End to End QoS and Triple Play

Quality of Experience for Residential Voice, Data and Video Services

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What is Triple play to the Consumer ?

- Service providers are increasingly offering multiple services
  - Cable Providers
    - Data (e.g. US DOCSIS)
    - Telephone Service (e.g. US PacketCable)
    - Video
  - Telephone Service Providers
    - Data (DSL, Fiber to the home/ curb)
    - Telephone Service (VoIP)
    - Video (IPTV)
- Consumer simply wants service quality and reliability to be as good as (or better than) it was before
- **It SHOULD be as good**

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Should be *?!?* Why not *?*

- TDM Telephone is a **dedicated** – and hardened – service – High QoS
- Broadcast and Cable television are **dedicated** services – Hi QoS
- These are designed and deployed to be single-purpose, high quality systems

BUT…

- VoIP and IpTV rely on **General Purpose** – and often **shared** - infrastructures.
- **Infrastructure failings**: Shared or Insufficient bandwidth, link failures and so on.
- **IP's inherent failings**: Lost packets, network congestion, jitter and so on.
- Analog portions – no control for providers

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What do do?

- Service providers must monitor their entire network
- Consumer device manufacturers should embed and enable system monitoring functionality in end devices
- Access and Gateway devices must provide monitoring – and reporting- capabilities.

Triple Play Architecture - VoIP

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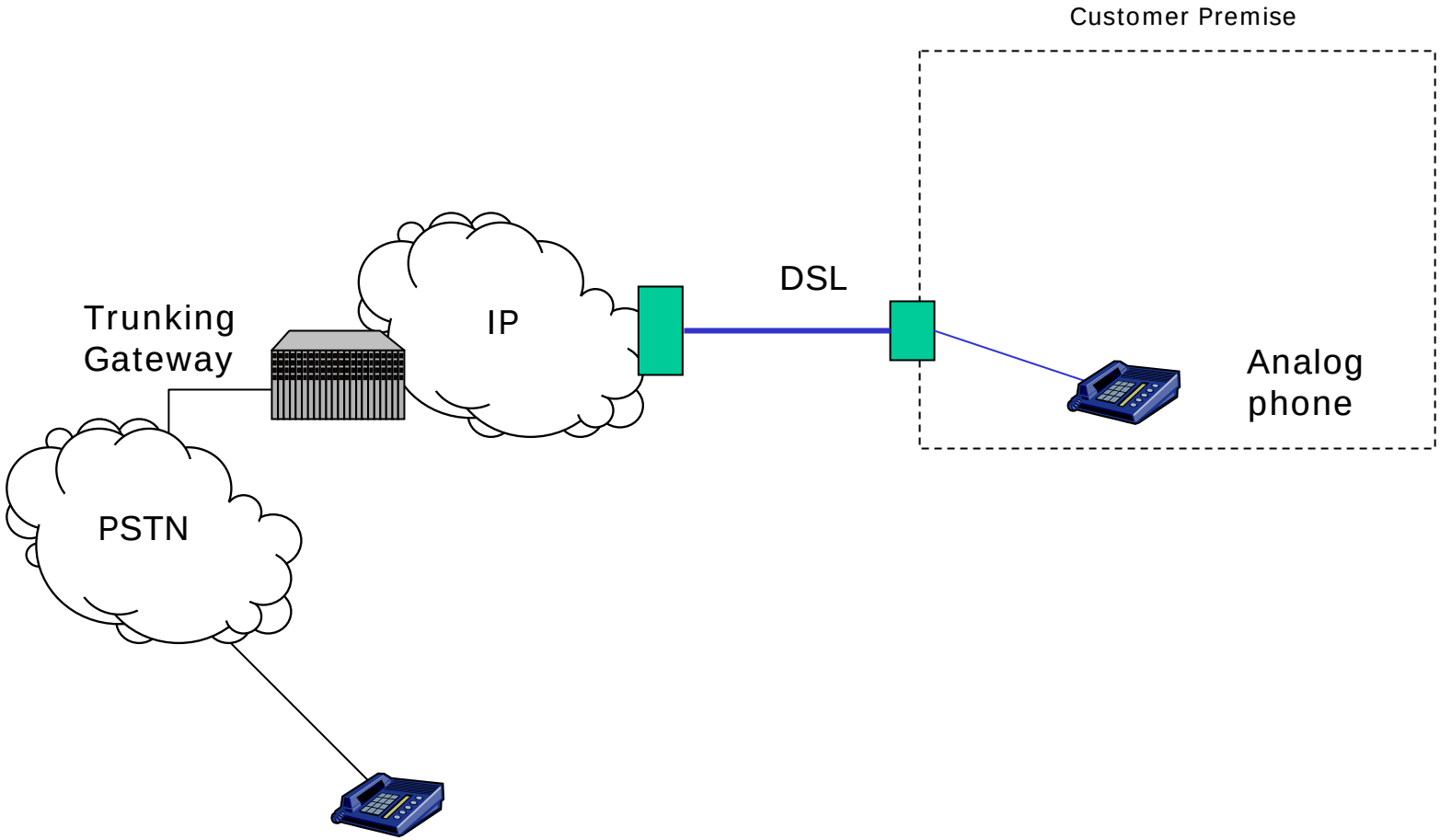

Triple Play Architecture - IPTV

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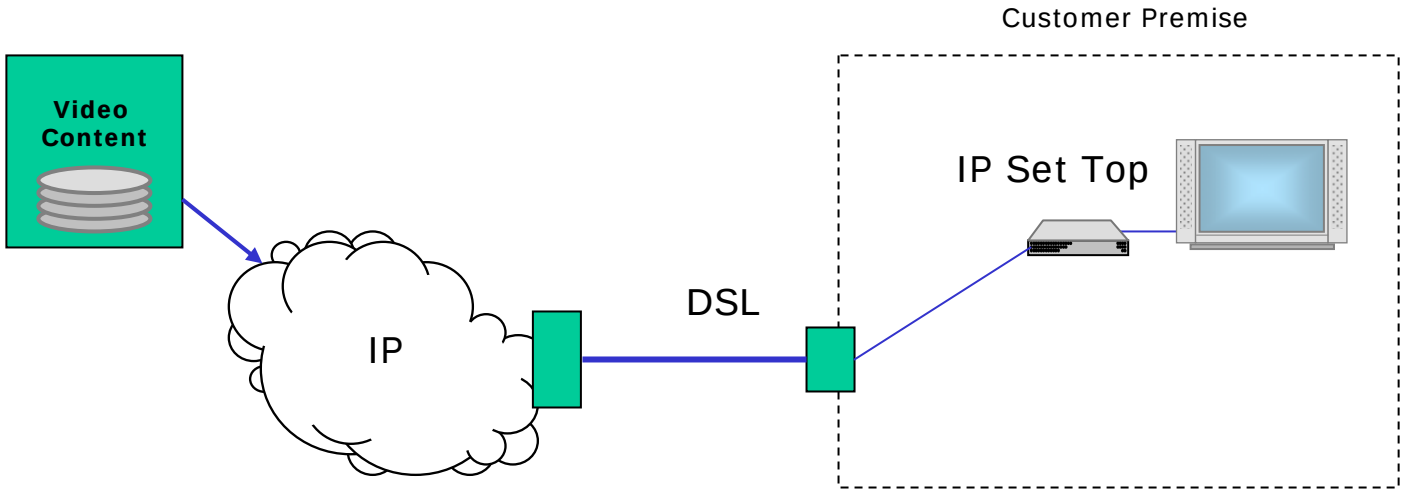

Triple Play - Issues and Problems

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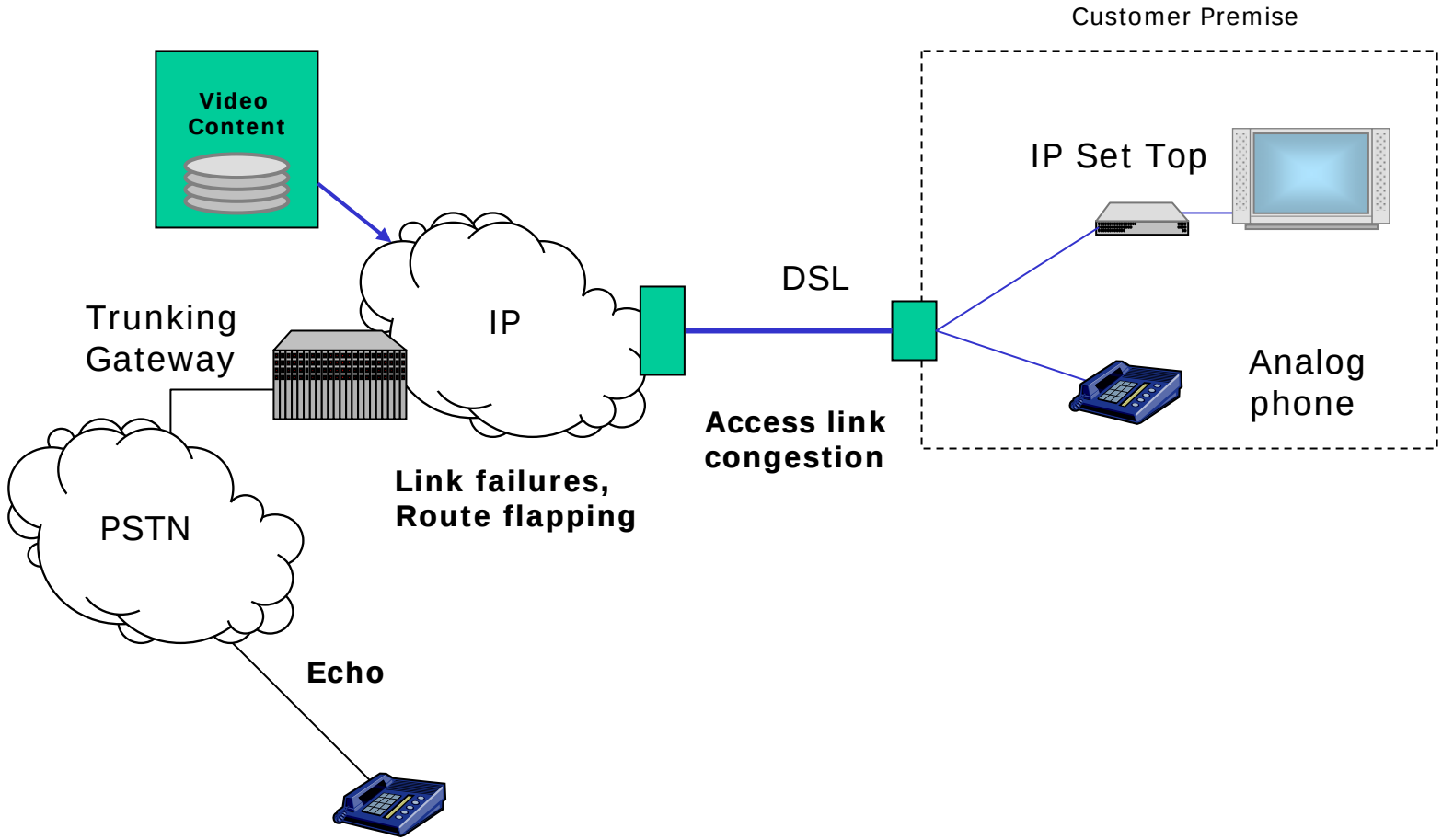

Typical IpTV implementation

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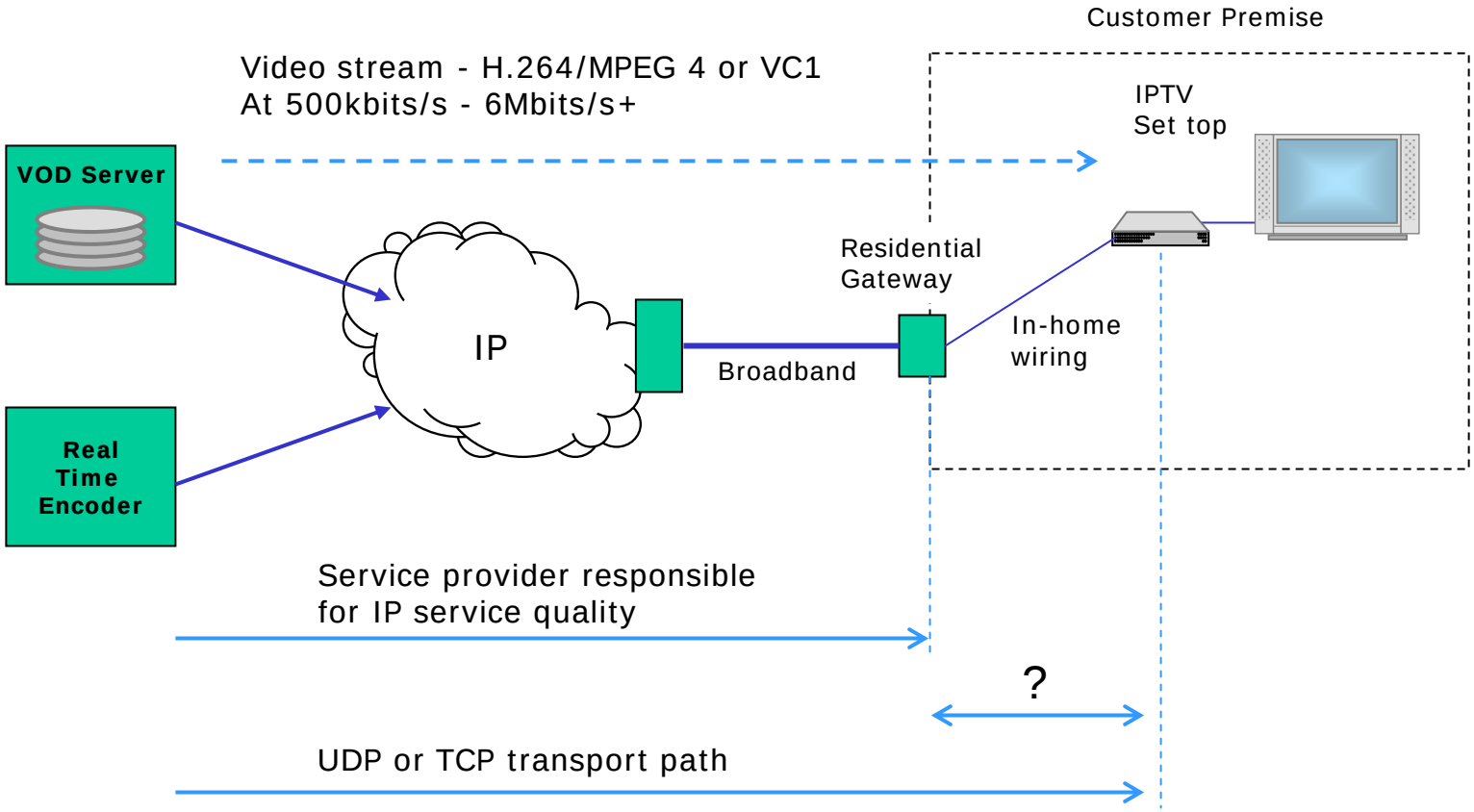

IPTV Potential Problem Areas

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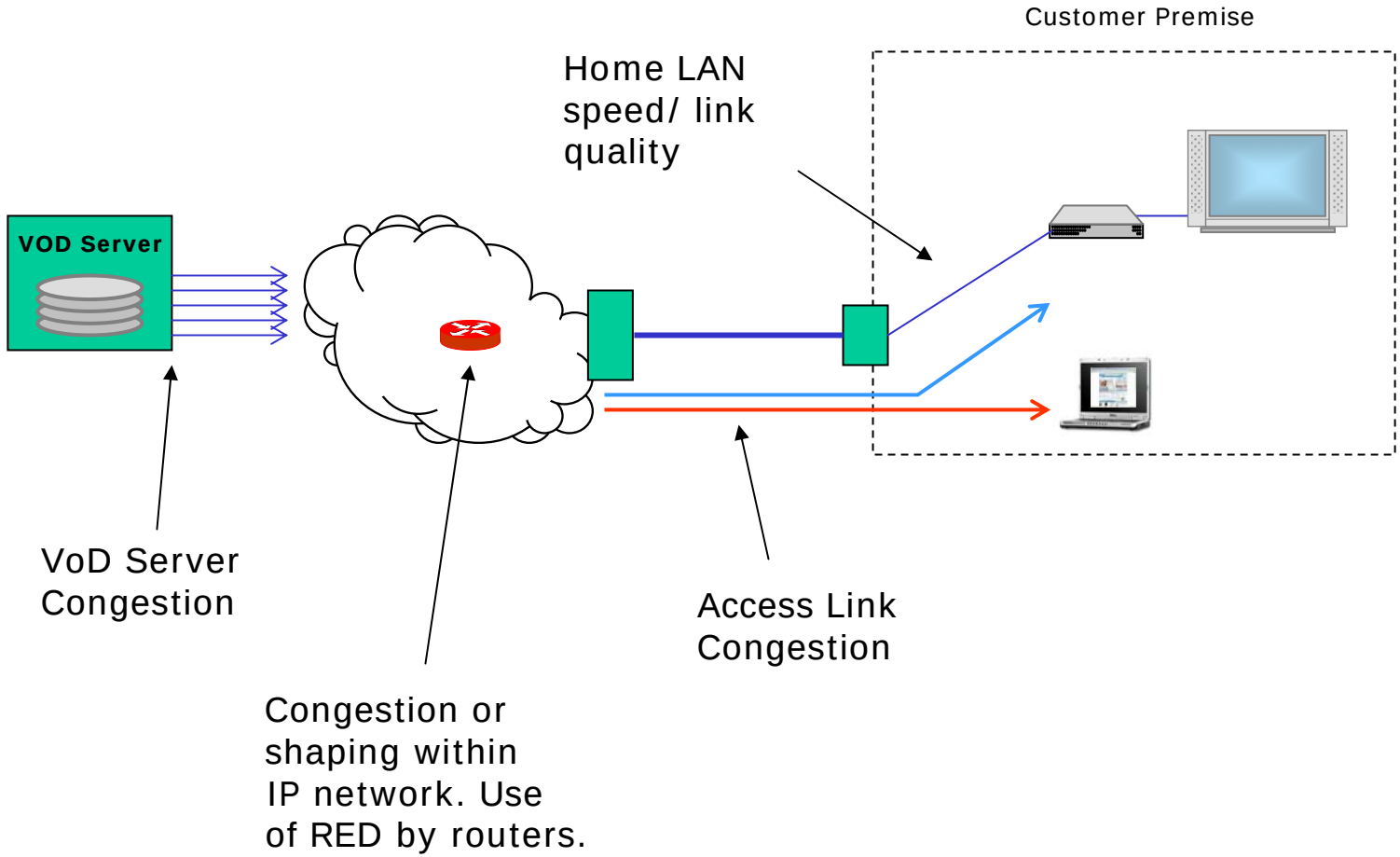

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What is the range of problems ?

- Lost packets, and Jitter: Discarded packets
  - Dropouts and PLC replacements in Voice
  - Motion freezes and block artifacts in Video
- Long delays: Conversational difficulties
  - IpTV is much more immune: One-way
- Varying delay: Jitter and Route Flapping
  - Congestion due to access link and LAN near occupancy limits.
  - Automatic rerouting for load balancing
- Content Dependency
  - Last game of the World Cup Finals
  - Call home by traveling family member
- One-way: Passive versus Two-way: Interactive
  - Video has leeway to increase protections that telephony does not have.

How do the problems effect users ?

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- VoIP:
  - Jitter and lost packets lead to signal dropouts and PLC replacements – More lost packets, lower quality.
  - Delay leads to difficulty in normal conversational flow.
  - Long delays can enhance Echo problems – **an analog problem**.
  - Route flapping alters end-to-end delay, leads to gaps in speech, Echo cancellation problems.
  - Bandwidth constraints lead to use of lower bit-rate and voice-quality codecs.
- IpTV
  - Jitter leading to packet discard and Lost packets lead to noticeable degradations in the picture – Visible blocks that persist until new I-Frames are received.
  - Lost I-Frames can cause halting of play out.
  - Bandwidth constraints lead to use of lower bit rate and video-quality codecs.

IP problems are transient

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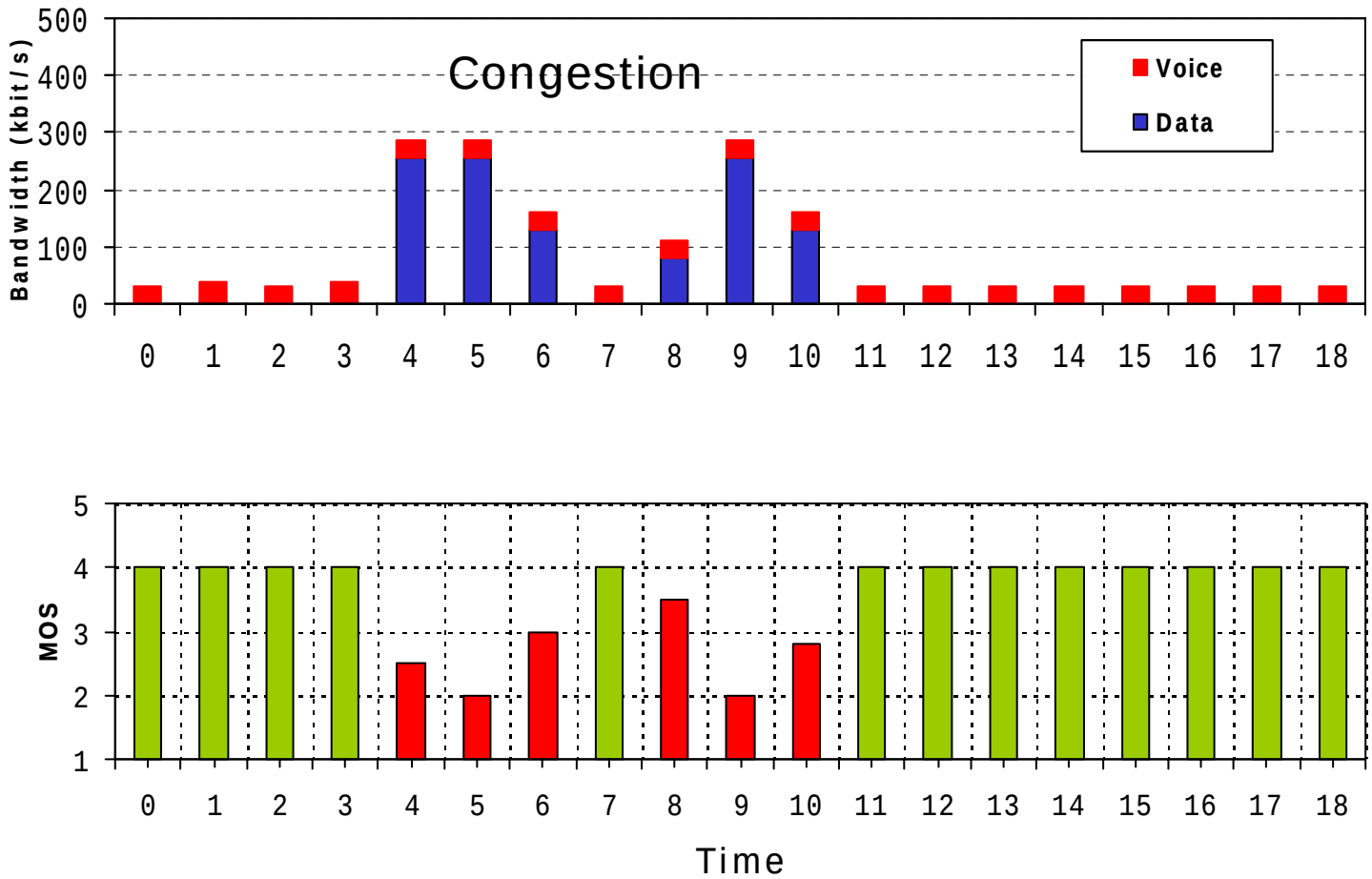

Perceptual effects of changing quality

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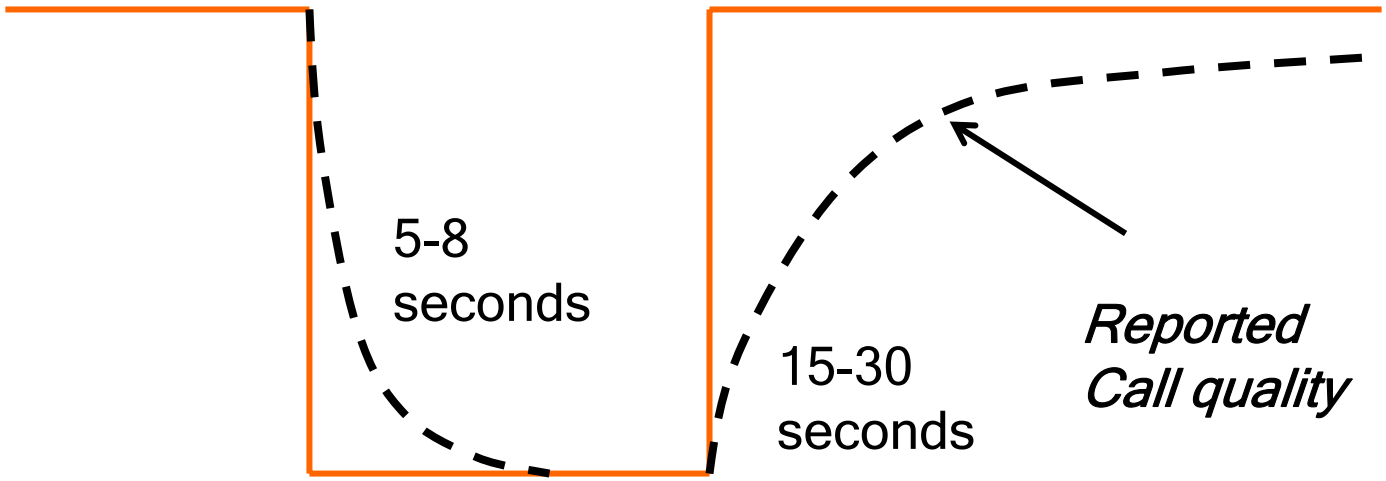
Good quality most of the time



Poor quality during burst of loss/discards

ETSI TS 101 329-5 Annex E

Multimedia Performance Monitoring Model

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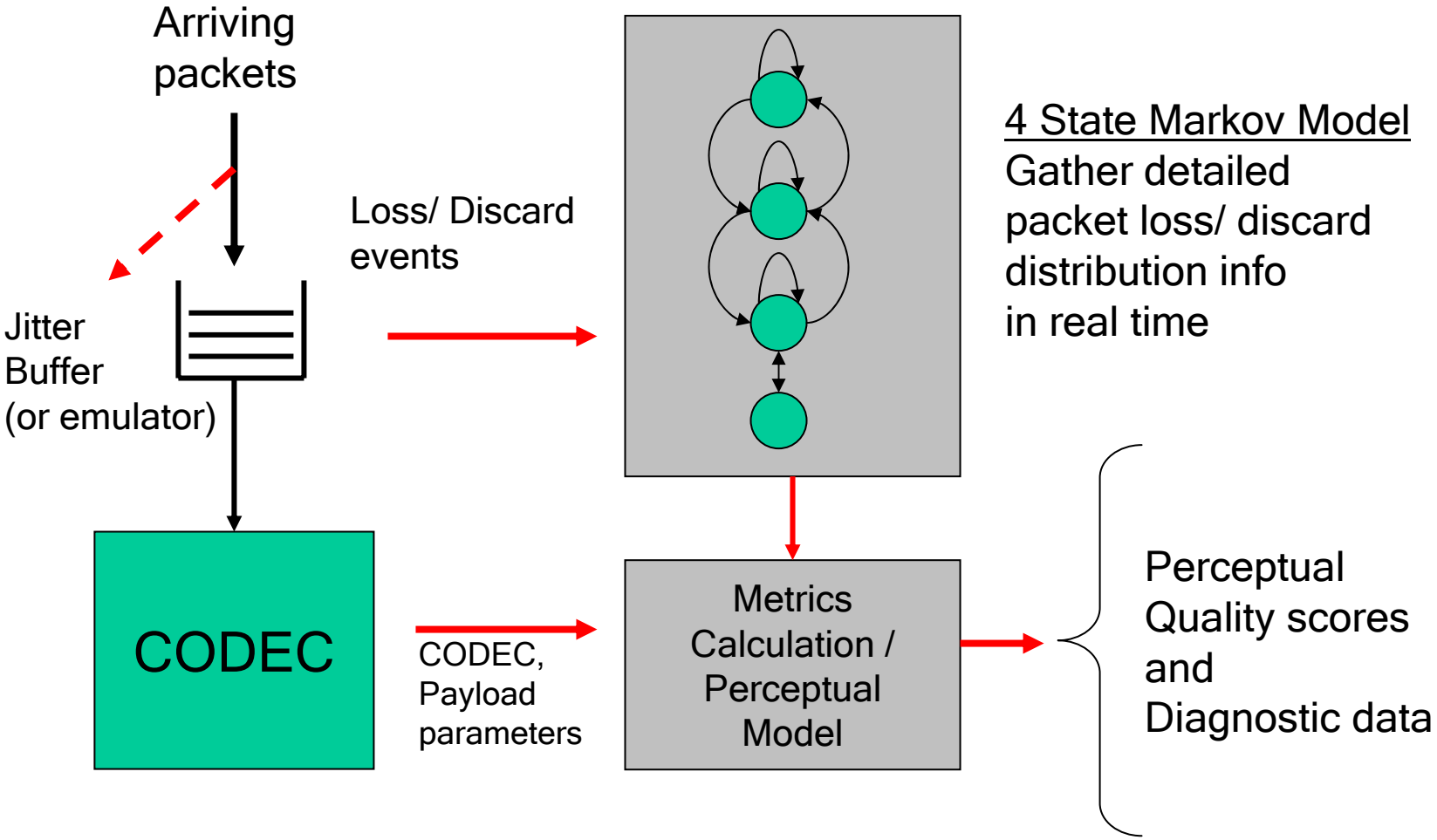

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Application to VoIP - e.g. VQmon

- Support Narrowband and Wideband codecs
- Report Listening and Conversational Quality
- Superset of ITU G.107 and ITU P.VTQ (P.564)
  - Incorporates time varying impairment model
  - Incorporates signal level, noise level, echo level
  - Non-linear impairment combination model
- Low processing power, small size…
  - Complexity 500 “IPS”

VQmon 2.0/2.1 computational model

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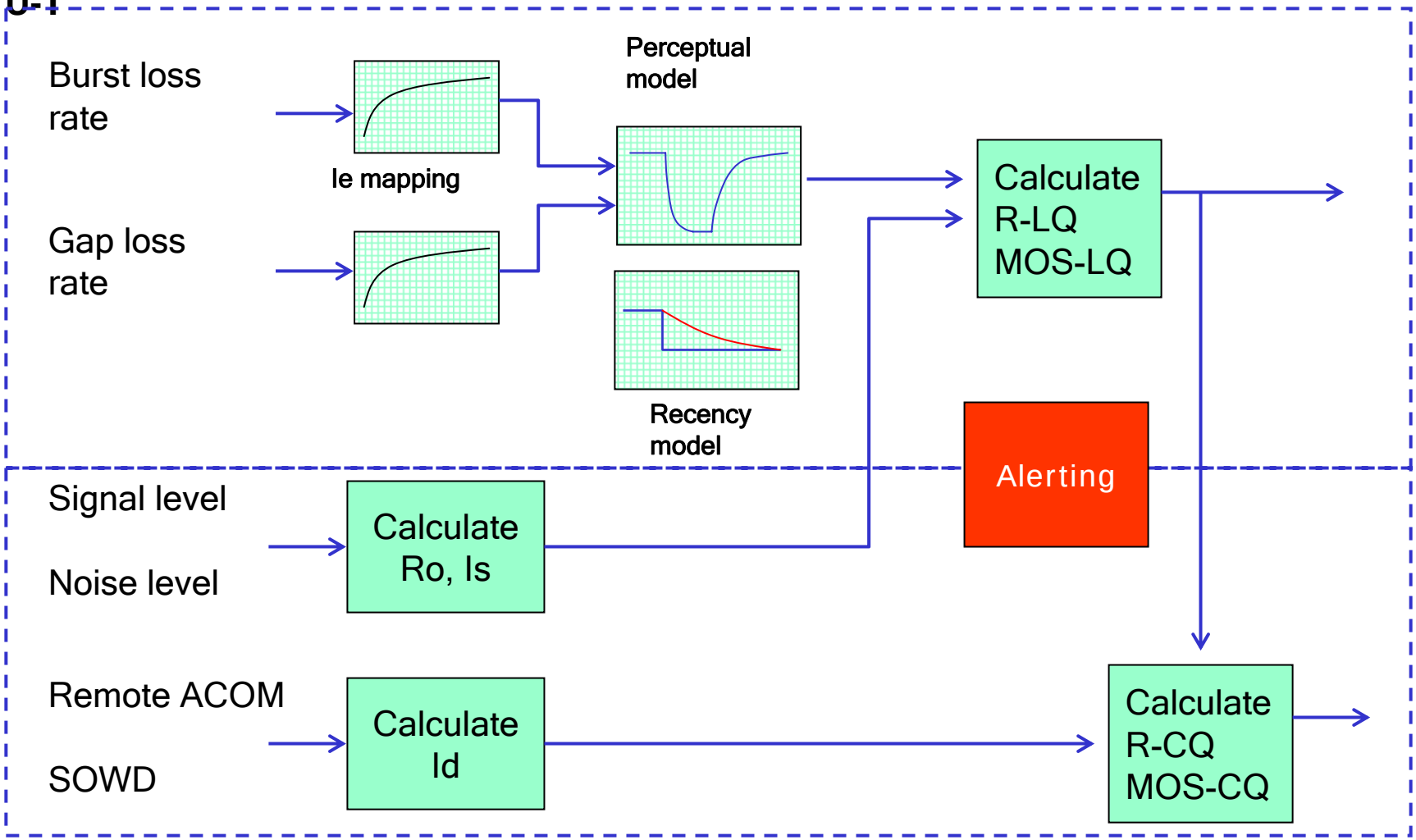

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Application to IPTV

- Supports MPEG1/ 2/ 4, H.261/3/4 codecs
- Supports various combinations of transport protocol
  - RTP, MPEG-TS, MPEG-TS over RTP….
- Low complexity
  - 0.01-0.1 MIPS/ stream, depending on packet rate

VQmon/SA-VM - computational model

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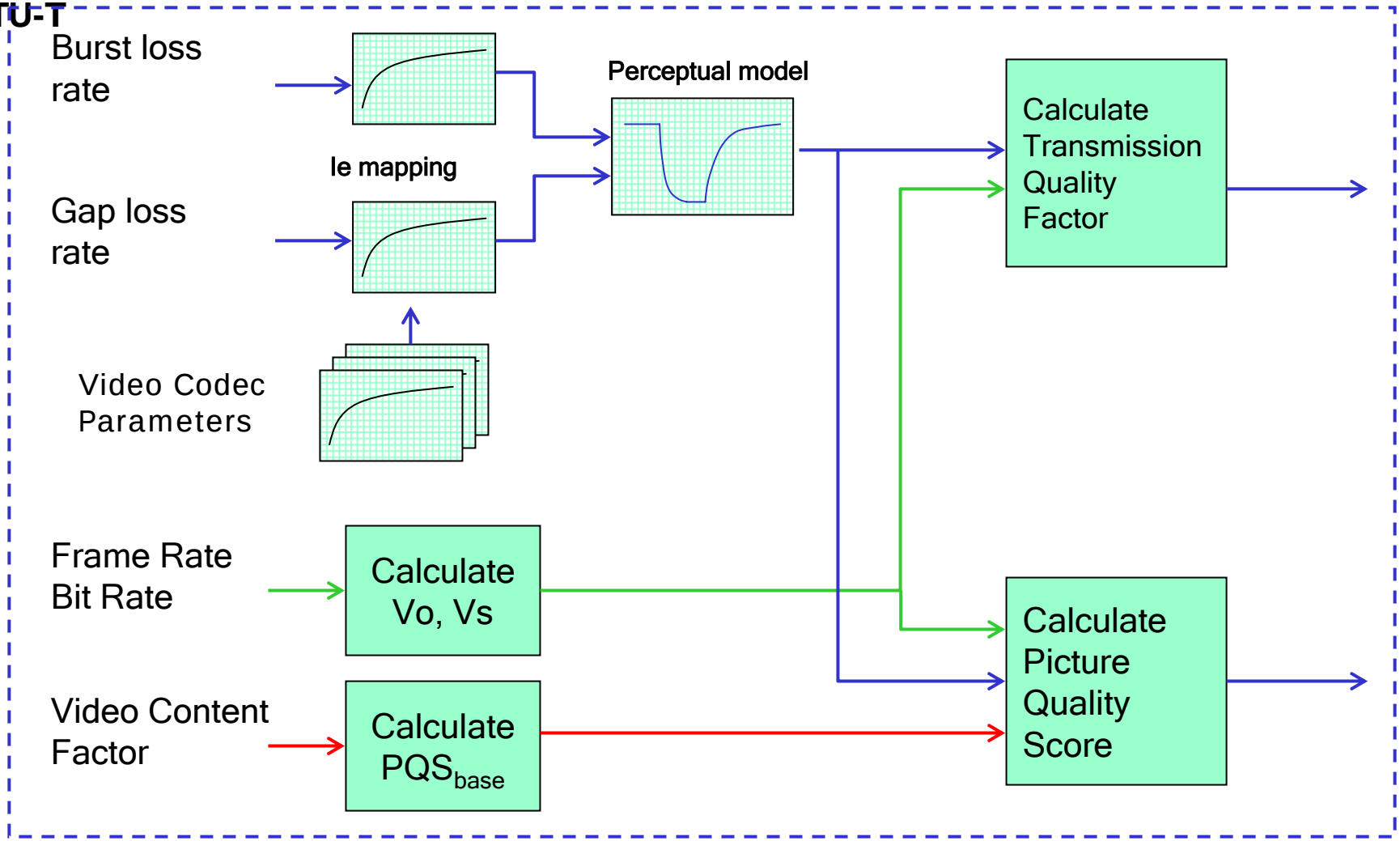

Measurement performance - VoIP

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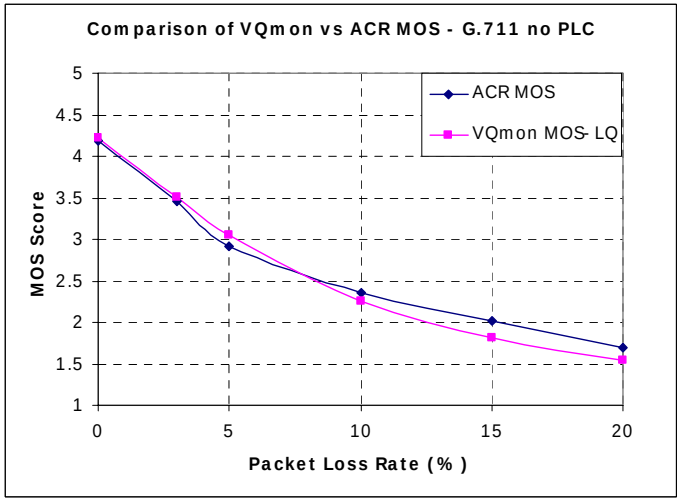

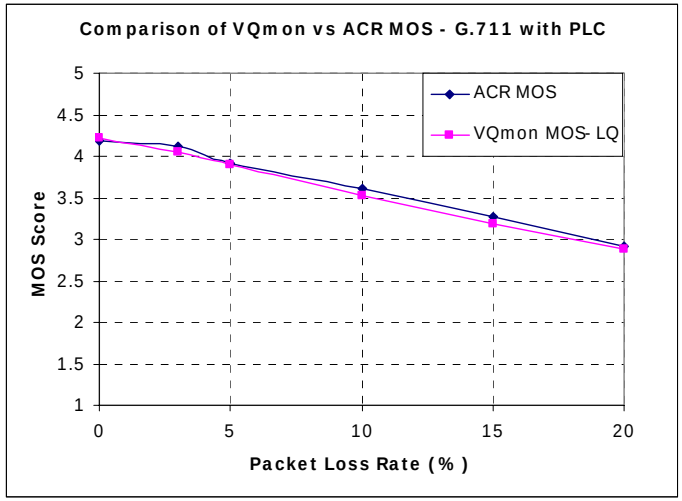

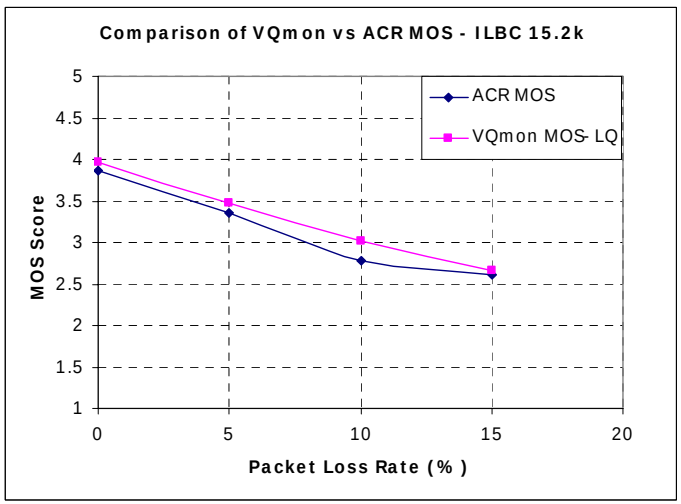

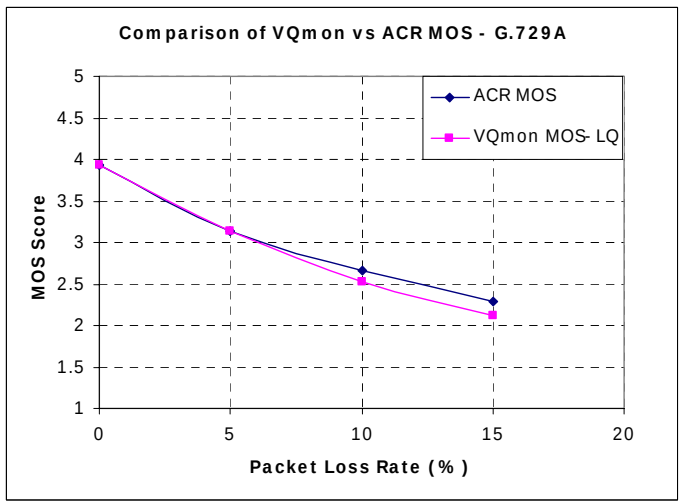

Measurement Performance - IPTV

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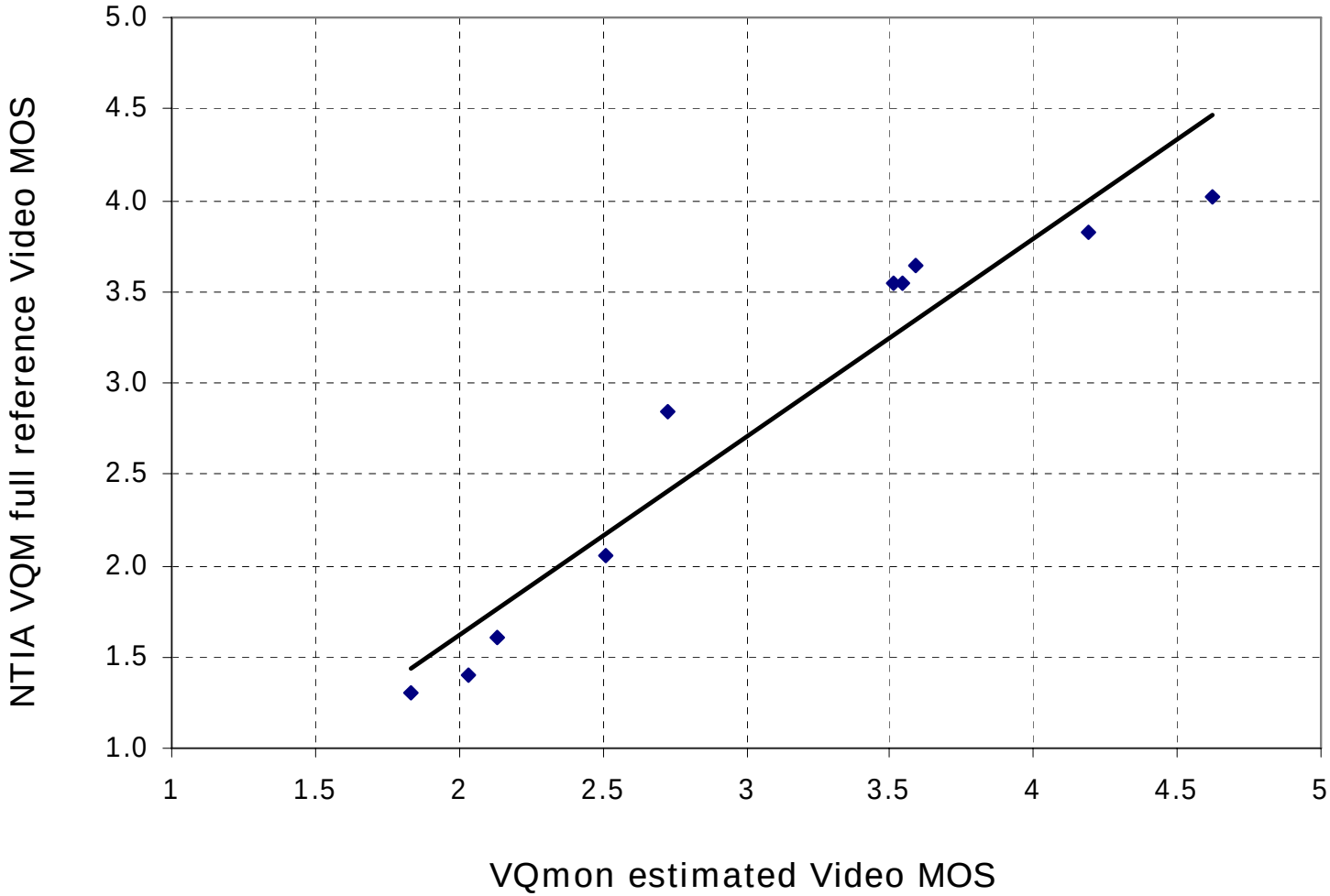
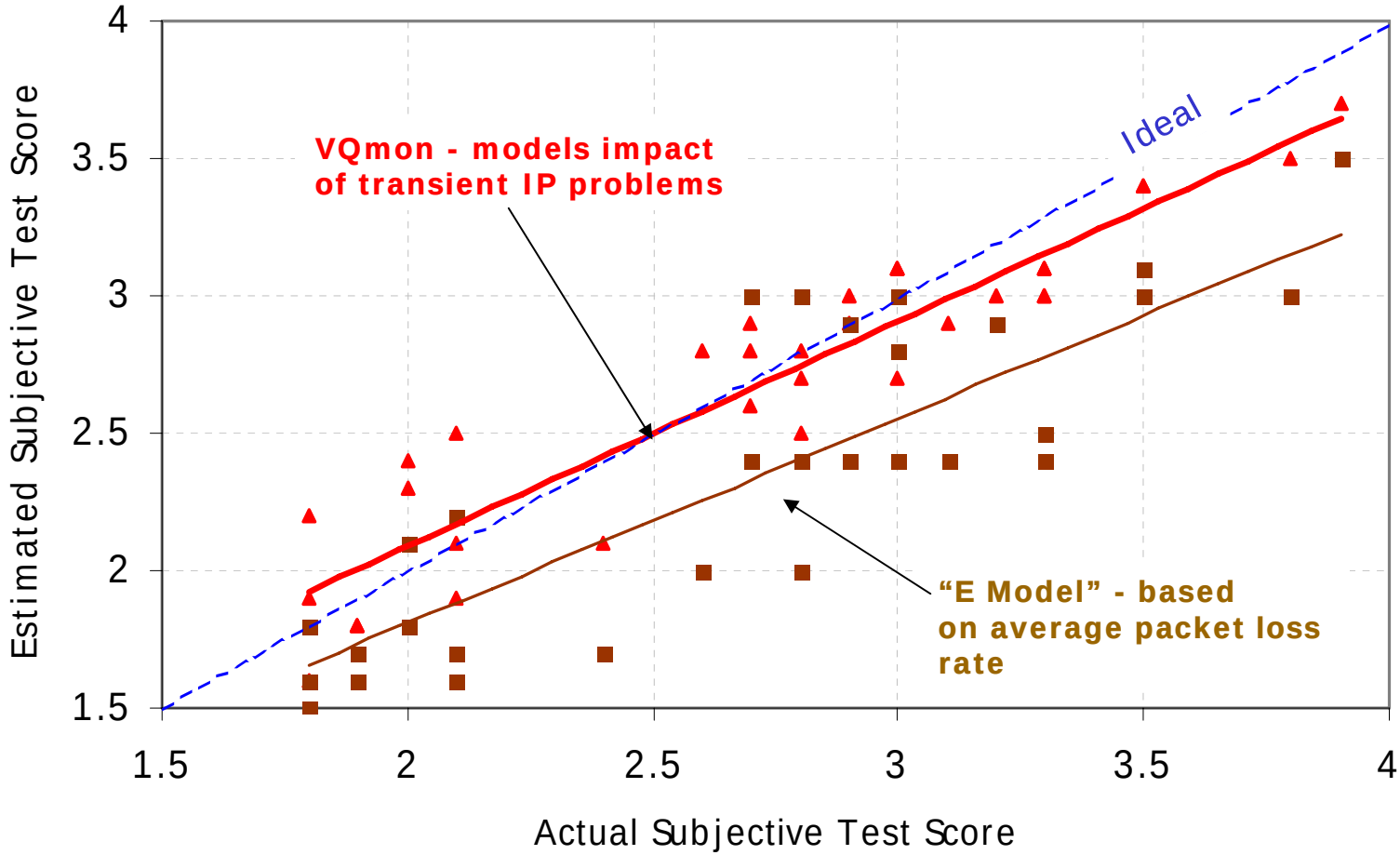


Impact of time varying problems



Independent test by France Telecom and University of Bochum

Where to measure?

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- Premises: Consumer equipment
  - IP Phones and residential gateways
  - Set top Boxes and Digital Tuners.
  - Home routers
  - Cable Modems and DSL modems
  - Soft phones (PC Based)
  - Cellular phones
- Network: Carrier Equipment
  - DSLAM, Gateways, Amplifiers, Head ends, CMTS, Switches, Session Border Controllers, IADs, Routers, ……
- Probes
  - In-network stand-alone probes
  - Field service equipment

Triple Play - Monitoring Architecture

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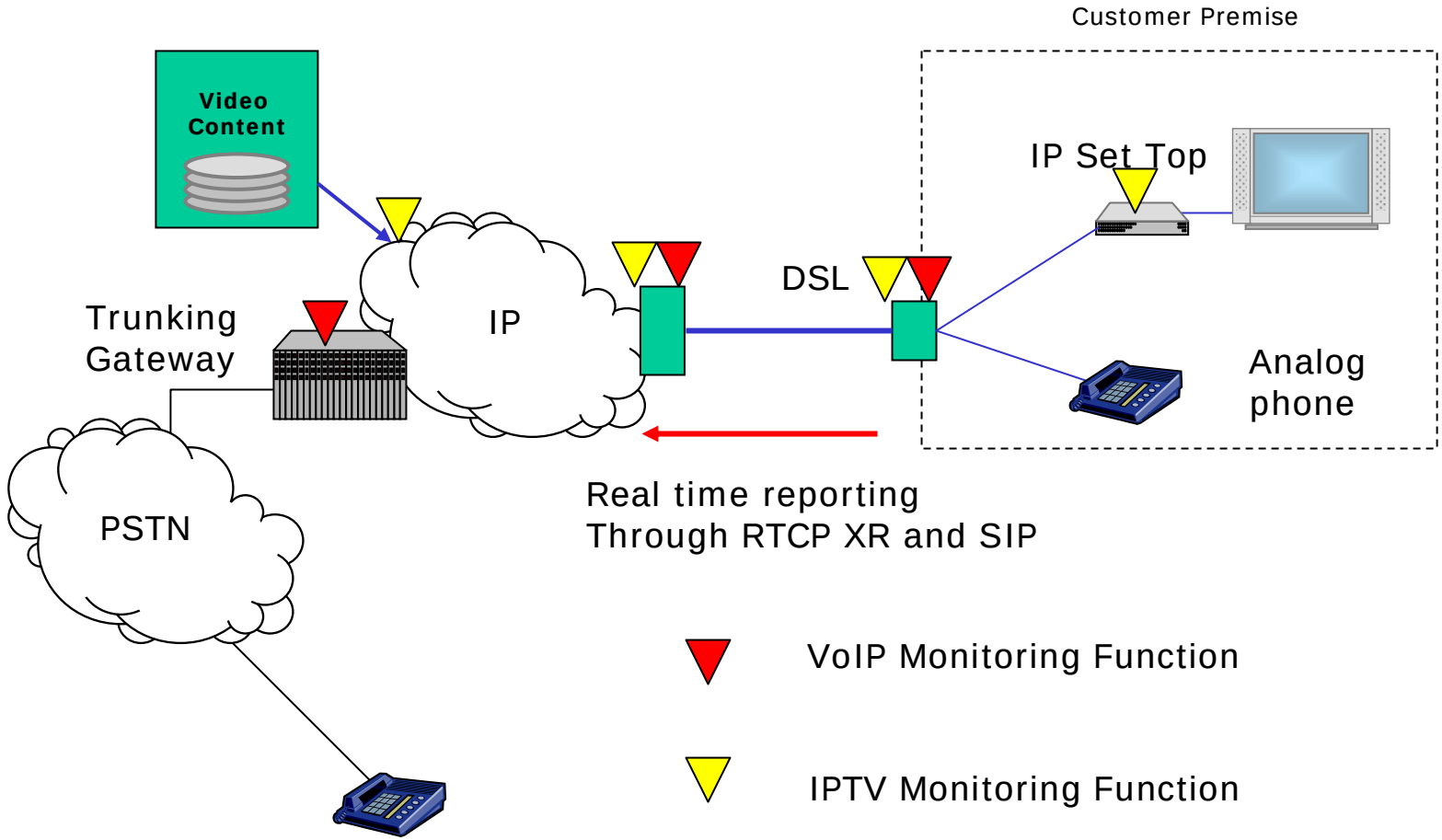

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Final thoughts

- Carriers delivering services over their own infrastructure
  - Better managed, fewer issues
  - Can identify problem areas
- Content and service providers using infrastructure provided by others – **Internet**
  - **Not managed: more problems,**
  - **Still, can locate problem areas**
- The future: Services to the **User** not the **Location**
  - **Problems will vary depending on user location**
  - **Same tools can be used irrespective of location**

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Summary

- VoIP and IPTV Deployments can suffer from performance problems
  - Transient IP problems due to congestion
  - Content/ environment/ encoding problems
- Monitoring functionality can be embedded directly into residential gateways, IP set tops…..
  - Least cost, closest to the customer
- Protocols and performance measurement technology already exists
  - Mix of ITU standard, extended standard, proprietary algorithms
  - Already available in silicon

Thanks!

Questions?