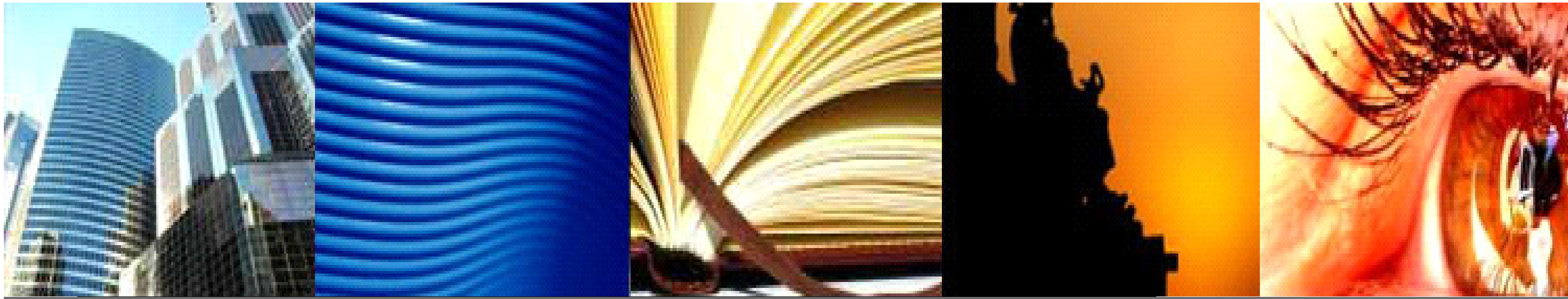
MultiPlay QoS / QoE test & monitoring



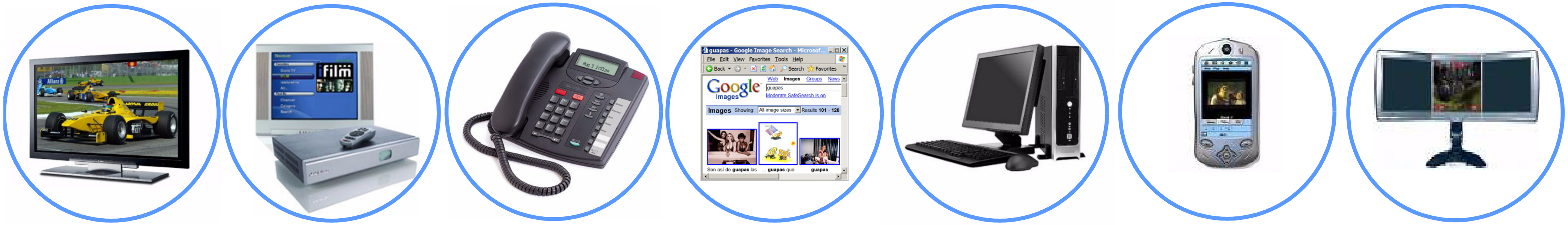
Introduction to:

Integrated Multimedia Test System (IMTS)
Enhanced TV Monitoring System (ETVMS)

ALBEDO Telecom
the Path to Excellence

The Triple Play Challenge

IPTV | VoD | VoIP | Internet | VPN | Mobile | Gaming



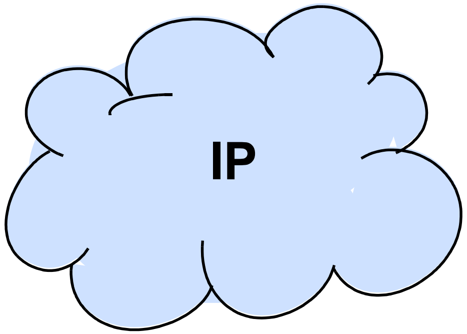
Triple play is a business concept; a bundle of services rather than a completely new development.

1. **Triple play is not a new technology**, but a marketing concept for delivering three services: broadband access, television and telephone services over a single access network.
2. If mobile services are included, the bundle is often referred to as **Quadruple Play**.
3. There are two concepts closely related to triple-play:
   - **Service bundling**: all the services are bundled into a commercial product.
   - **Technological convergence**: one network supports voice/data/video applications.
4. Triple play can be delivered over various network types - copper, fibre, coaxial and wireless.
5. Inter-operability is not a requirement, but **IP is at the heart** of every implementation.

Triple Play business: provider view

Network Convergence

- IP-centric
- Packet-oriented
- QoS-enabled
- Multiservice
- Multiterminal

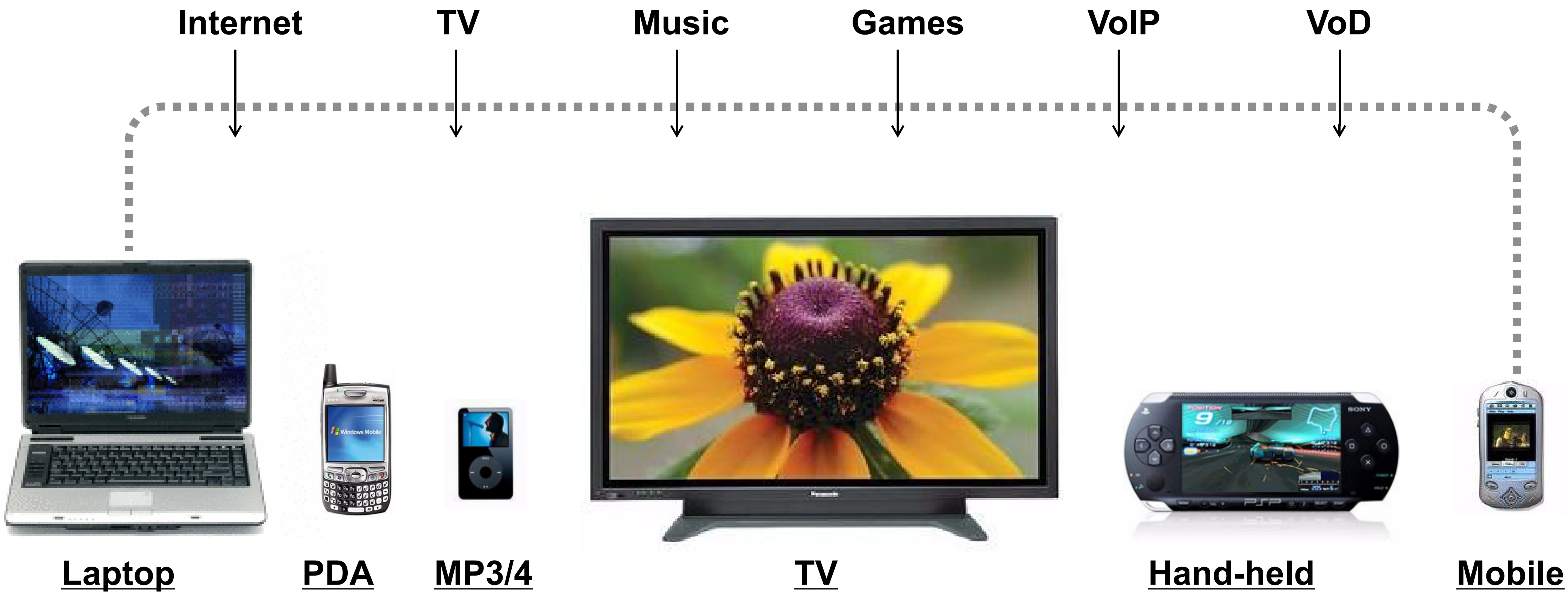


Multiple Services

- Internet access
- Telephony / Video calls
- Television
- Video-on-Demand
- Mobile bundling

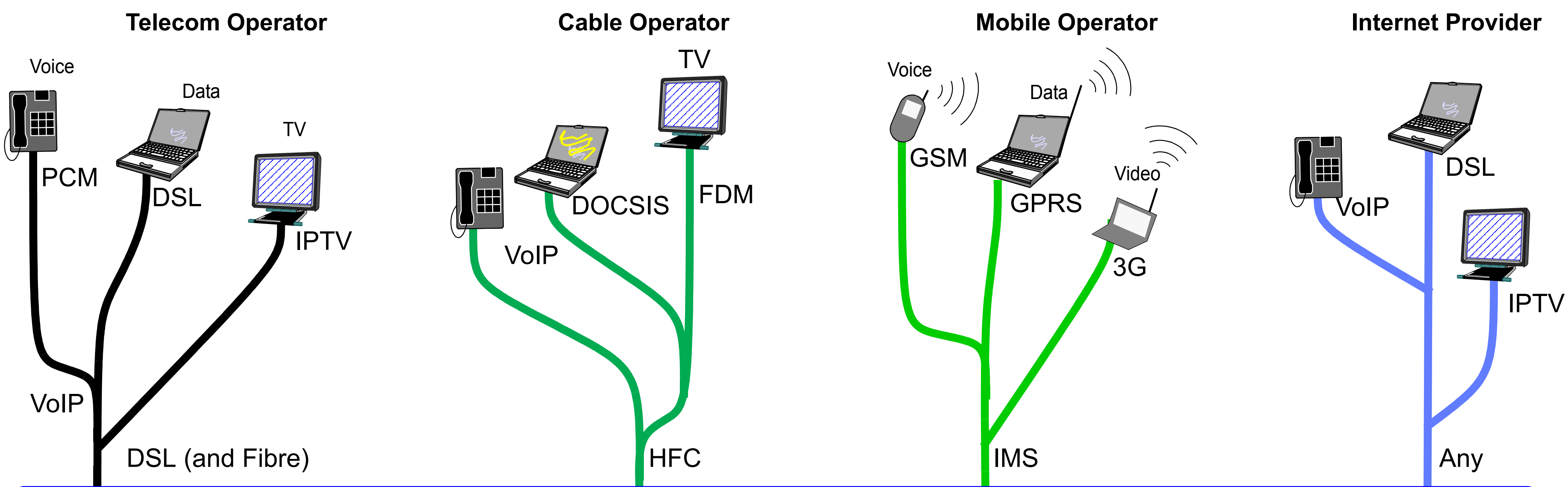
Telecom operators are embracing a new strategy to deliver new, thrilling services by means of **next generation networks**. This packet of services includes **line rental** and **fixed telephony** with a combination of **Internet access**, **IP television**, **video-on-demand**, **entertainment applications** and, eventually, **cellular phone** services.

Network Convergence and Device Diversity



Triple Play is not only a set of multiple information flows, but it is a way to make a wide range of devices and terminals manage data, audio and video applications.

The Business Challenge for Service Providers



Telcos, Cable, Mobiles and ISPs Become Competitors

Threats

- Voice revenue drop
- Attacked by ISP in VoIP
- LLU (Local Loop Unbundling)
- High churn

Opportunities

- Triple Play

Threats

- Telcos video entry
- Access restriction

Opportunities

- Two-way upgrading

Threats

- ARPU drop
- Flat subs growth
- Fierce competition

Opportunities

- New video technologies
- 3G, Triple Play

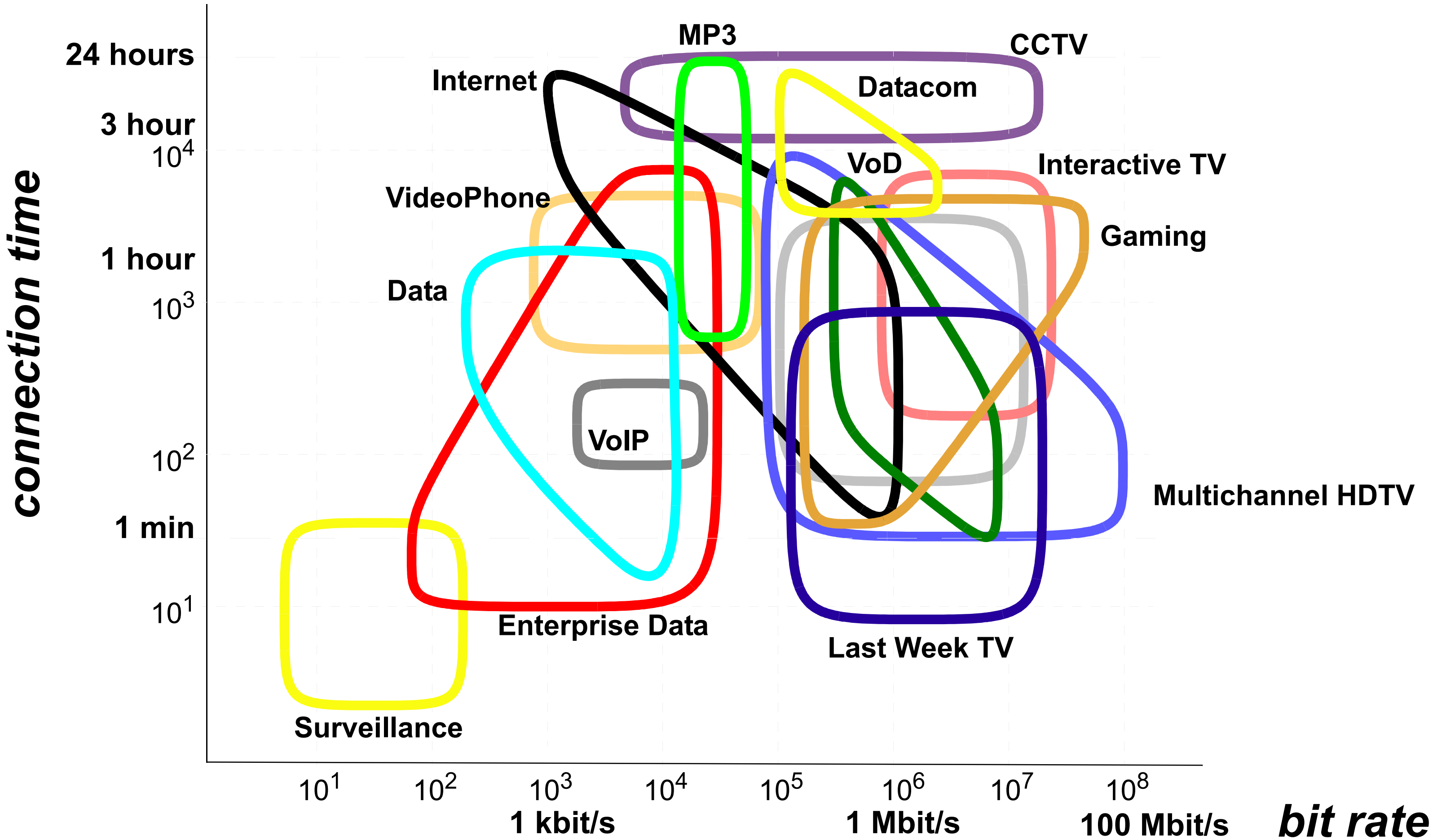
Threats

- Limited market size
- Competition from ISPs
- Networks not owned

Opportunities

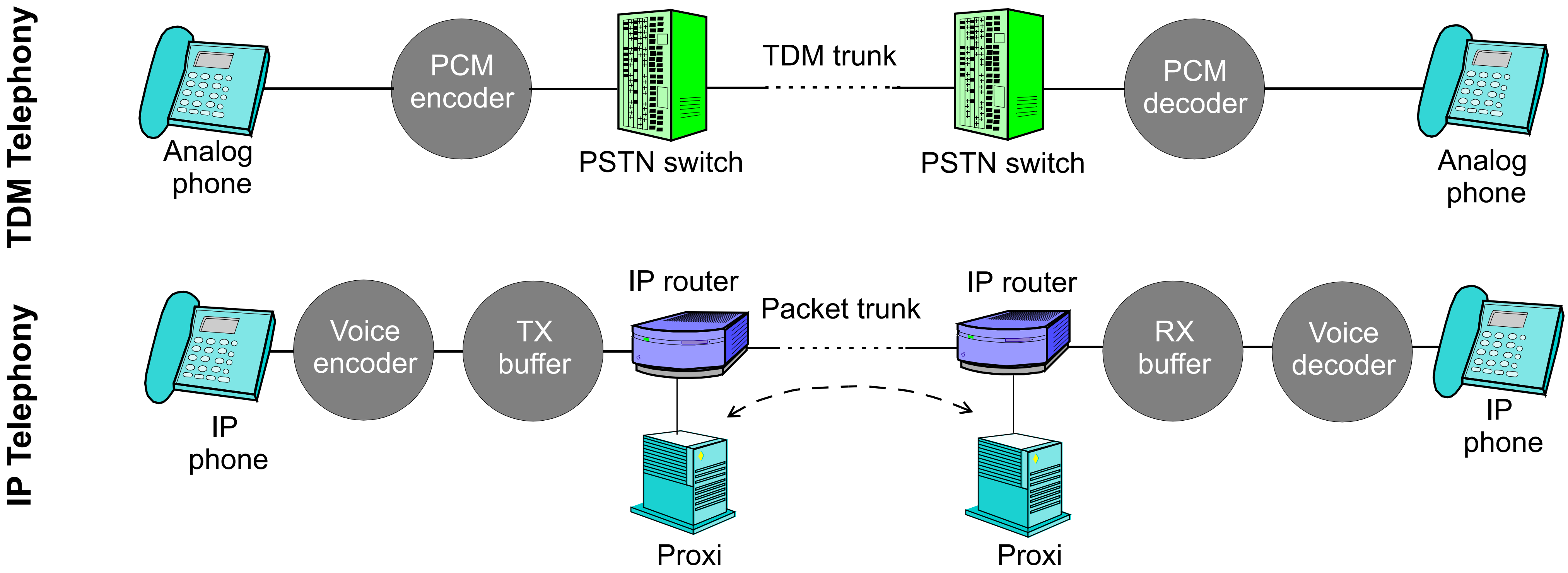
- More bandwidth
- Triple Play

Triple Play Applications



The new IPTV services can be seen as the combination of television with the highly interactive of Internet concepts. The result is a number of new applications based on the delivery of audiovisual contents in a bidirectional, customized and controlled way.

Voice over IP



IP telephony can potentially bring benefits to subscribers, service providers and carriers:

- *Subscribers* benefit from lower call costs because operators can avoid paying interconnect charges.
- For *carriers*, IP telephony brings the ability to integrate voice and data over the same network.
- For carriers it offers new opportunities by means a new class of services that goes beyond classical telephony such as video telephony, integration of mobile and fixed telephony or telelearning.

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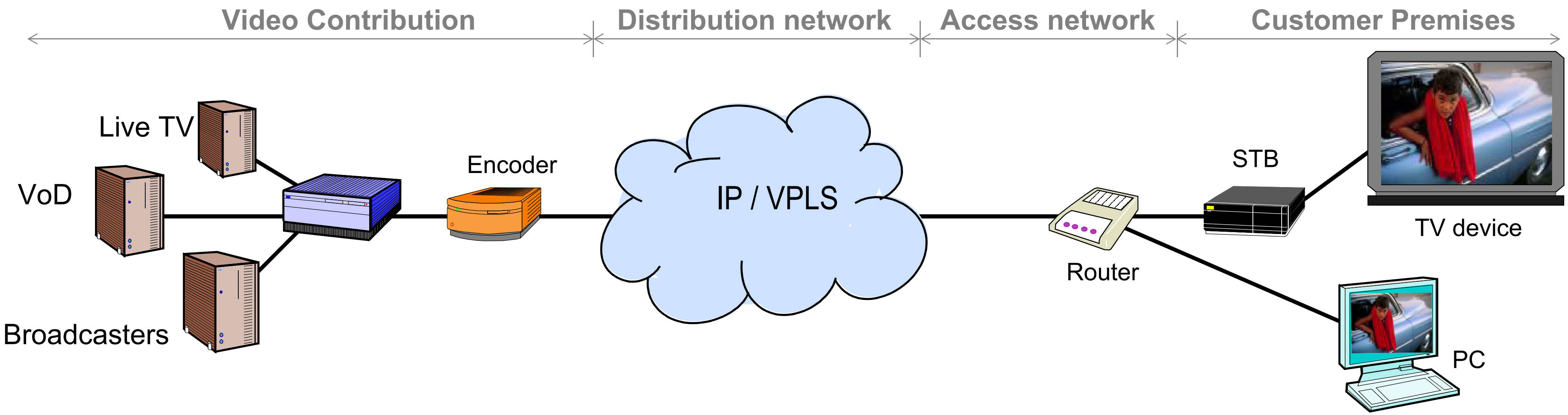
IP Television



IPTV is made with at least four component:

1. Video contribution, which may include television and video on MPEG demand applications. Contents is coded, formatted and streamed according the addressing scheme and the protocols to transport the signal and distribute the programs across the subscribers.
2. UDP is the most common higher-layer envelope to forward packets across the network.
3. Access network, audio an video packets reach the customer premises thought the access network which may be based on ADSL2, ADSL2+, VDSL2, FTTN, PON, or WiMax
4. Customer Premises, to reach the Set Top Box (STB) where are signals decoded and finally displayed on a TV or a PC. The Internet Group Membership Protocol (IGMP) is used for channel tuning.

The Video on Demand (VoD) applications are a bit different to live IPTV since it requires the establishment of a point-to-point unicast relation between the server and the subscriber to enable subscribers to select and watch an stored video interactively across the IP network.

There are two groups of VoD applications:

1. **Streaming VoD**, real-time service the video is downloaded directly from the server to the TV.
2. **Downloading VoD**, best-effort service, the file is downloaded and saved before being displayed

Personal Video Recording Services

Each subscriber has his own storage disk at the network, or at the subscriber site, to record programs that will be playbacked according user convenience using VCR-like functions. Implementations:

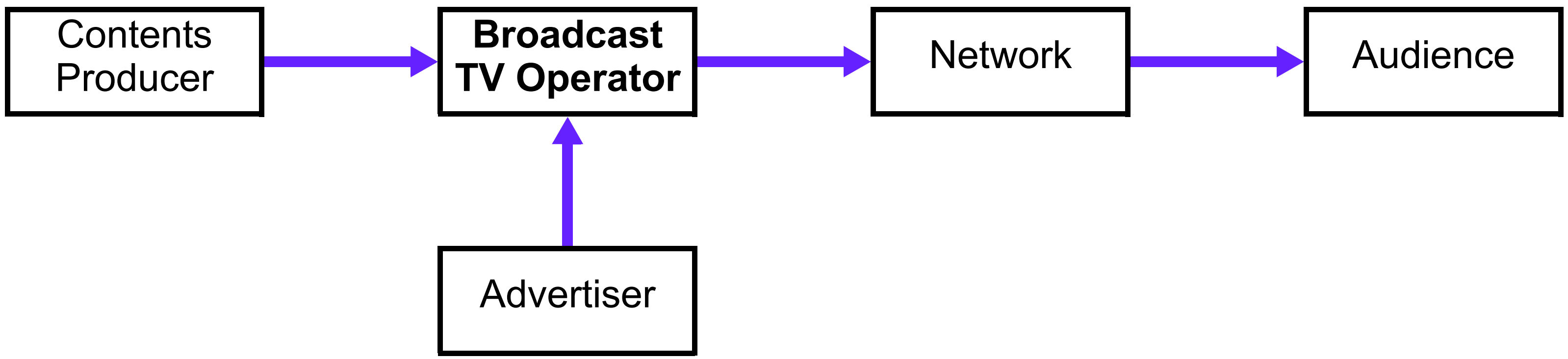
- **Networked Personal Video Record**, user can record TV programmes in the network-based server.
- **Client Personal Video Record**, user have their own PVR device at home
- **Private TV**, closed groups of user can create their own TV uploading their videos and programs to be downloaded by VoD or even scheduling the transmission to a their associated subscribers.
- **Last week TV**, the IPTV operator may offer the complete retrieval of last week programs
- **Time Shift TV**, subscriber of real time TV can record the program while watching it. This allows pauses, or to skip the ads section, and then go back again to some time point of the live broadcasting.

Triple Play Strengths and Weaknesses

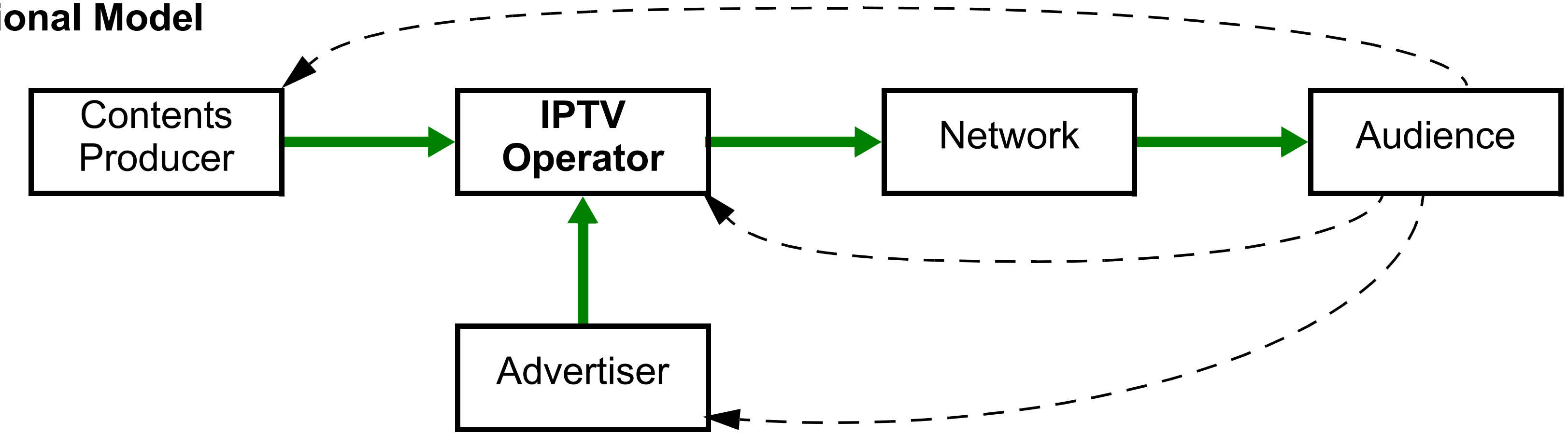
Strengths - Bidirectionallity - Network Convergence - High Demand of TV services	**Opportunities** - Interactive TV services - Increase the ARPU - Customized publicity
Weaknesses - Immature technology - Premium contents required - Complex and expensive	**Threats** - Television is a mature market - Sold as a cheap bundle - Competitors are moving to IP

Strengths: Bidirectionallity

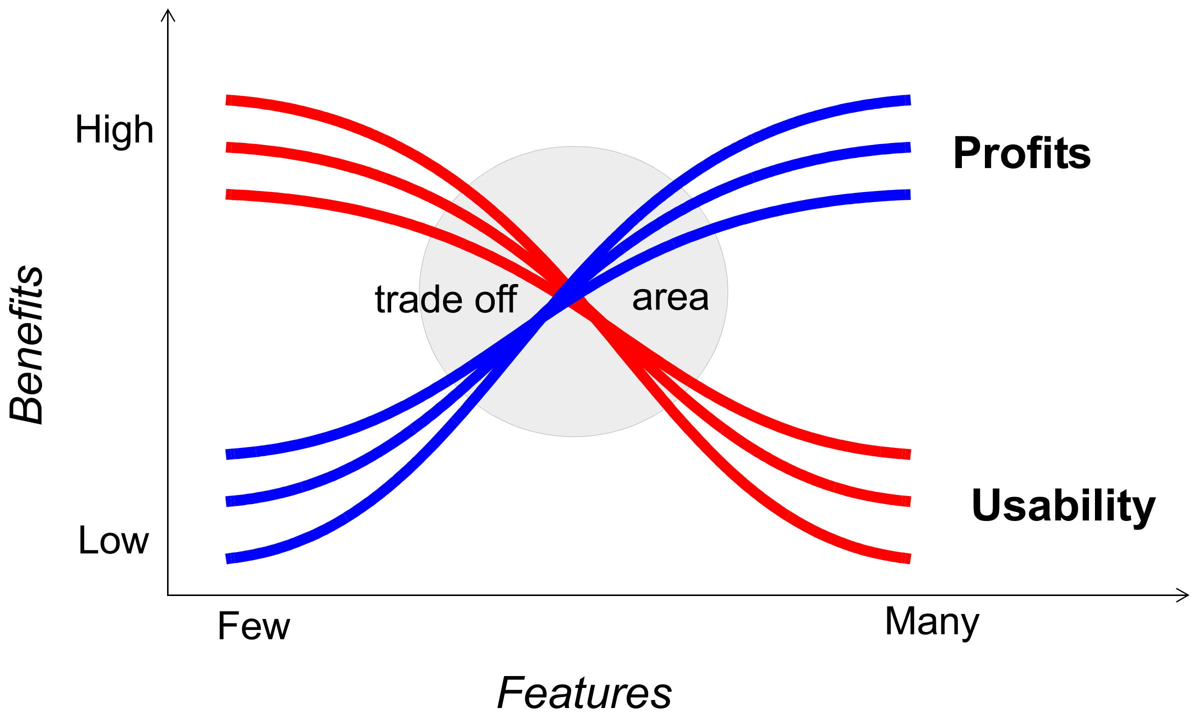
TV: Unidirectional Model



IPTV: Bidirectional Model



Weaknesses / Threats



To create real demand for audiovisual services delivered over IP will not be enough bundling television with broadband access and phone services

- **Immature Business,** providers must discover their specific market segment.
- **Quality Contents**, which is fundamental to enter and to stay in such a mature market of TV.
- **Complex,** interaction increases the complexity of the middleware, and the user interfaces as well.
- **Very Expensive,** consolidating
- **Competitors**, will react offering lower prices, consolidating companies and improving the services

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Quality of Service (QoS) Control

Section

Alternatives to QoS Control

Audio

	VoIP	Streamed MP3
Bandwidth	*12~106 kbit/s*	*32 ~ 320 kbit/s*
Loss	*1%*	*2%*
Delay	*150 ms*	*5 s*
Jitter	*30 ms*	*Jitter buffer*

Video

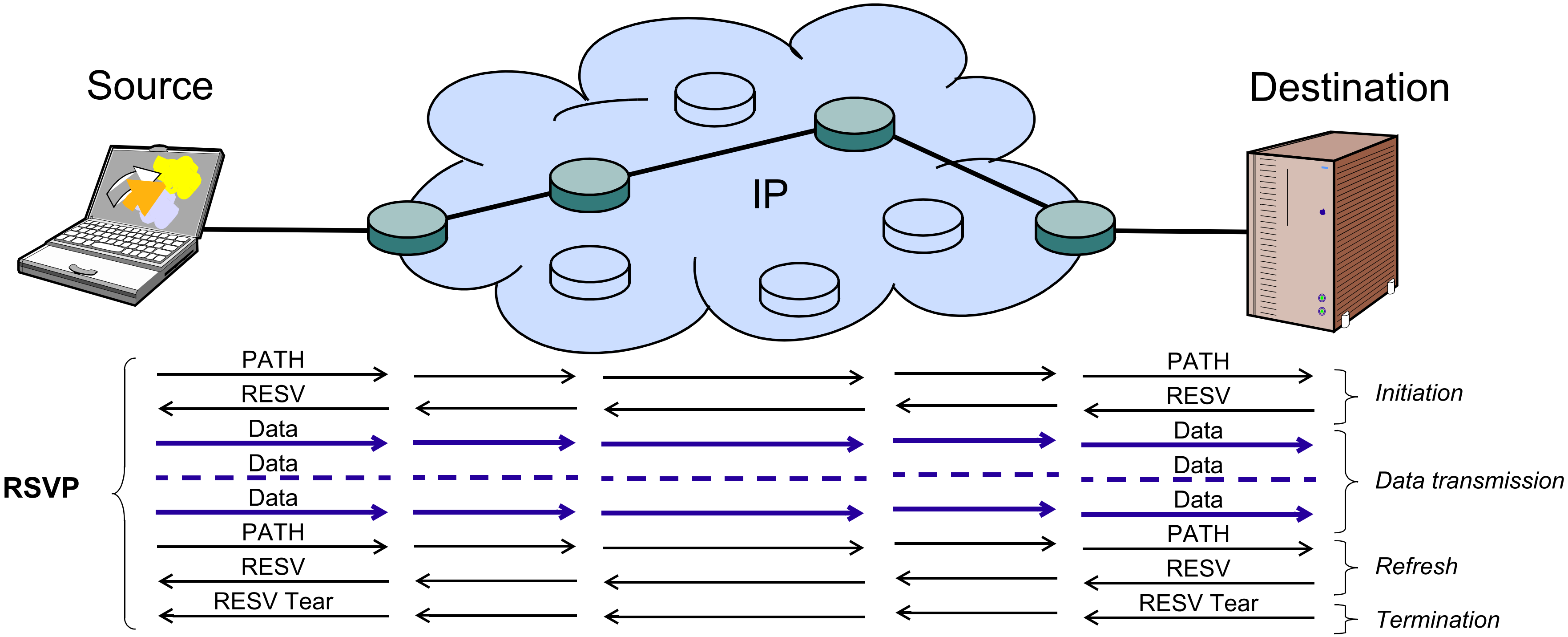
Bandwidth	*0.005 ~ 10 Mbit/s*
Loss	*2%*
Delay	*5 s*
Jitter	*Jitter buffer*

Data

Bandwidth	*Variable*
Loss	*Sensitive*
Delay	*Insensitive*
Jitter	*Insensitive*

1. Over-provisioning
   - Traditional solution for private and public networks
   - May work for a while; requires regular updates
2. Traffic Engineering (MPLS)
   - Improves routing performance and indirectly helps QoS
   - Compatible with most networking technologies and protocols
3. Resource Reservation (IntServ)
   - End-to-end guarantee of QoS; needs a signalling procedure (RSVP)
4. Differentiated routing (DiffServ)
   - Edge routers classify packets into priority classes

Integrated Services (IntServ)



Based on resource reservation using end-to-end signalling

- Applications require resource management
- Resource reservation is done per flow by means of Reservation Protocol (RSVP) signalling
- Guaranteed service and controlled load for QoS-sensitive flows
- Source-to-destination packet handling at each hop and per each flow
- It's not very scalable: RSVP is end-to-end and too complex
- Large packet processing and resource reservation makes RSVP inappropriate for core routers

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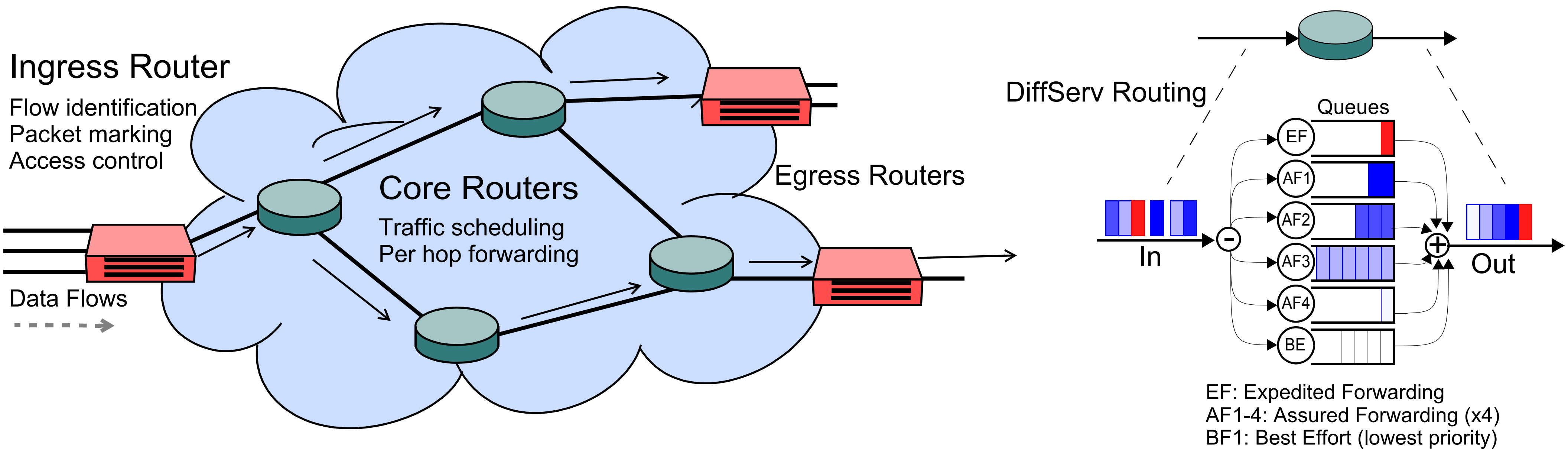
Differentiated Services (DiffServ)



Key QoS control is managed at the Ingress router

- IP packets are marked and classified into categories or DSCP
- In charge of packet access, shaping and policing

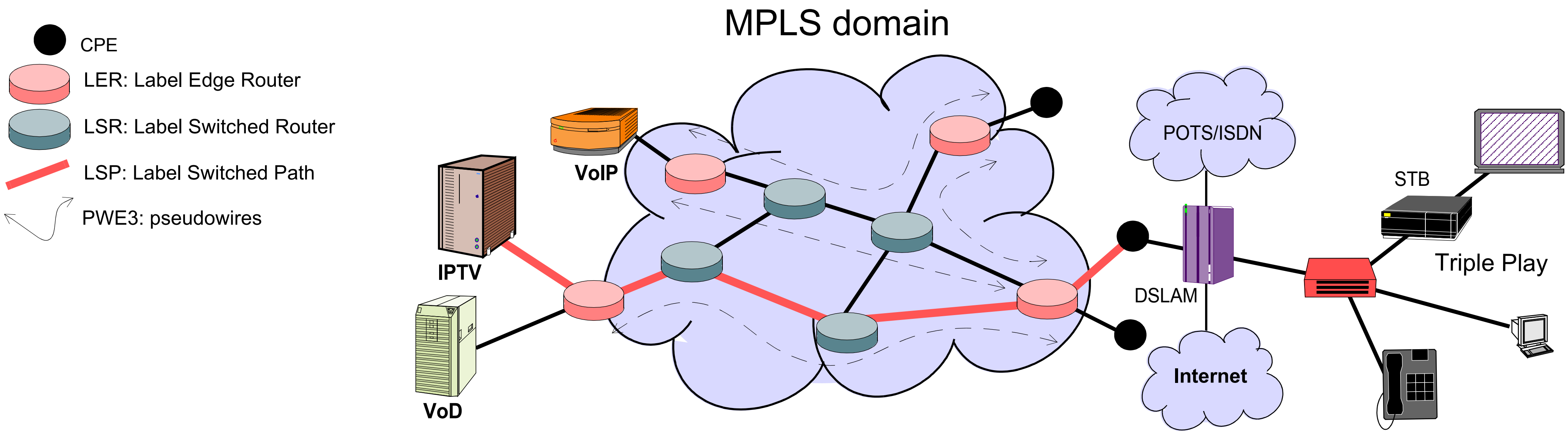
Core routers just forward packets

- Fast routing to the next hop (rather than end-to-end management like in RSVP)
- Packet scheduling per DSCP. No previous signalling, no resource reservation
- End-to-end QoS built with PHBs

DiffServ does not guarantee a QoS but manages flows differently

- Simple and scalable solution

Multiprotocol Label Switching



MPLS manages traffic streams by separating route selection and packet-forwarding functions.

Pseudowire Edge-to-Edge Emulation PWE3 require a **Tunnel label**, used for guiding the frame through the MPLS domain, and a **VC label**, used to identify each customer's traffic matching an MAC, Port or VLAN tag to a constant label.

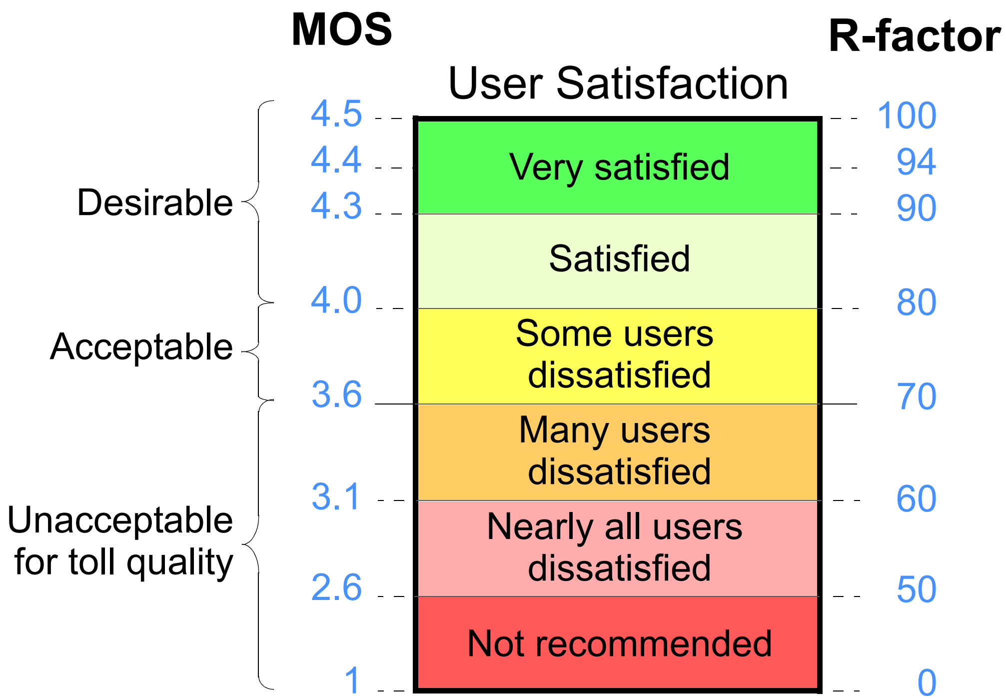
Including VPLS (the PWE3 multipoint implementation) the Metro Ethernet network can provide easily:

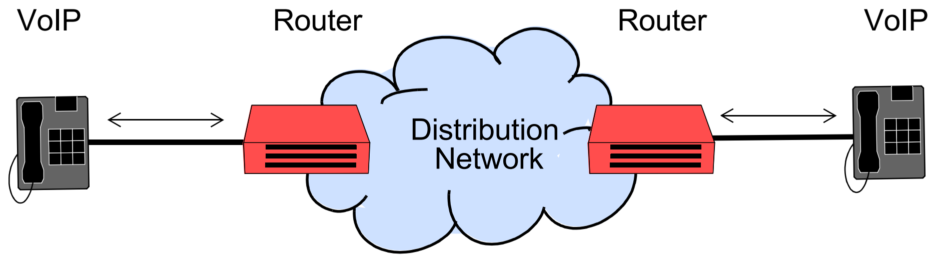
- QoS to support triple play services
- Increased scalability overcoming the MAC address explosion issues
- Integrated protection architectures
  - Advanced management

IP Network QoS control (ITU-T Y.1541)

		Upper bound QoS Parameters			
Class	**Applications**	**Delay**	**Jitter**	**Loss**	**Error**
Class 0	Real-Time, Jitter Sensitive, High Interaction (VoIP, IPTV, VTC, VoD)	100 ms	50 ms	$1x10^{-3}$	$1x10^{-4}$
Class 1	Real-Time, Jitter Sensitive, Interactive (VoIP, IPTV, VTC, VoD)	400 ms	50 ms	$1x10^{-3}$	$1x10^{-4}$
Class 2	Transaction Data, Highly Interactive (Signalling)	100 ms	Undefined	$1x10^{-3}$	$1x10^{-4}$
Class 3	Transaction Data, Interactive	400 ms	Undefined	$1x10^{-3}$	$1x10^{-4}$
Class 4	Low Loss Only (Short Transactions, Bulk Data, Video Streaming, VoD on local disk)	1 s	Undefined	$1x10^{-3}$	$1x10^{-4}$
Class 5	Best Effort IP Networks	Undefined	Undefined	Undefined	Undefined

VoIP Opinion Models (in-service test)





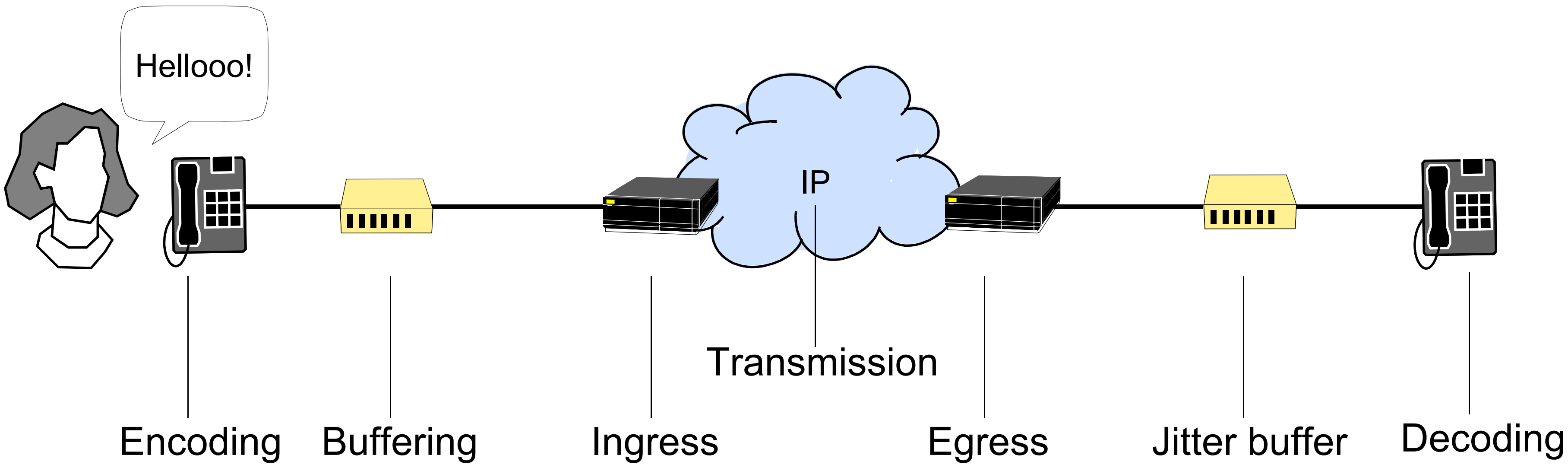
Conversational MOS evaluation (Bidirectional)

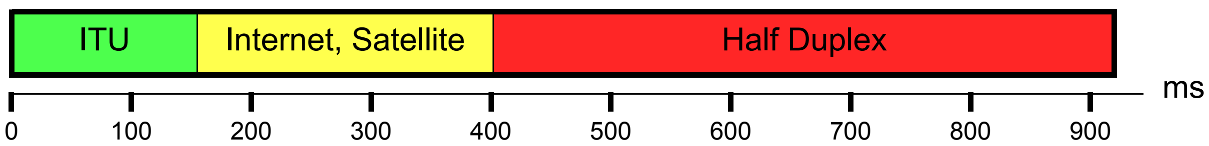
MOS (Mean Opinion Score): To arrive at an MOS score, a tester assembles a panel of "expert listeners" who rate the quality of speech samples that have been processed by the system under test.

- Ideally, a panel would consist of a mix of male and female listeners of various ages
- The samples should reflect a range of typical voice conversations
- Each panelist rates the quality of the system output from 1 to 5, with 1 indicating the worse and 5 the best
- The scores of the panelists are then averaged

E-Model: a computational model that uses transmission parameters (errors, packet loss, delay, echo...) to predict the subjective quality of voice. Good for conversational MOS evaluation using R-factor.

VoIP Delays

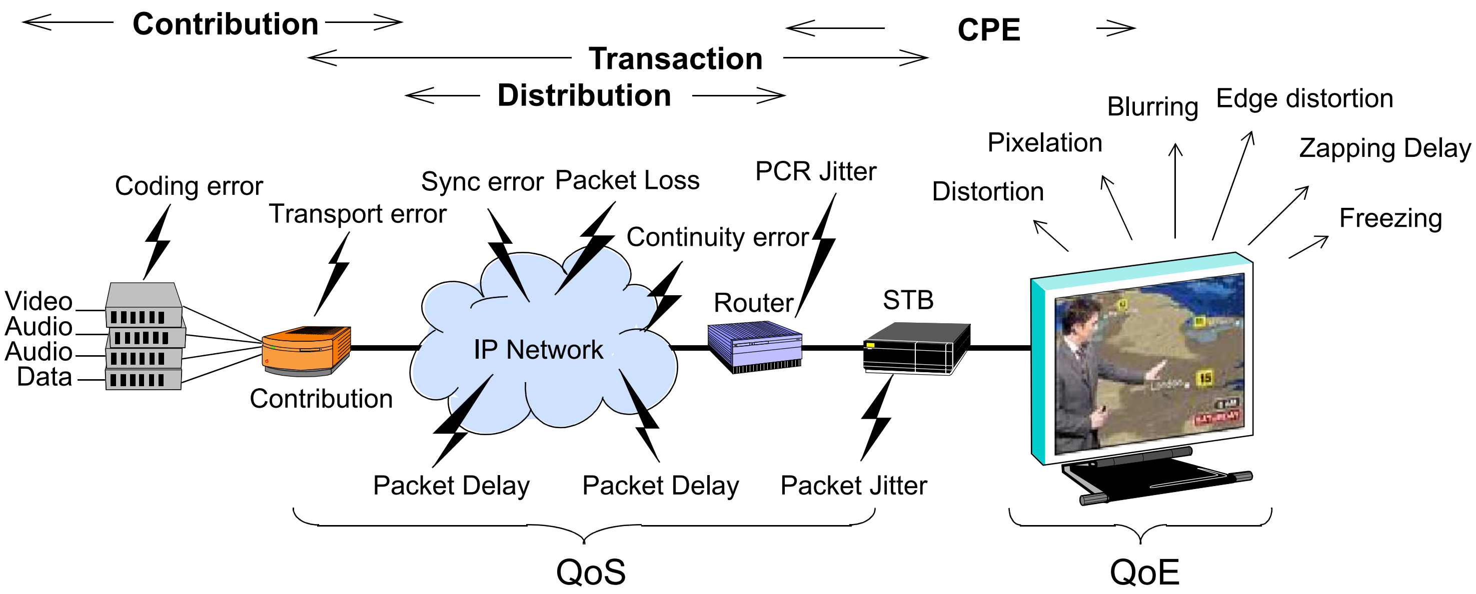




Rec. ITU-T G.114, unidirectional delay in ms:

- **0 - 150**: acceptable for most applications
- **150 - 400**: acceptable, but degrades the QoS
- **> 400**: unacceptable; only for voice messages or walkie-talkie gadgets

IPTV: The Subscriber's Point of View



Where	*QoS Event*	*Where*	*QoS Event*
Head-end & Contents	- Coding distortion - Server overload - Coder impairment - Encoder impairment - Error Indication	**Distribution Network**	- Network contention - IP packet loss, jitter, delay - RTP packet loss, jitter - TCP Retransmissions
Transport Stream	- PCR jitter - Continuity error count - Synchronization error - Interarrival jitter - Error on PSI table - Unacceptable latency	**Transaction**	- IGMP latency (IPTV) - RTSP latency (VoD)

Quality of Experience (QoE)

Quality of Experience (QoE) is intended to measure how good the service is from the customer's point of view, rather than under the service point of view as the Quality of Service does. QoE is a subscriber centric paradigm when the IPTV service is degraded producing effect like:

- **No service at all**, frequent service interruptions, wrong formatting, very high latency, authentication problems to watch private programs like pay-per-view.
- **Video degradation**. freezing, blurring, visual noise, loss of color, edge distortion, pixelation, tiling.
- **Audio degradation**. Drop out, lips synchronization, voice distortion, bad signal to noise relation, echo.
- **Poor Interaction**. No zapping capability, loss of VoD functions like start/stop/fwd

Verify the IPTV Service

Video rendering is important for qualitative video performance assessment.

A single lost packet in an MPEG-2 video stream is displayed as several errored pixels or even lines in

- a video frame (spacial error propagation),
- several video frames with errored pixels (temporal error propagation).

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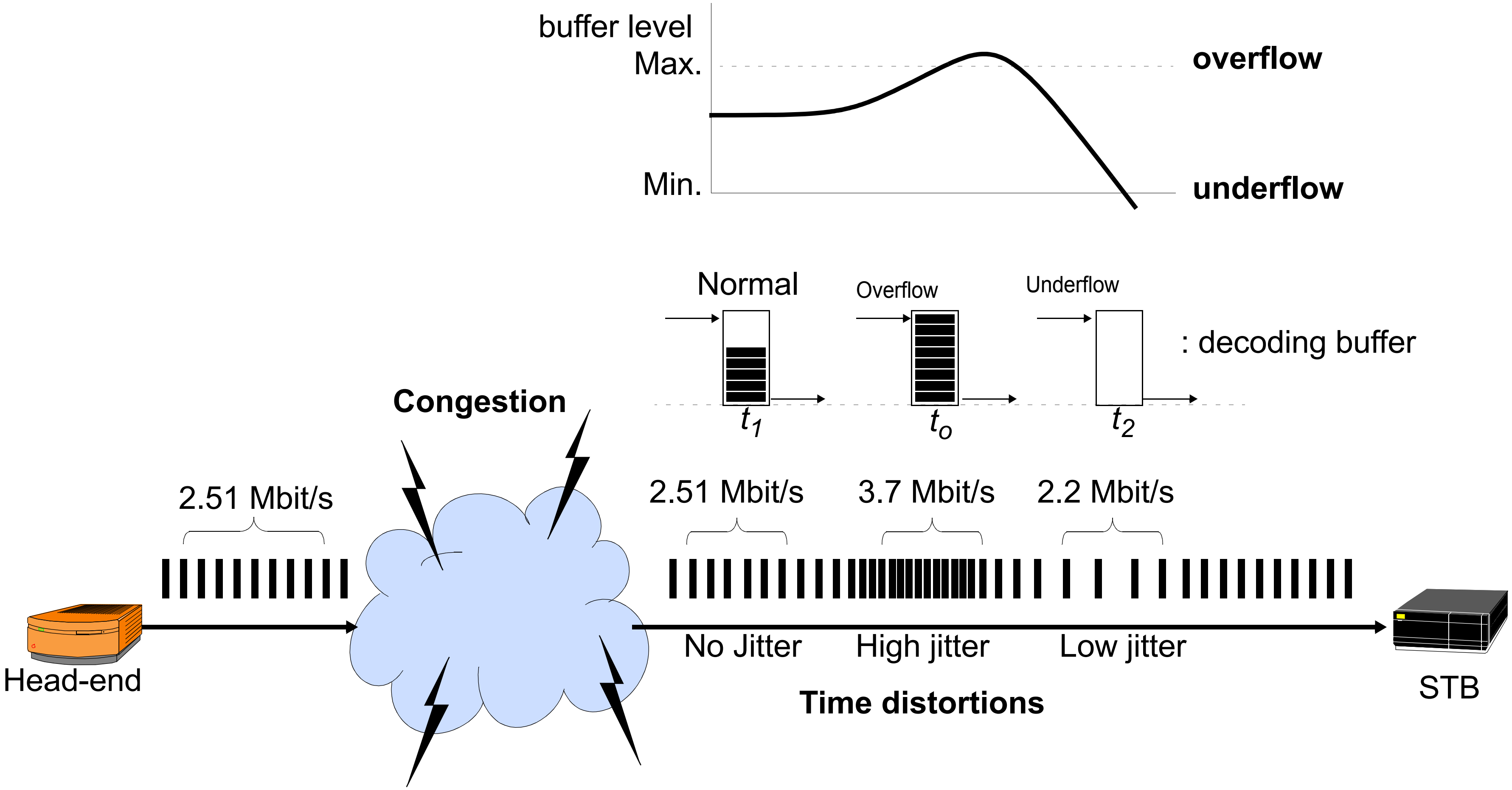
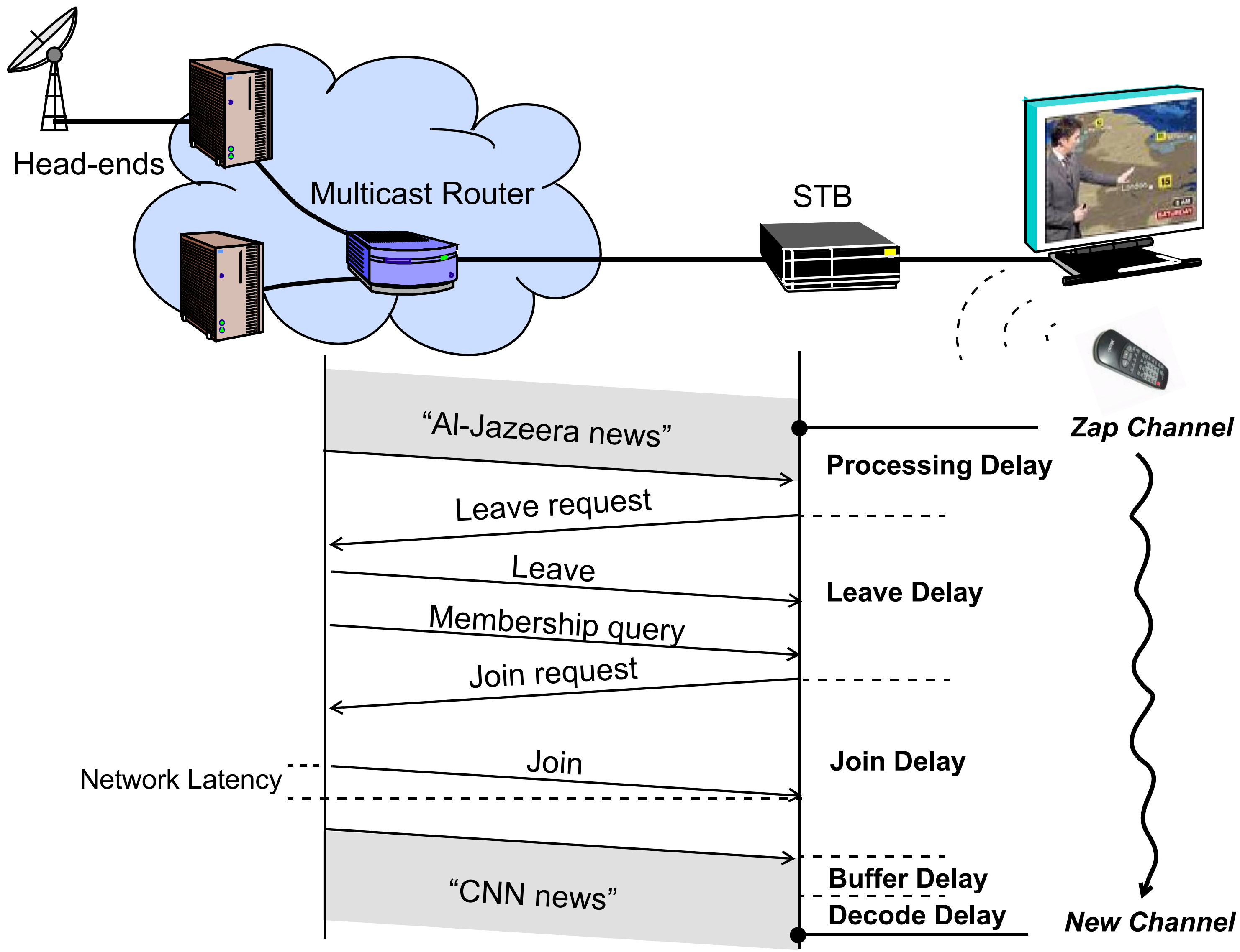
Interarrival Packet Jitter



Interarrival Packet Jitter is filtered with he decoding buffer but. Higher rates may produce decoder buffer overflow while lower rates me cause buffer underflow.

The consequence is, in both cases, a bad quality.

Video IGMP Delay



Transport Stream impairments (TR 101 290)

Tests are grouped into three tables according to their importance for monitoring purposes.

1. **Priority 1**, This category classifies the critical elements necessary for decoding of the MPEG signal. The events can be grouped into three types:

- *TS sync loss, PAT and PMT error*,
- *Continuity Count error*, indicate loss of packets, dropped packets, out of order or packet duplications.
- *PID error*, occurs when the data of a referenced PID is lost for a period of time

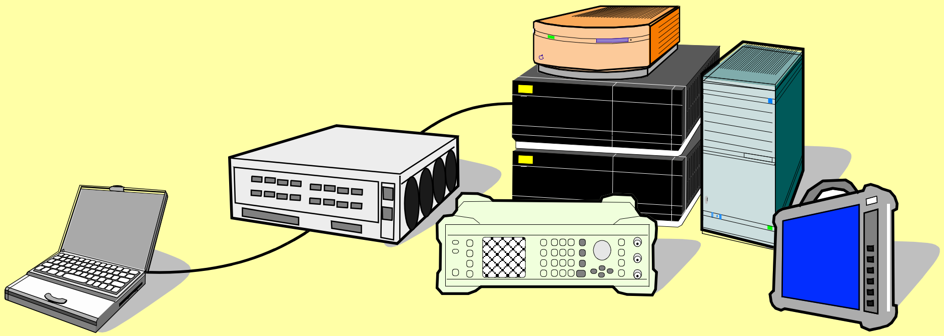
2. **Priority 2**, The following elements should be kept under control to achieve the quality targets:

- *CRC error*, indicates corrupted data in the PSI tables.
- *Timing events*, indicates difficulties to recover PCR then synchronization problems are likely.
- *CAT error*, there is an indication to decode a private program but no CAT table has been found to unscramble it

3. **Priority 3,** optional category since many implementations have simplified the structure of the TS.

- *Buffer error*, For this indicator a number of buffers of the MPEG-2 reference decoder are checked whether they would have an underflow or an overflow.
- *Unreferenced PID*, Each non-private program data stream should have its PID listed in the PMTs.
- *SDT error*. The SDT describes the services available. Without the SDT, the STB is unable to give the viewer a list of what services are available

Integrated Multimedia Test System (IMTS)



Section

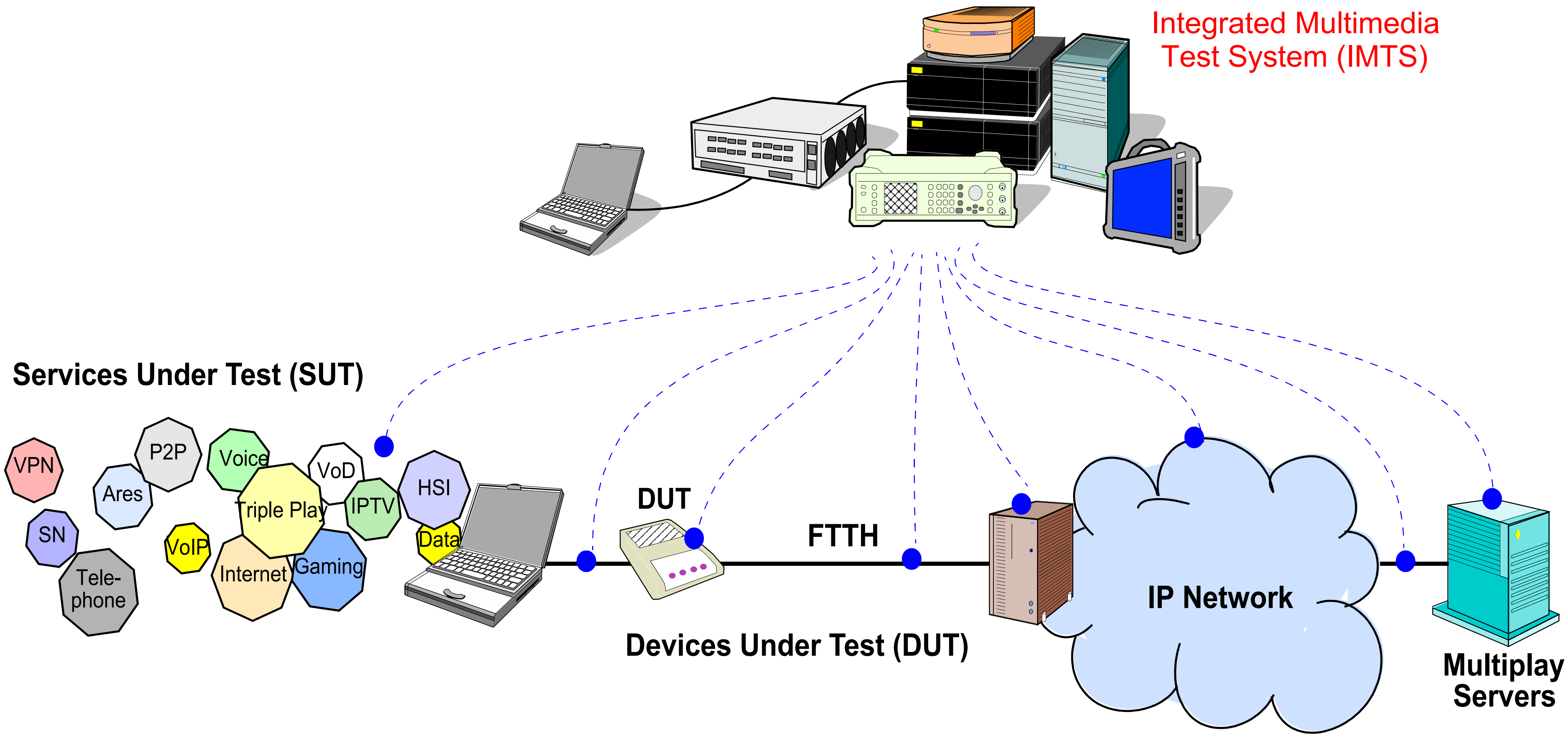
IPTV, VoIP & HSI Lab Solutions

ALBEDO Integrated Multimedia Test System (IMTS)

IP Television | **Video on Demand** | **VoIP** | **email** | **FTP** | **P2P** | **Internet**

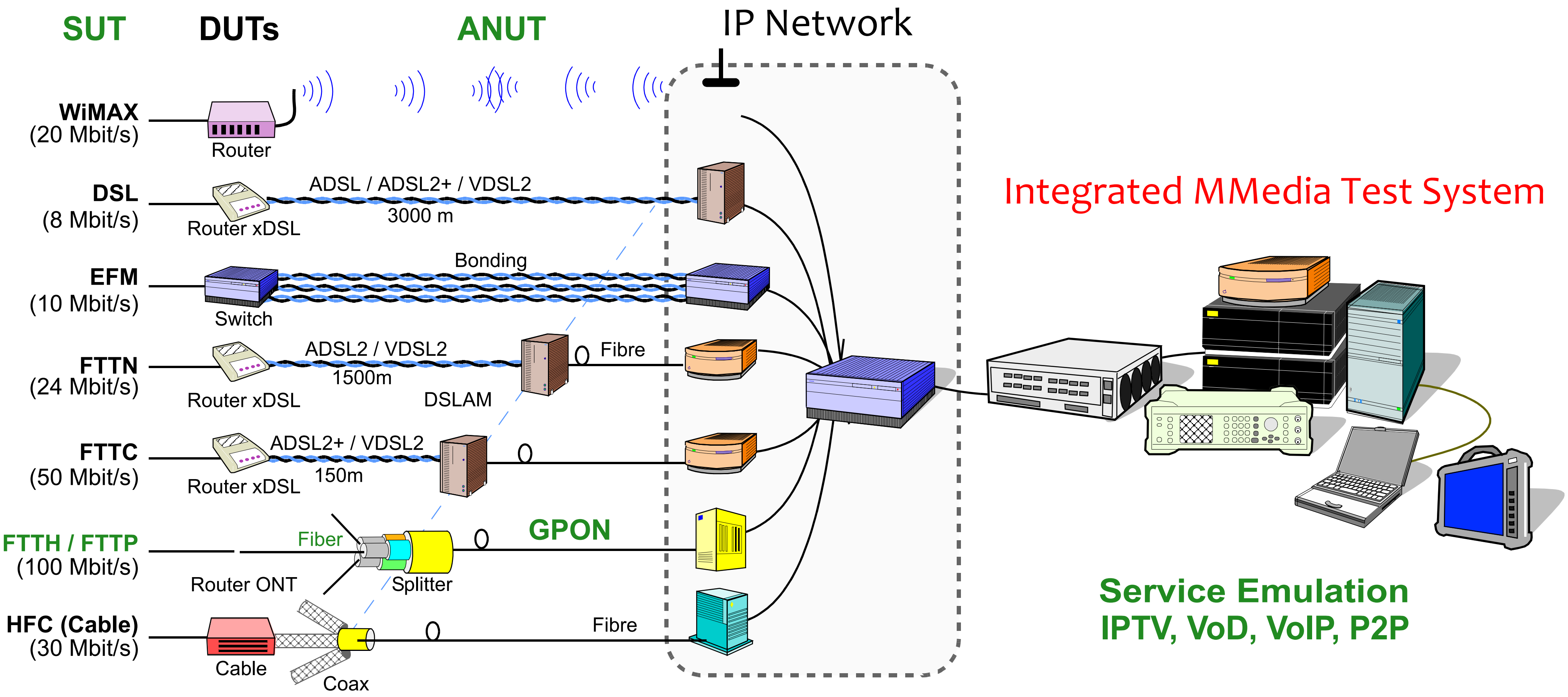
The system allow the verification of network elements and their compliance capabilities of IP phones, STB, IPTV, PC and components for interconnection (wireless, coax, PLCs).

Integrated Multimedia Test System



This Multiplay Test System includes a series of facilities, equipment and optional services to provide an optimal solution, scalable and effective safeguards need to evolve with complete ability to create new tests and trials expected in futur.

Acces Network Verification



The Integrated System Test verifies network and the Multiplay services such as IPTV or VoIP particularly in the case of a failure or bad quality is not determined the cause if it is on the network or device that is being evaluated. The System is a known and 100% controlled environment. The simulation of the network and the subscriber, involves the generation of traffic, often a client / server, which is not in itself proof traffic but at the same time it is essential to ensure that evidence can function correctly.

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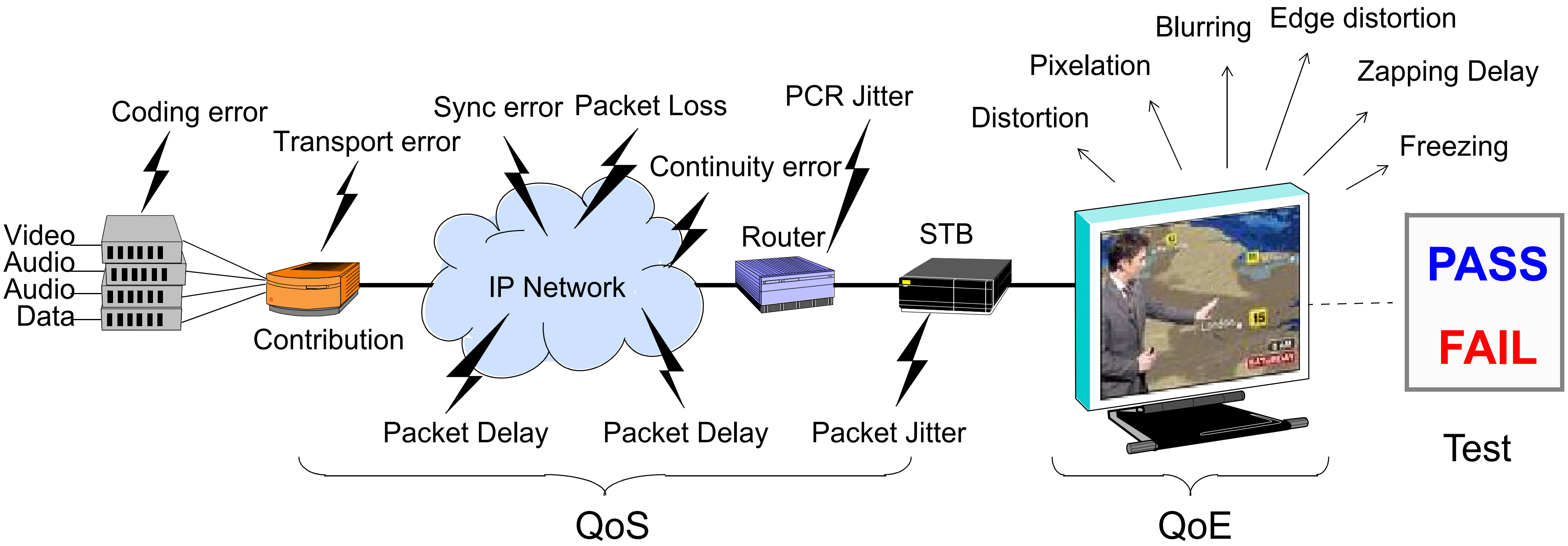
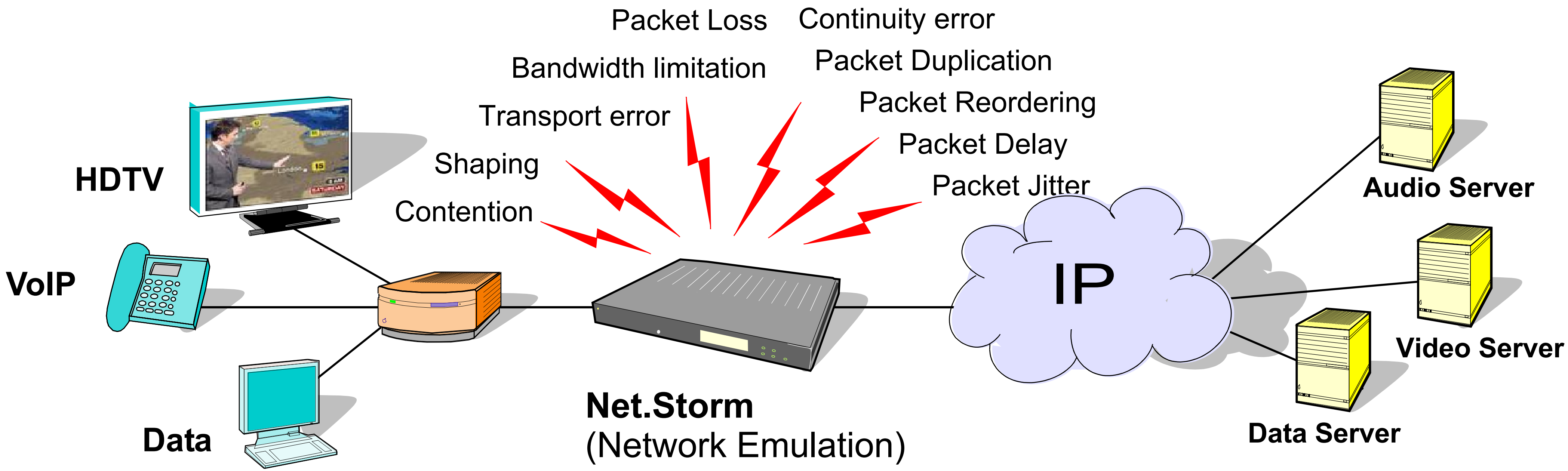
QoS vs. QoE



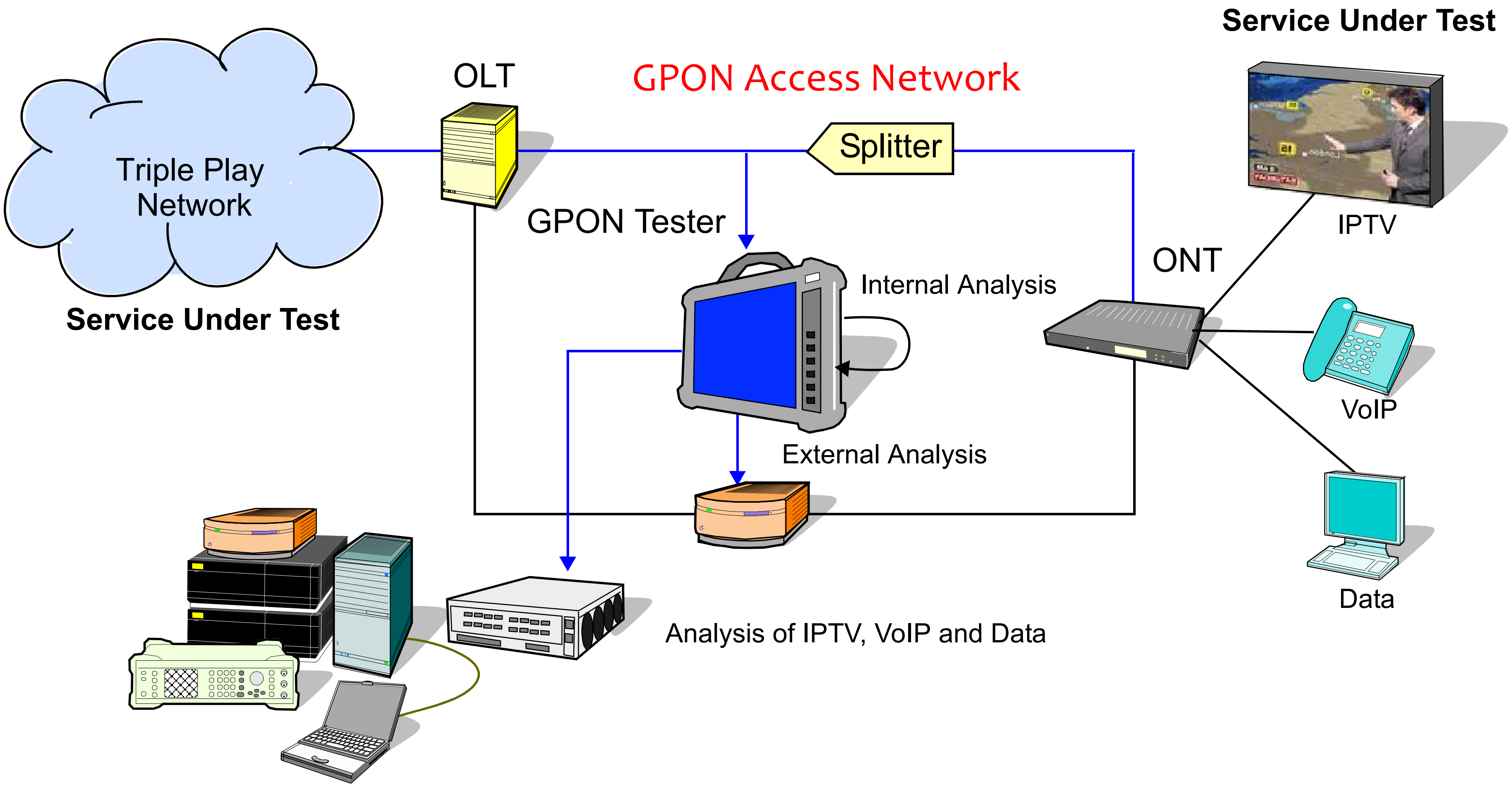
Disruptions can occur anywhere on the network and determine the quality of the network service (QoS) that affect the experienced quality (QoE).

ALBEDO Net.Storm



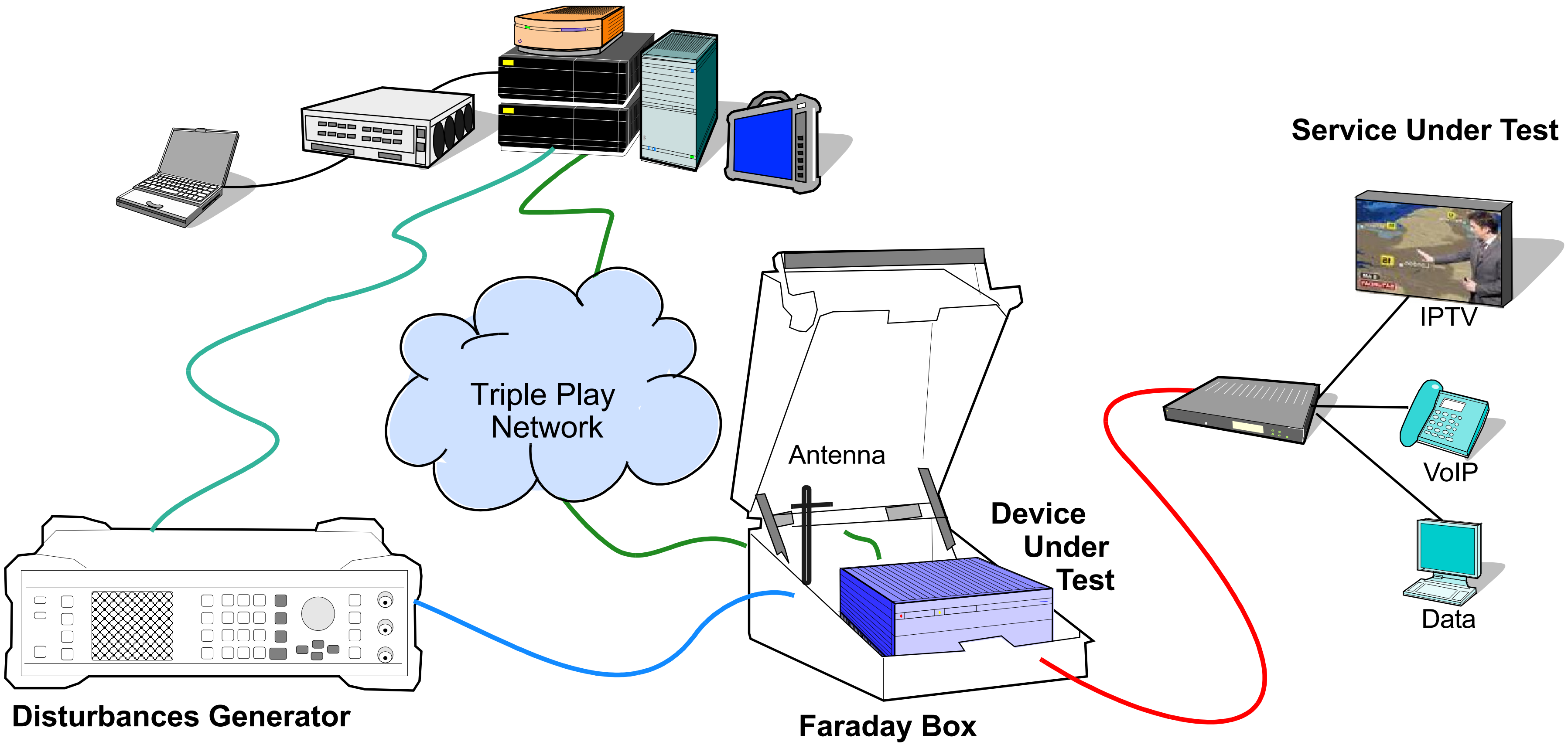
The diversity of underlying technologies, and the adaptive behavior of applications requires more sophisticated testing technologies. NetStorm facilitates the verification of new applications, services and nodes through emulation of the real nature of IP networks. NetStorm enables engineers to model and modify arbitrary performance dynamics including packet delay, jitter, bandwidth limitations, congestion, packet loss, errors and duplication on live IP packets.

GPON analysis



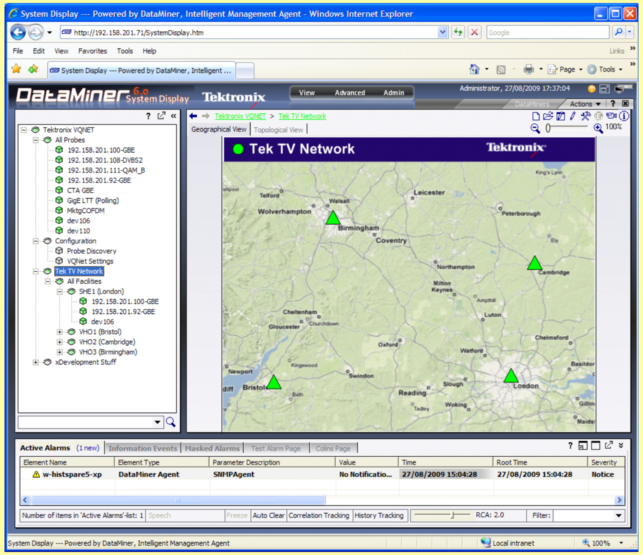
Albedo GPON analyser can capture and analyse traffic in real time and can drop data for further analysis with other applications and instruments

Acceptance Test of CPE equipment



An interfering signal in the frequency band in which you want to create disturbance in the physical environment. The equipment being measured (DUT) is inserted into the suitcase of Faraday. If it were a router, as the case illustrated in Figure, first access network to the test system and on the other client computers using the appropriate physical environment Coax, UTP or PLC. In the case of WiFi transmitter and receiver must be placed inside the Faraday Box.

Enhanced Television Monitoring Sytem (ETVMS)



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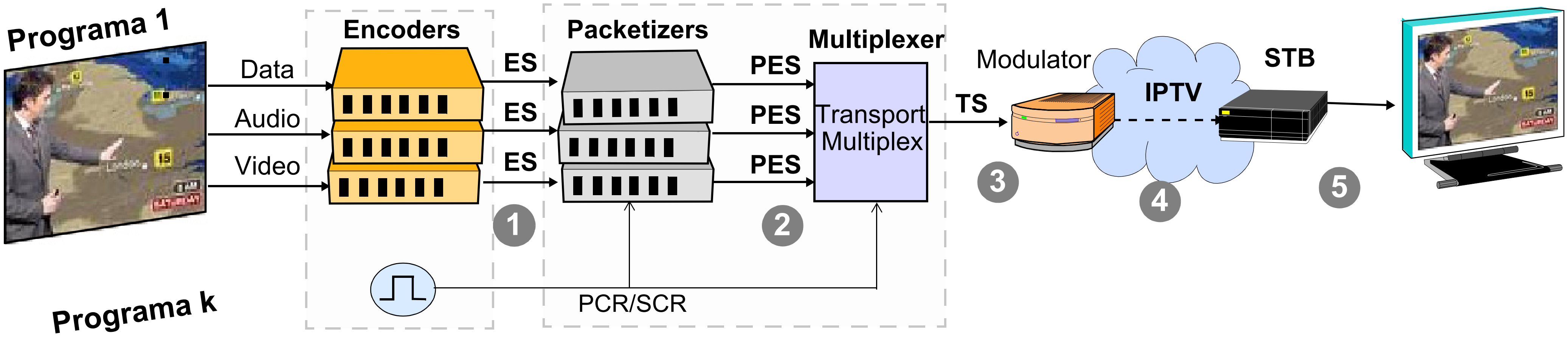
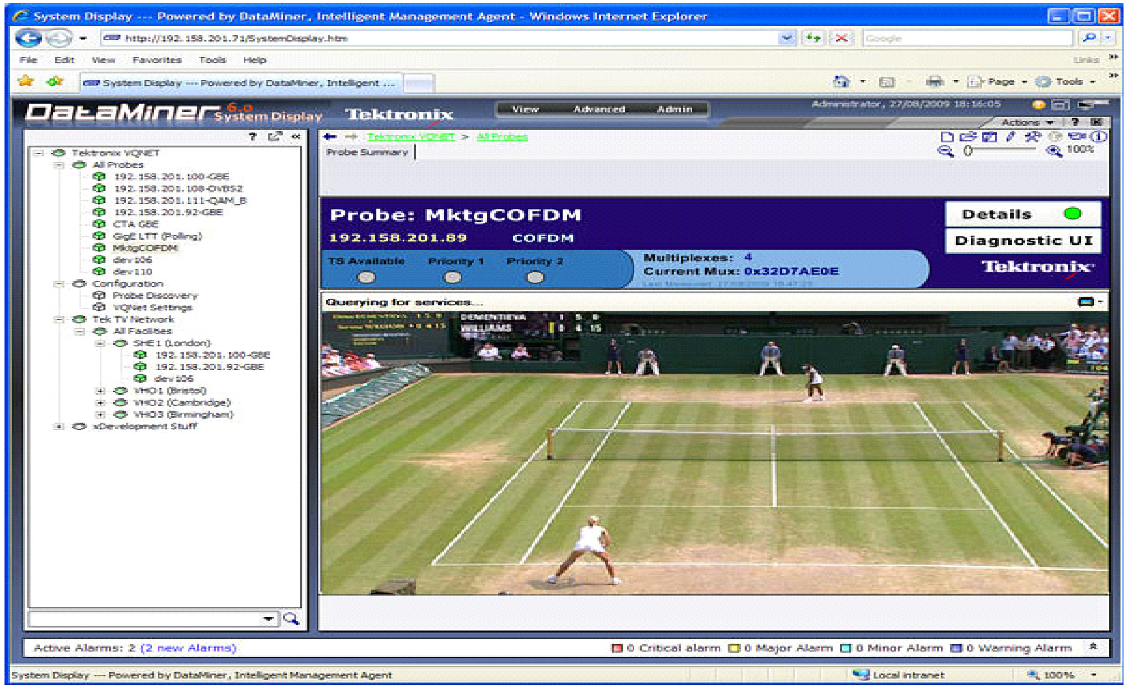
Enhanced Television Monitoring Sytem (ETVMS)



This ALBEDO solution is a monitoring system up to four different TV and Video technologies :

- **DTT based on a SDH distribution network.** The signal is converted into DVB-T interface (COFDM modulation) and delivered to the end users through transmitting antennae.
- **IPTV service with IP/MPLS distribution network.** IPTV services reach the end user in (either multi-cast or unicast) IP and are processed by a special STB before being displayed.
- **Mobile video services supplied over a UMTS and GSM cellular networks.** The monitoring points are standard Ethernet/IP (distribution network is IP/MPLS) ports signal encapsulation is 3GP.
- **Analogue video (PAL)** over dedicated wavelength in GPON network (video overlay). Distribution net-work is IP/MPLS and the video signal is converted into analogue in the remote HE.

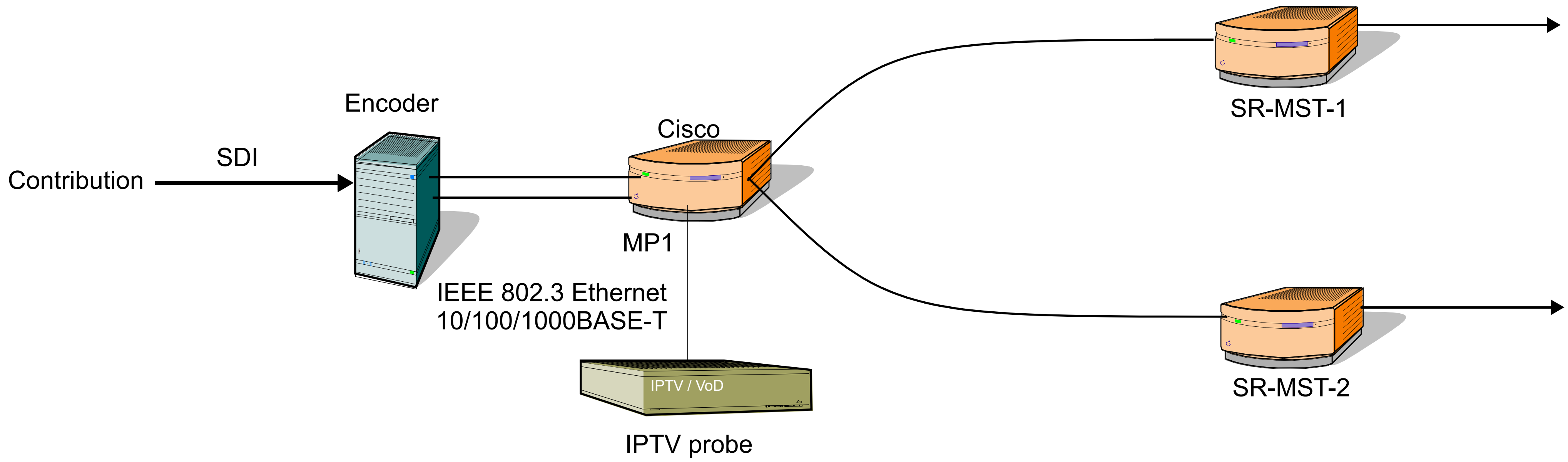
QoS monitoring of TV signals



This solution delivers comprehensive service fulfillment, service assurance, and service optimization capabilities to RFoGPON, DTT, IPTV, and Mobile TV services. The integrated solution reduces operational expenses and increases TV service revenues by combining rich Diagnostics and Management functionality into DataMiner, a comprehensive platform that integrates seamlessly multiples technologies from different vendors, into a unified management system.

Whatever the TV technology is the goal is to identify when and where a problem is likely to occur. Monitoring equipment can be deployed at critical points in the network. Therefore a unified platform for all is required. For this reason a purely reactive approach to video quality problems is unlikely to be viable. Our goal is to provide with a solution for fault management that will improve service fulfillment, service assurance and service optimization.

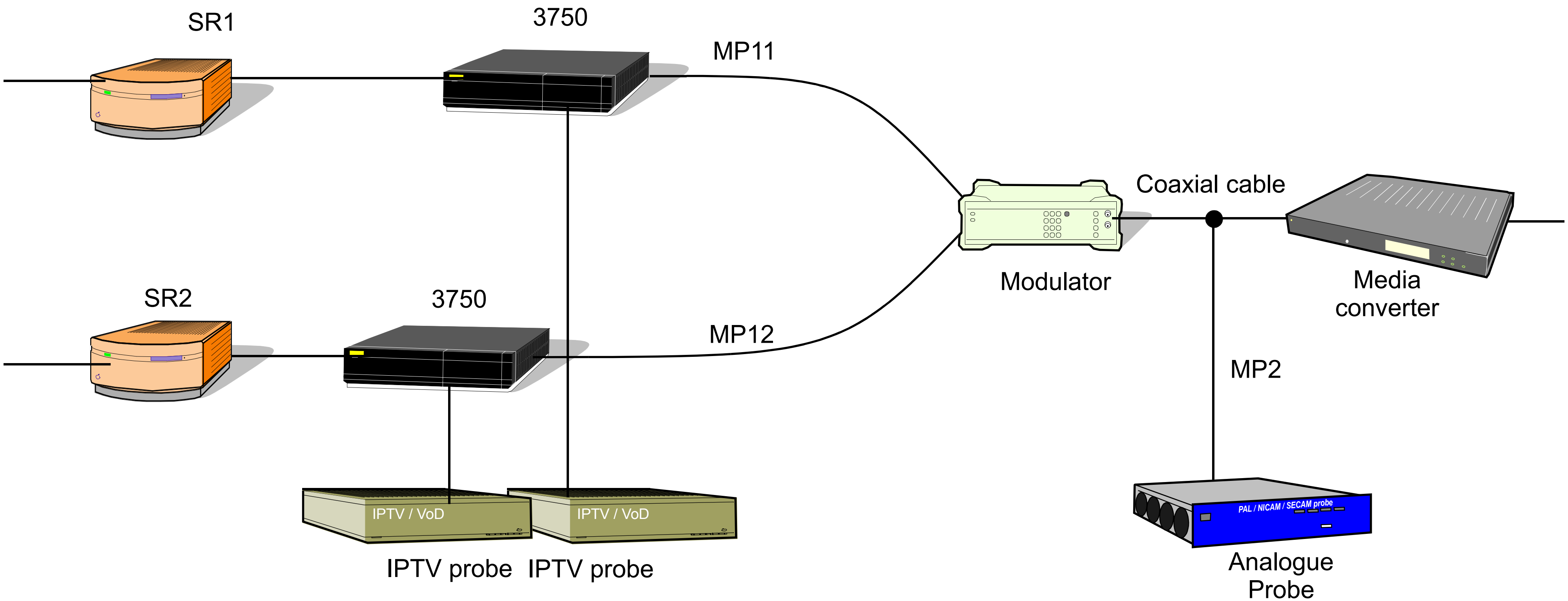
RFoGPON TV Monitoring Network



Monitoring the contribution contents for the RFoGPON.

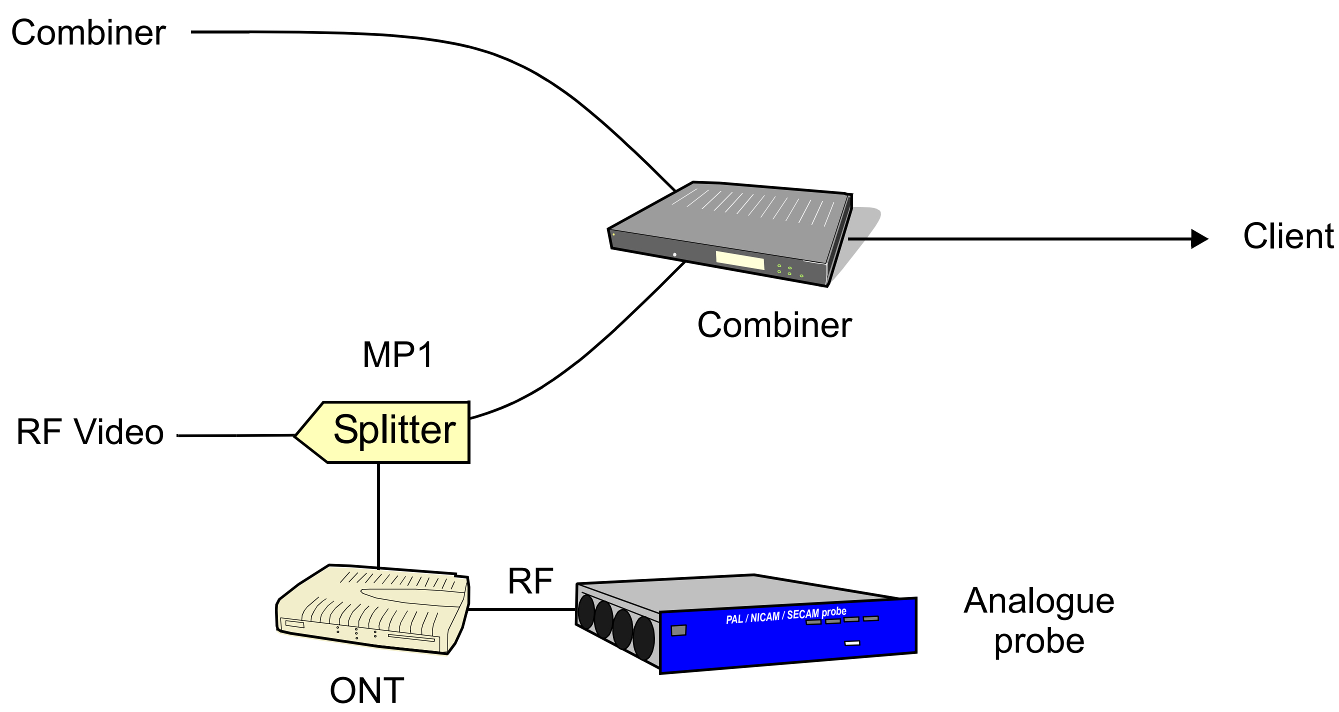
Connection to the network requires a 10/100/1000BASE-T interface containing the signal to be monitored. This interface could be mirrored from the in service port or link aggregation group (LAG).

Monitoring the TV / GPON at the HE



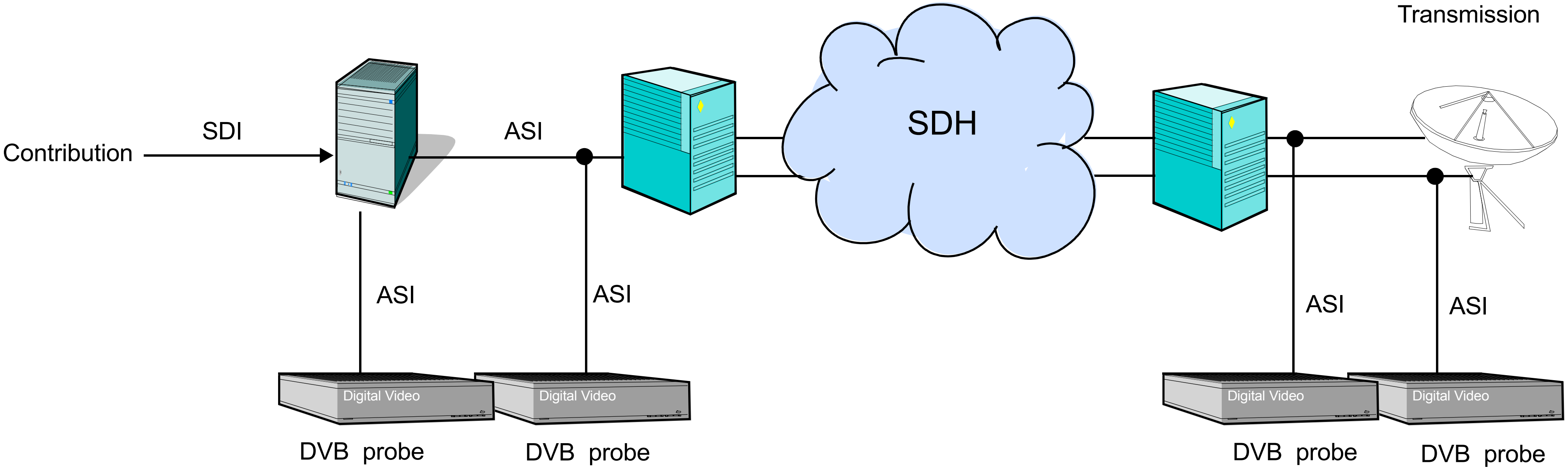
The signal is converted to analogue format in the remote HE and injected in an optical fibre. It is required to monitor de signal after being converted into analogue and before being transmitter to the optical fibre. This is accomplished with the Analogue probes. Signal is directed to the probe with the help of a coaxial T connector.

Monitoring the RFoGPON network at the centra



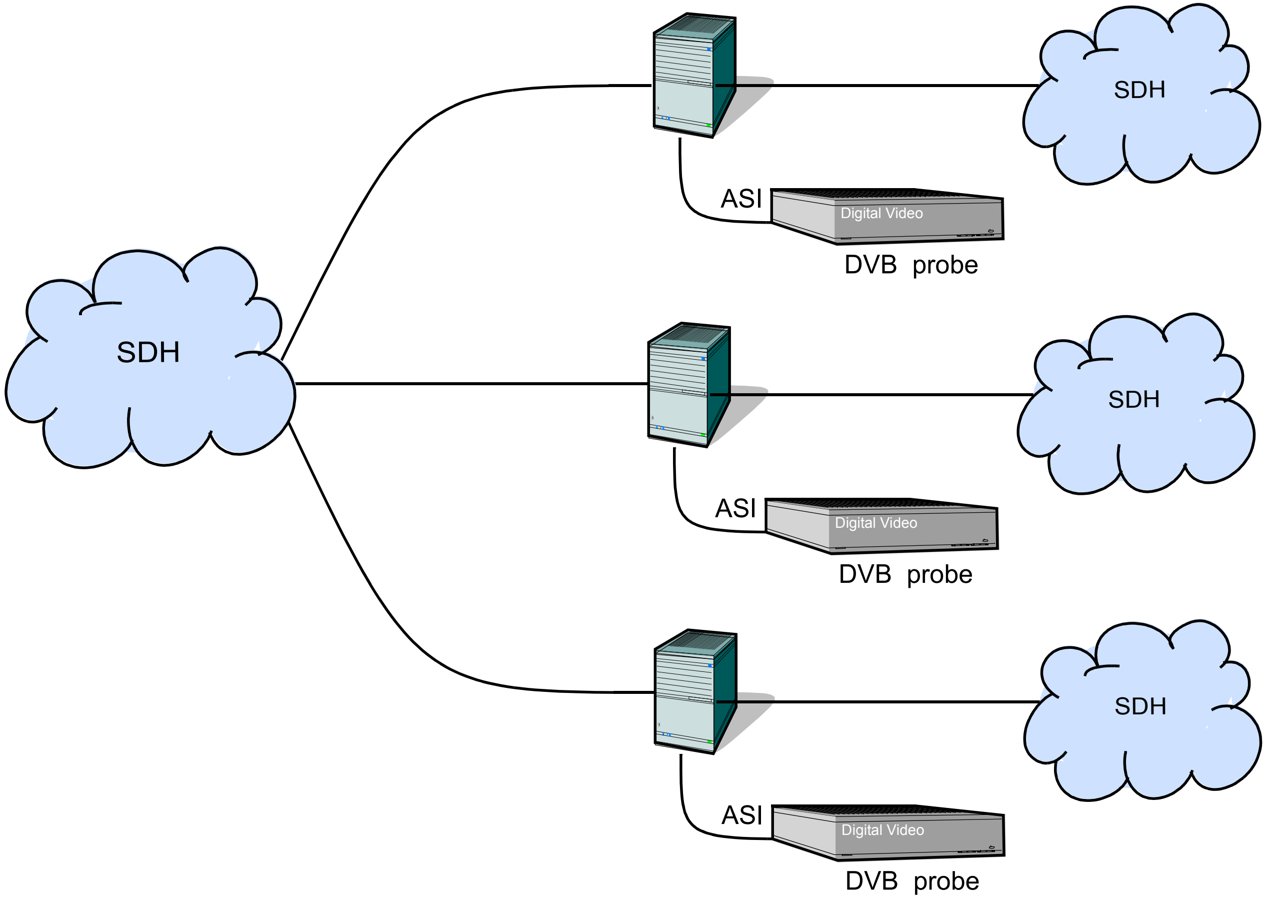
The video signal is received in the local exchanges in an optical fibre over a dedicated wavelength (1550 nm). This probe is combined with services carried in other wavelengths and delivered to the subscriber.

Monitoring the DTT (TDT) network



For DTT, network is fed in the Contribution site. Here, signal is either transmitted to end users (DVB-T) or distributed to RF transmitters over the country through an SDH network. In the Contribution Network there are three or four monitoring points.

DTT network SDH redundancy nodes



DTT signal is distributed to the transmission nodes through SDH redundancy nodes. Monitoring architecture for the redundancy nodes is similar to the Contribution DTT monitoring architecture. Video signals over SDH is converted to DVB ASI to enable monitoring.

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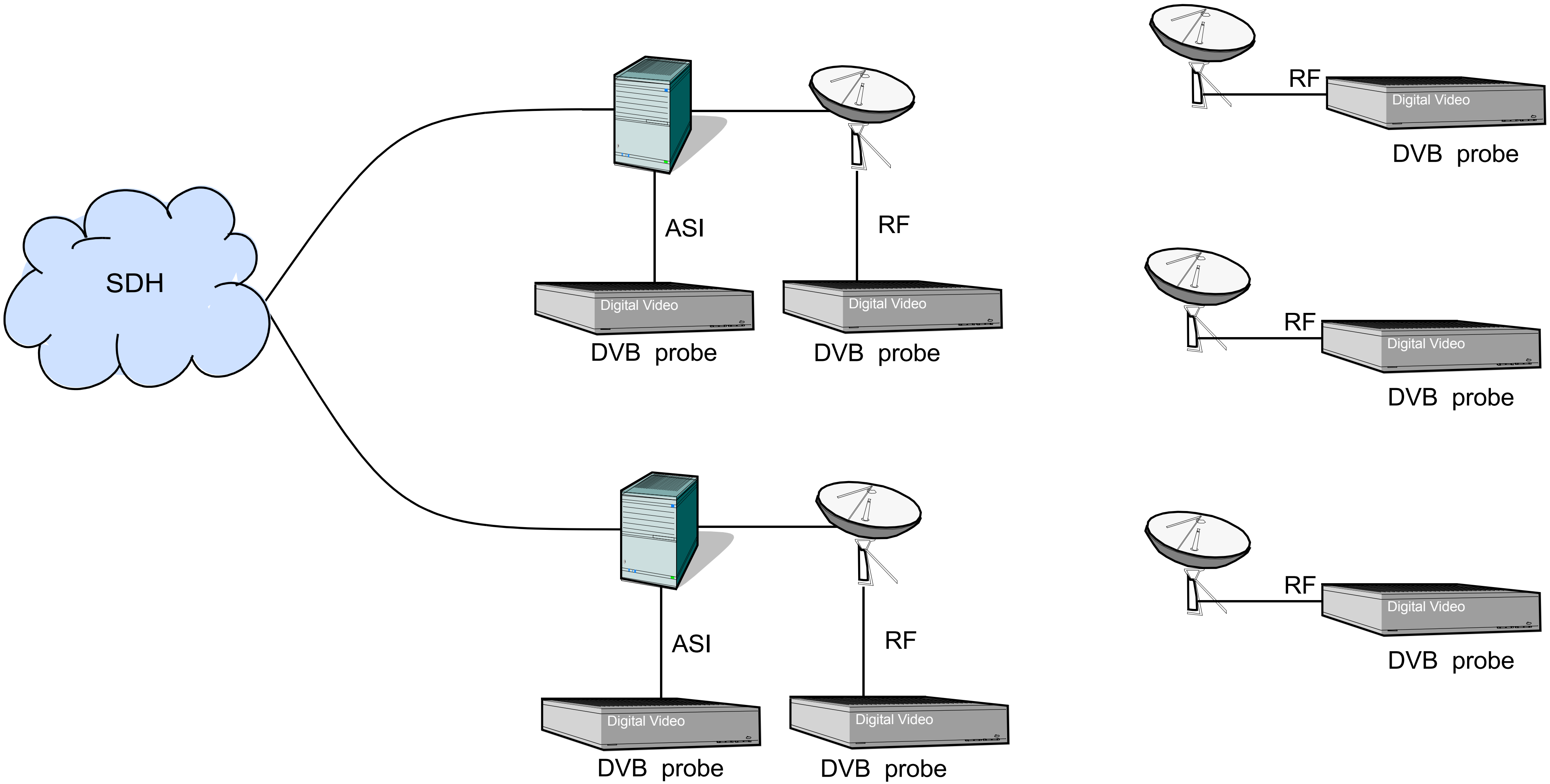
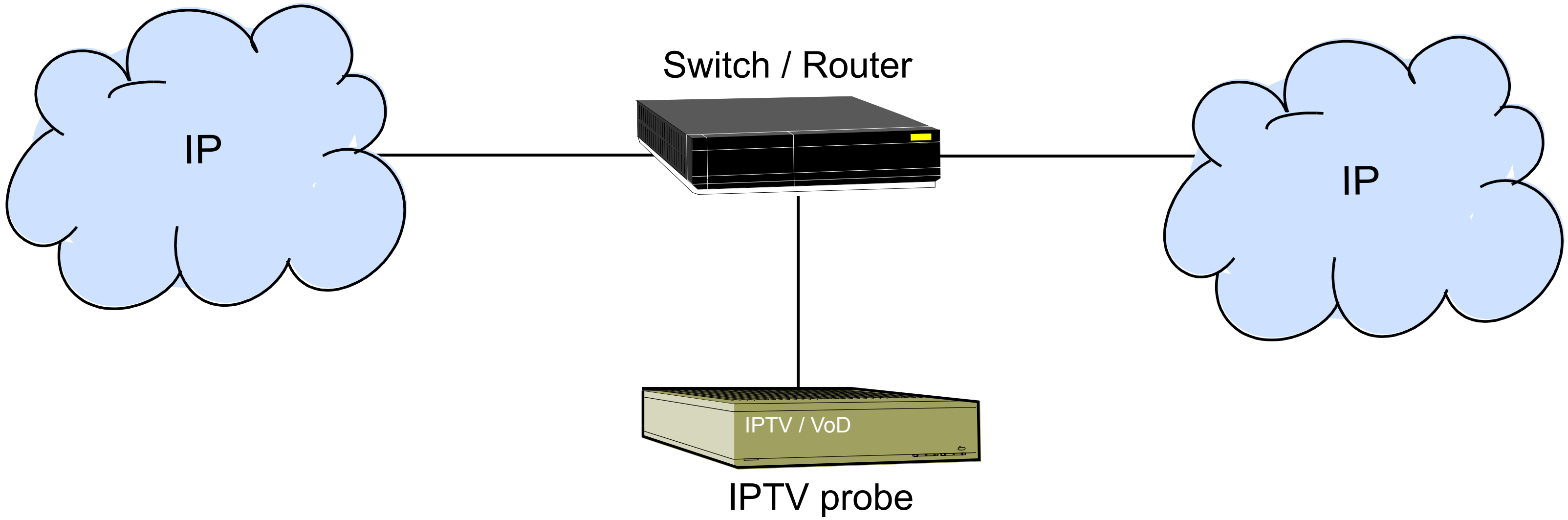
DTT radio transmission and reception nodes



The transmitter has two monitoring points. One of them (ASI) checks the signal before being modulated, the second one monitors the RF signal once it has been modulated. Both monitoring points require DVB probes. For the receiver there is a single RF digital monitoring point.

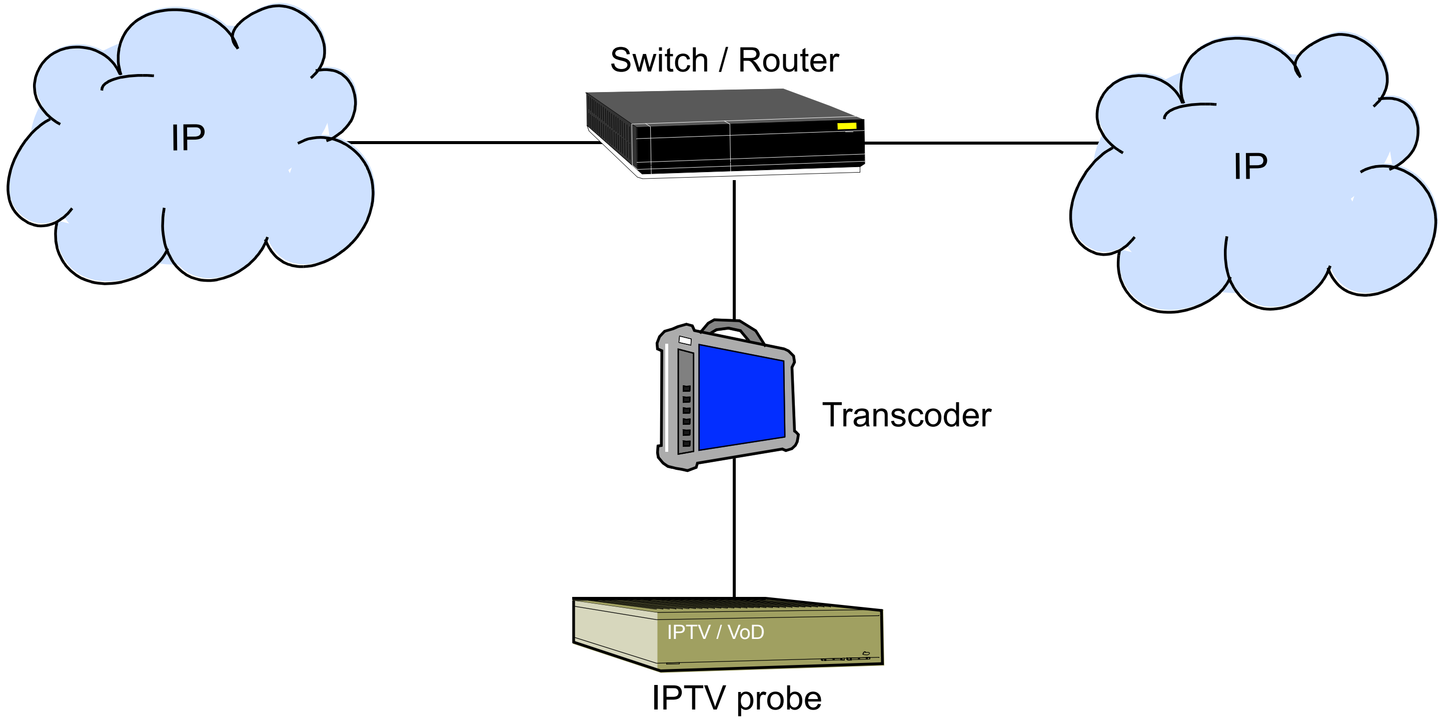
IPTV service monitoring



Contents for the IPTV service fed the network at the the Contribution Network facilities and it is distributed through an IP/MPLS network to local exchanges. CPEs get access to the video services through the access network. Multicast and unicast IP video is multiplexed with standard IP services. Video is decoded with the help of a dedicated STB installed in the customer premises.

It is understood that monitoring of the IPTV service will be carried out from Ethernet / IP interfaces. In fact, requirements for the monitoring points are the same that for most of the IP monitoring points already described in this presentation.

Mobile TV Monitoring



Monitoring video services for the mobile network is carried out form standard IP/Ethernet ports. Probes will be fed by signals got from the network in the same way that for the IPTV network.

There is however an important difference between the monitoring application for the cellular network and the fixed IPTV service. For IPTV video is encapsulated in MPEG2 TS but mobile video contents has a 3GP encapsulation. Using an IPTV probeDVB probe for monitoring the mobile video requires transcoding de signal into a format it can receive.

That's all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