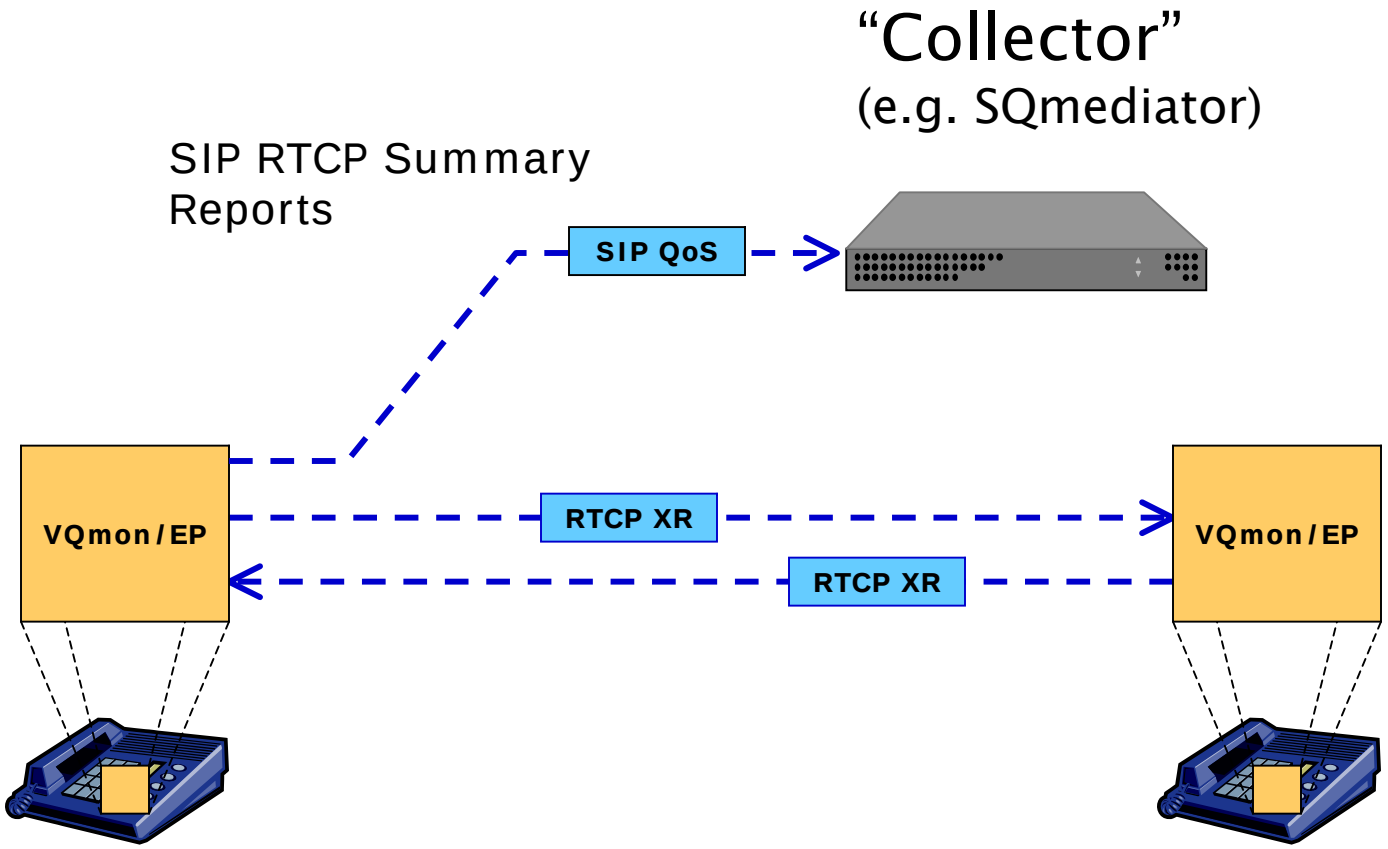
SIP as a reporting protocol



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SIP RTCP Summary

```
PUBLISH sip:collector@example.com SIP/2.0
          ……
        Content-Type: application/rtcpxr

        VQSessionReport
        LocalMetrics:
        TimeStamps=START:10012004.18.23.43 STOP:10012004.18.26.02
        SessionDesc=PT:0 PD:G.711 SR:8000 FD:20 FPP:2 PLC:3 SSUP:on
        CallID=1890463548@alice.uac.chicago.com
          ……
        Signal=SL:2 NL:10 RERL:14
        QualityEst=RLQ:90 RCQ:85 EXTR:90 MOSLQ:3.4 MOSCQ:3.3
                QoEEstAlg:VQMonv2.1
```

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Passive Monitoring – Pro's and Con's

- Pro's
  - Understand problems affecting actual calls
  - Capture information that can be post-analyzed to address customer problem reports
  - Generates virtually no overhead traffic

- Con's
  - Can't detect a problem until it impacts a live call
  - Limited ability to run additional diagnostic tests to isolate and diagnose problem
  - Can't deal with failed connections

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Downloadable Active Test Agents

- Test agents (VoIP, IPTV…) downloadable from web server
- Agents run tests against a network based server
- Agents initiate tests – minimizes firewall problems
- Results retained by server
- Agents can be static or transient

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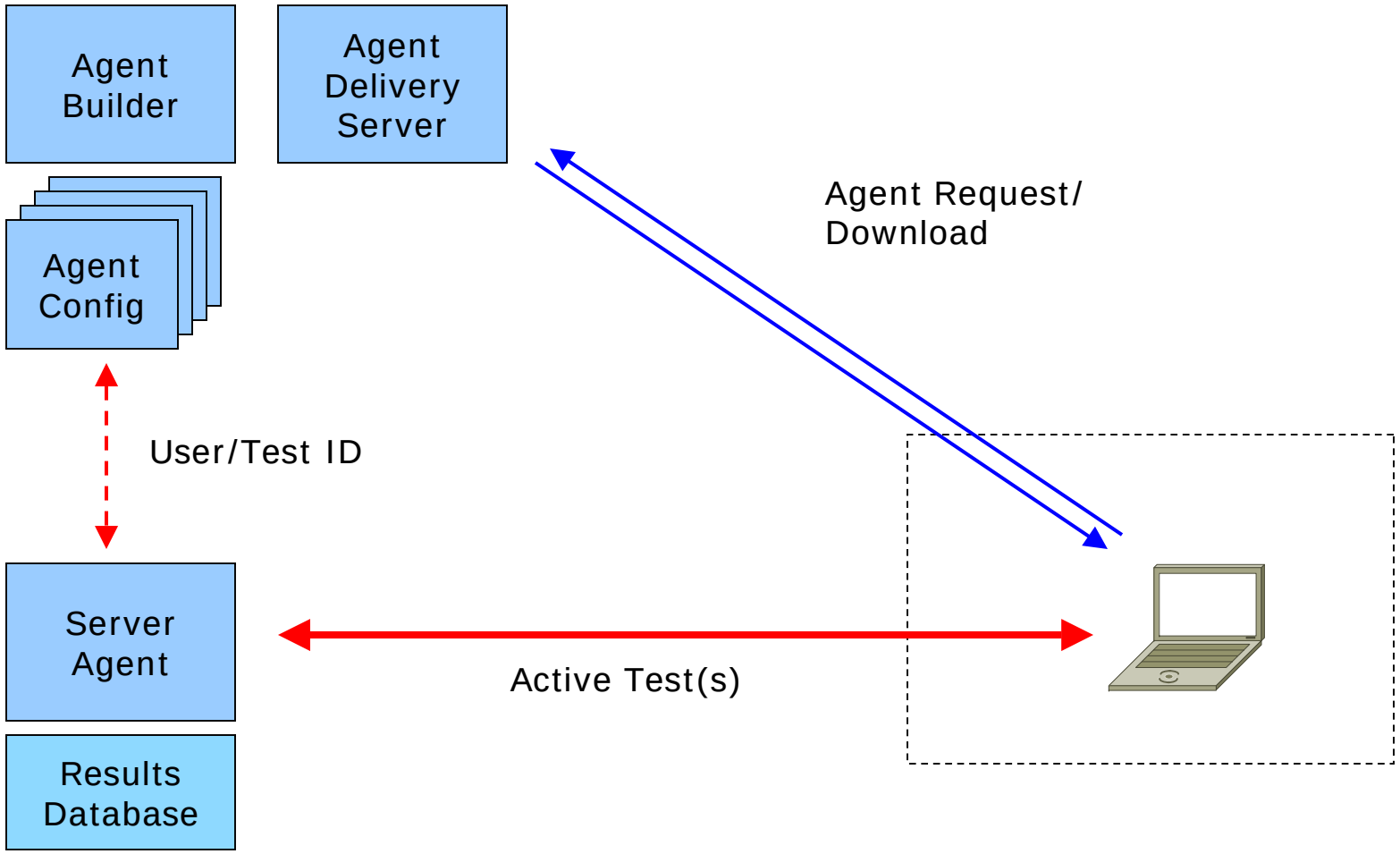
Downloadable Agent - Architecture



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Example VoIP test process

- Call connect
  - *Try SIP on port 5060*
  - *Try SIP on alternate port*
  - *Try encrypted SIP on alternate port*
  - *Agent reports what it had to do in order to connect*

- Media path quality
  - *Establish bidirectional RTP stream using voice payloads, measure quality*
  - *Establish bidirectional "non-RTP" stream, measure quality*

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What can active tests discover?

- Call connect tests
  - Service provider may be blocking SIP
  - Residential gateways can (mistakenly) block SIP
  - Problem accessing server
  - ……..
- Media path quality
  - Network congestion
  - Layer 1-2 problems, duplex mismatch, bit error problems……
  - Net (non) neutrality

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Use Active or Passive tests?

- Need both
- Active tests
  - Predeployment testing
  - SLA monitoring
  - Troubleshooting
- Passive monitoring
  - Service assurance
  - SLA monitoring
  - Customer service

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Looking forward to IPTV

- IP Video is much more sensitive to transmission impairments than VoIP
- Much more complex video structure makes quality estimation more difficult
- IPTV is usually encrypted, which makes quality estimation even more difficult
- Making IPTV work over existing DSL infrastructure
- Service providers need to prove that IP based services work

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Summary

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