

Timing Requirements In IPTV Solutions

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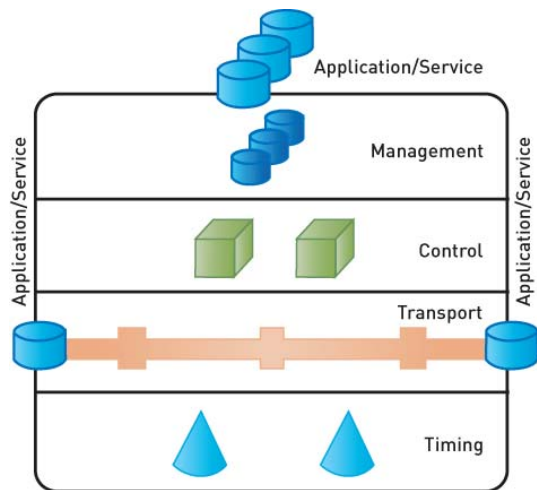
Symmetricom

November 15, 2006



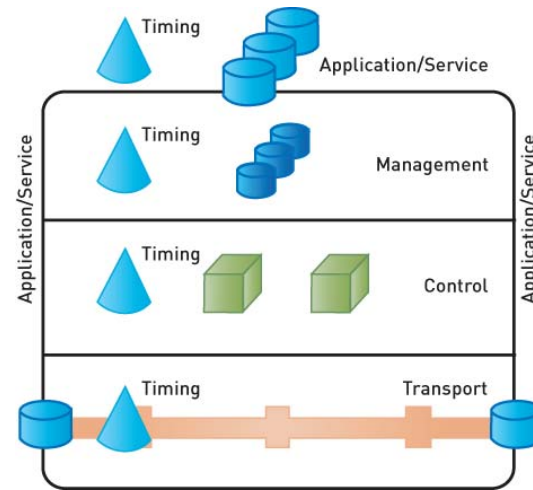
Past

- ▶ Frequency
 - Transmission Alignment
 - Real-time services – voice, fax



Future

- ▶ Frequency
 - For Certain Types of Transport Alignment
 - Controlling Element Clocks For Real-time Applications & Services in Packet Networks
 - Circuit Emulation and Mobile Call Hand-off
- ▶ Time
 - Ways to Measure Packet Performance
 - Billing & Management Application
 - Synchronize Different Aspects of an End-to-end Application/Service Delivery



- ▶ Internet Protocol Television(IPTV) is an end-to-end delivery of live broadcast and/or stored video signals to users over a broadband connection using Internet Protocols in a managed services network with user interactive features

- ▶ What it is not
 - Peer to peer video/image sharing
 - IP streaming over the internet
 - Digital/Packet/IP video – Transport of video over IP/Ethernet Backbone
 - DTV

- ▶ IPTV Service Is Not the Same As Delivery of Video in Cable/satellite Broadcast Model
- ▶ Transport Network Changes
- ▶ Service/Application Delivery Changes
- ▶ Last Mile & Home Distribution

Carrier Challenge : Ensuring end-to-end QOS
Customer Satisfaction

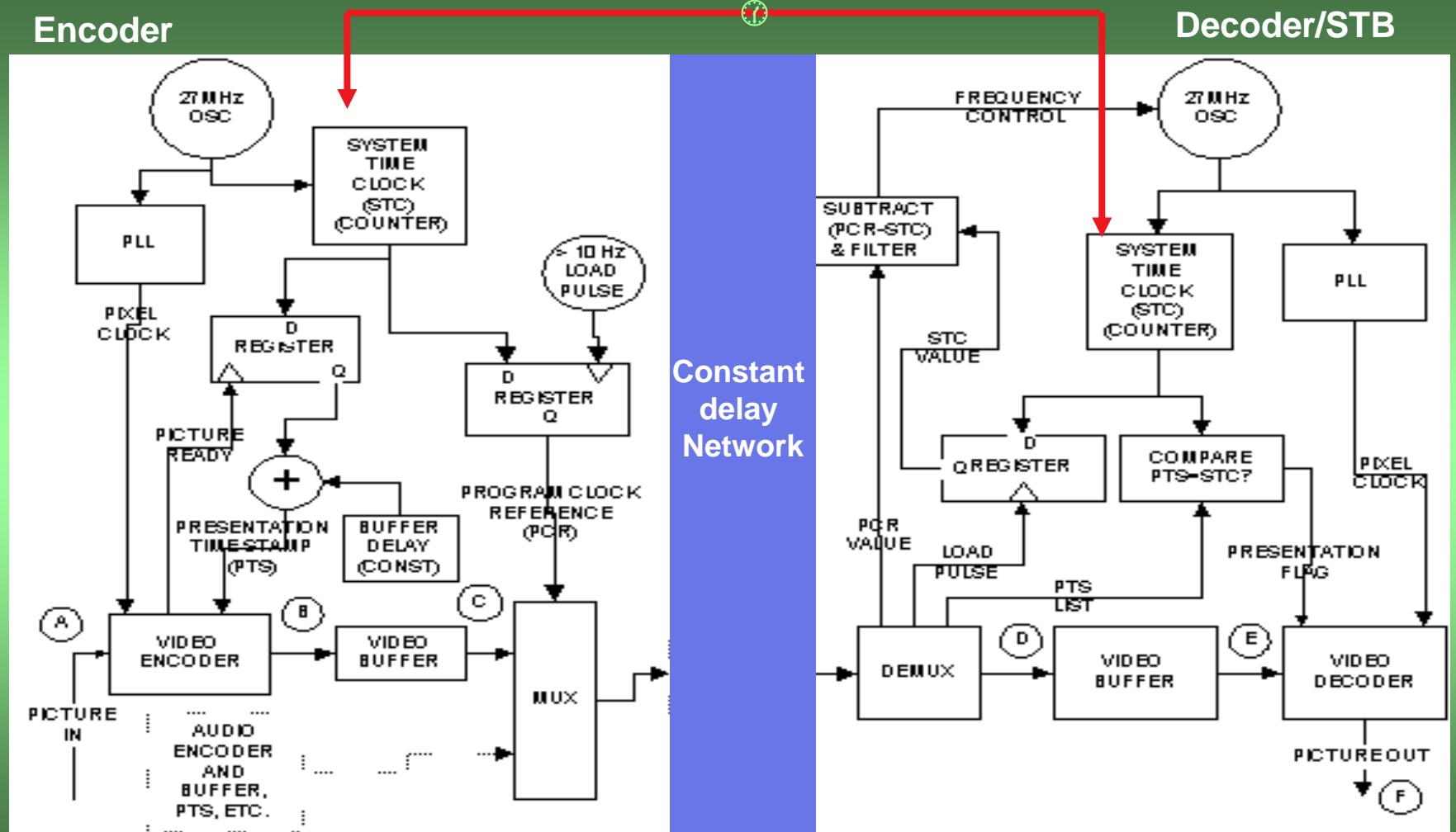
- ▶ Encoder and decoder clocks must be synchronized per specifications standardized

- ▶ Related to PCR:
 - Frequency offset : $\leq 30\text{ppm}$
 - Frequency drift rate : $\leq 2.8\text{ ppb/s}$
 - Time-stamp accuracy : better than 500ns
 - Decoder tolerance is typically $50\mu\text{s}$

- ▶ Related to PAL (color sub-carrier)
 - Frequency offset : $\leq 2.3\text{ppm}$
 - Frequency drift rate : $\leq 23\text{ ppb/s PAL}$

- ◀ MPEG Timing Model assumes constant delay network (e.g. ATM)

MPEG Timing Model for encoder and decoder(STB) synchronization

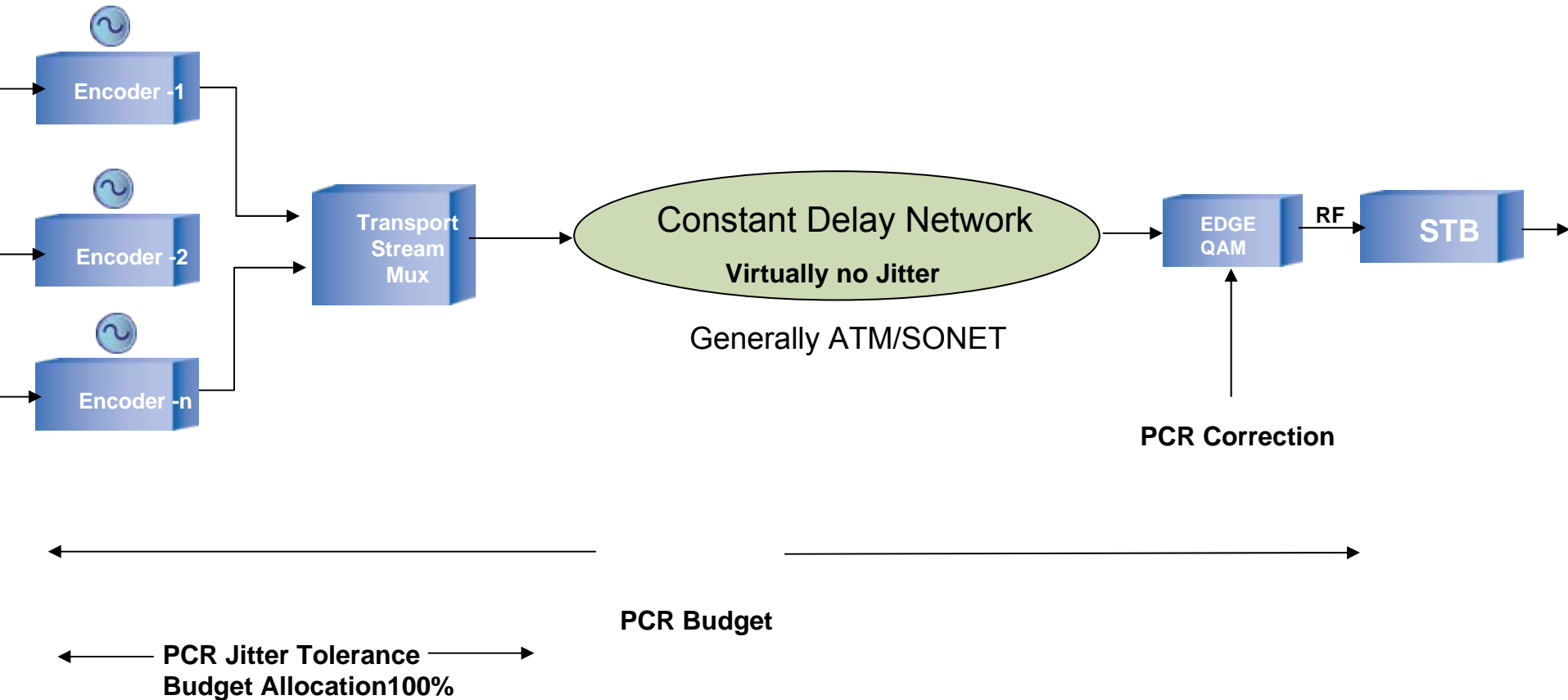


STC: System Time Clock PCR: Program Clock Reference

PCR – a time stamp generated by encoder STC, inserted into a transport stream packet. Used to synchronize decoder STC with encoder STC

PCRs extracted before the receiver buffer to synchronize decoder STC

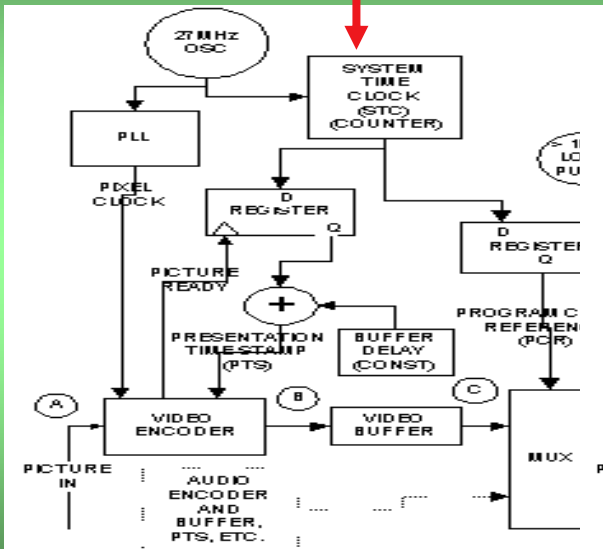
PCR Integrity in Traditional Video Network



- ▶ Even in a constant delay network, some jitter is introduced which is handled through buffering at STB
- ▶ In addition, PCR correction and reinsertion is applied at the edge before the RF segment, particularly where backbone transport is IP

Encoder/STB synchronization in IP networks

Encoder



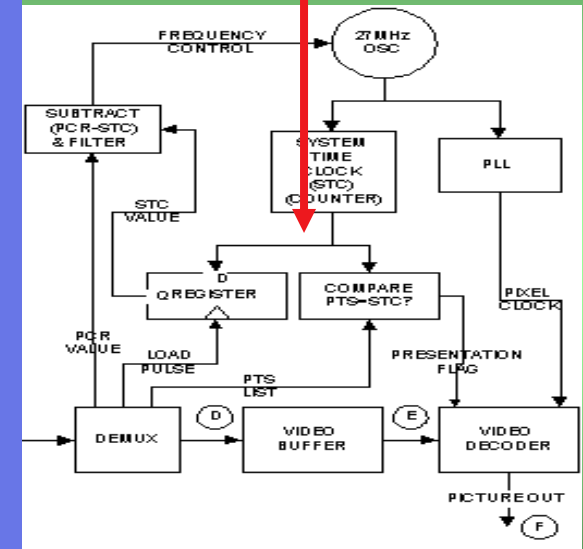
Not a constant delay network

Network jitter adds to PCR Jitter from other sources

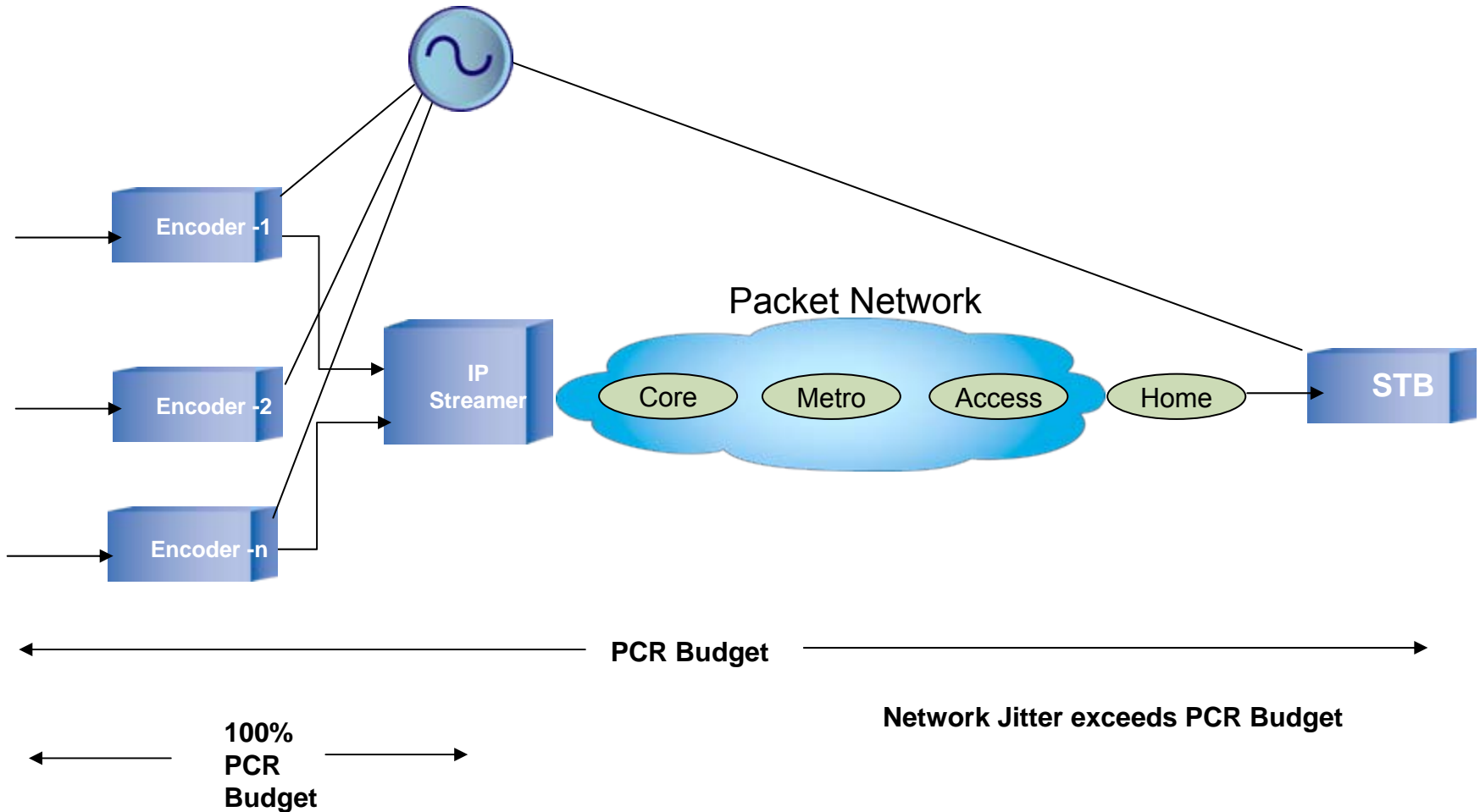
Even brief intervals of high jitter impact QOS

Buffering, FEC not adequate

Decoder/STB



Mechanism to maintain PCR Integrity in end-to-end IP Delivery



- ▶ Ensure all encoder clocks are synchronized
- ▶ Provide network time reference at both ends (ISO/IEC 138181-1)
- ▶ Currently proprietary implementations, standards being defined e.g. ATIS

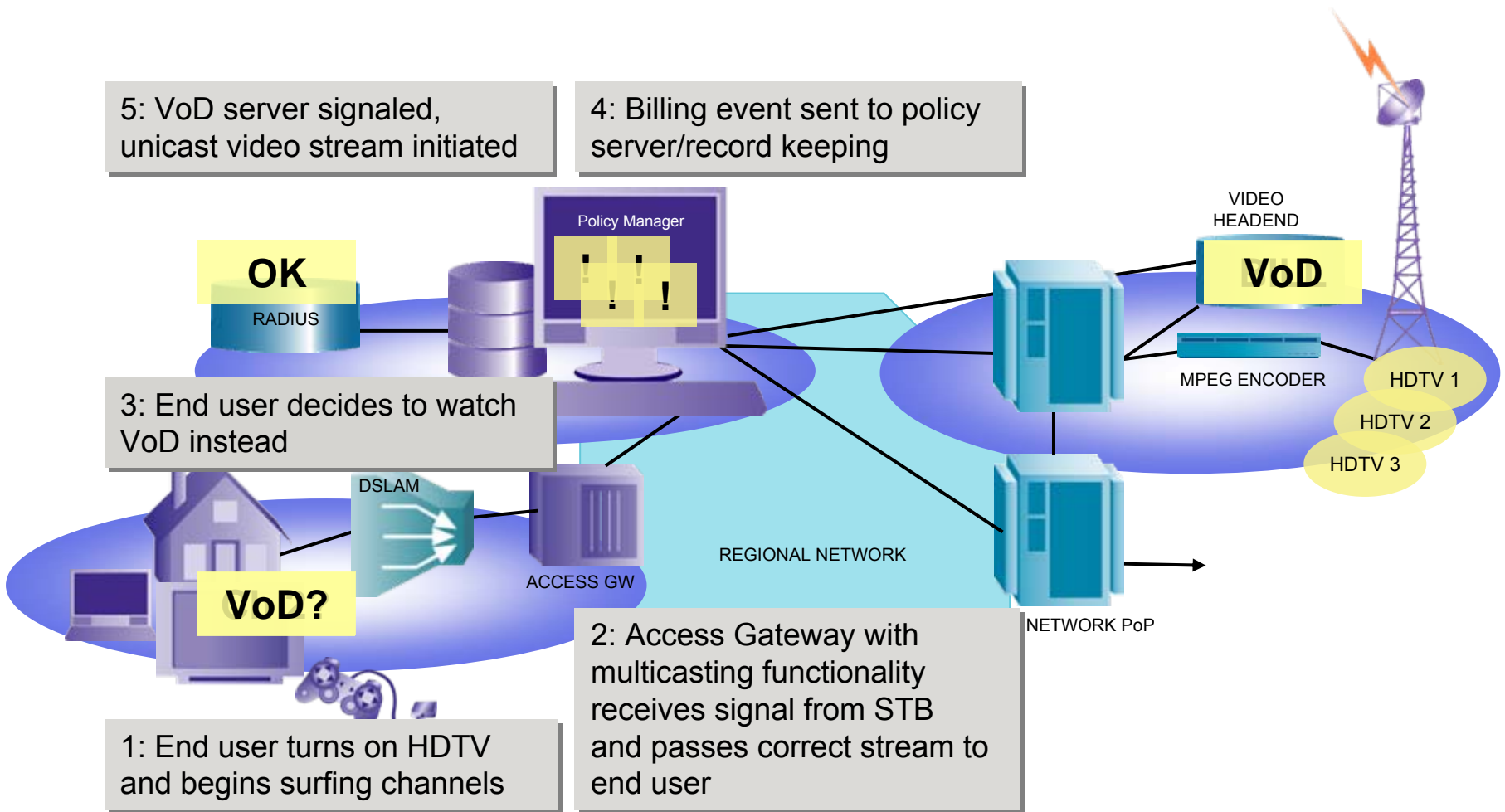
- ▶ Interactivity/On Demand Is New
 - Fast channel change response times
 - New service paradigm – interactive/on demand/customized/targeted/ personalized

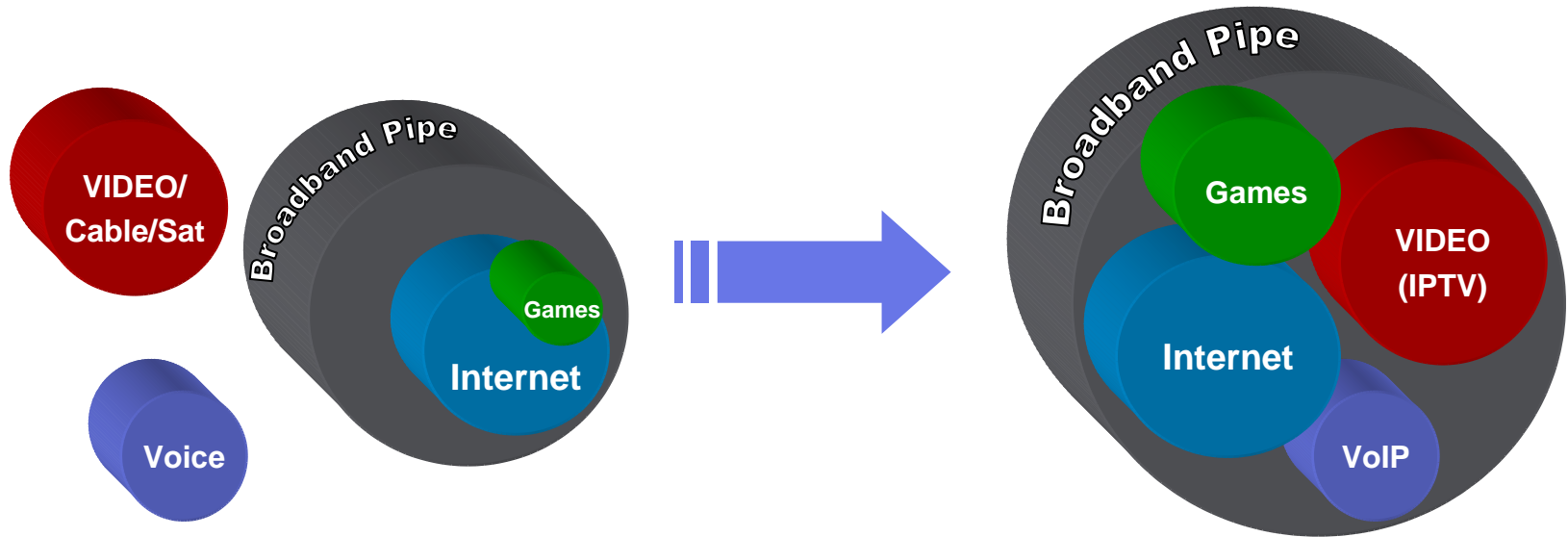
- ▶ Service delivery infrastructure is highly distributed
 - A single service request involves multiple geographically dispersed servers All need to have consistent time
 - DRM/ Billing/Authentication/Content Server/Ad Server

- ▶ Subscriber Authentication and Billing Transaction Handling
 - Lack of consistent time across all systems could cause service disruption e.g.
 - DRM license expires while program in progress
 - BSS/OSS integration
 - Millions of transactions/day

- ▶ Network Security and Content Protection is a Must
 - Secure and authenticated time required

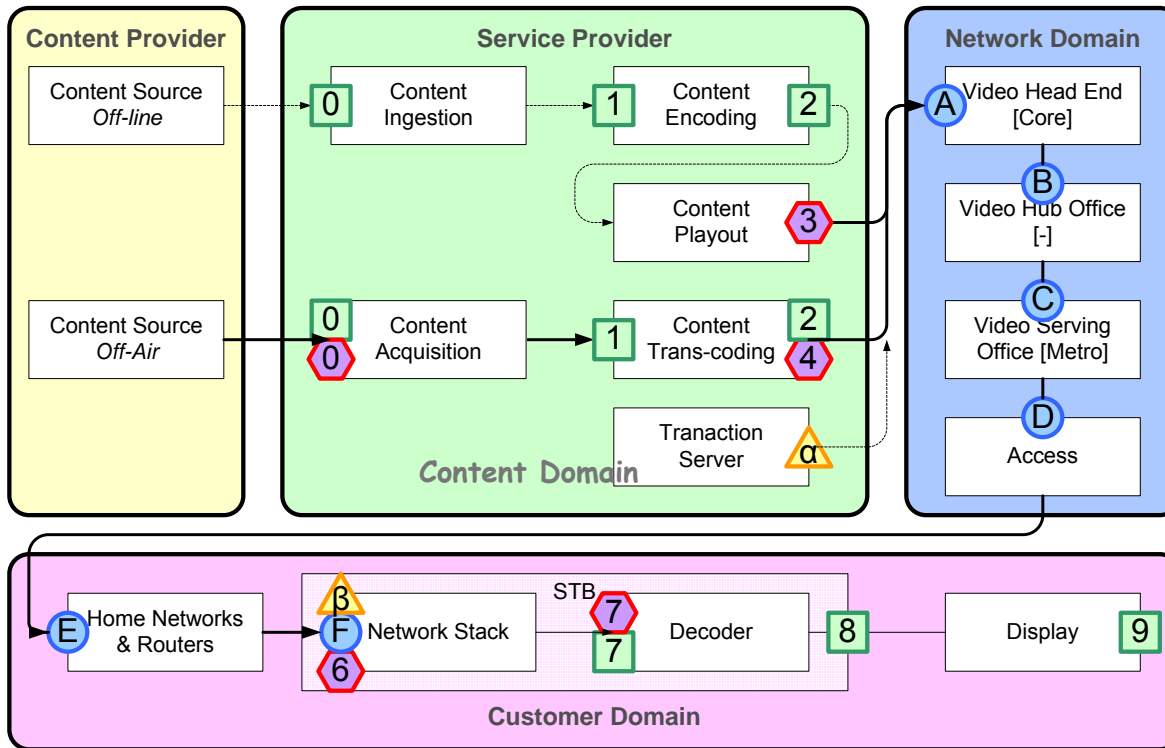
Geographically Distributed Service Delivery





- ▶ Ensuring QoS in the Last Mile a challenge
 - Video delivery is on a shared pipe with other services
 - Last mile prone to physical layer impairments
 - Contention within the home network

 New requirements for synchronization emerging



ATIS IPTV QoS Measurement Model

(Original Contribution by Simon Jones/Bob Bissell, British Telecom)

- | | |
|---------------------------------|-------------------------|
| (A) Video Headend Office(Core) | (D) Access Network |
| (B) Video Hub Office | (E) Residential Gateway |
| (C) Video Serving Office(Metro) | (F) STB |

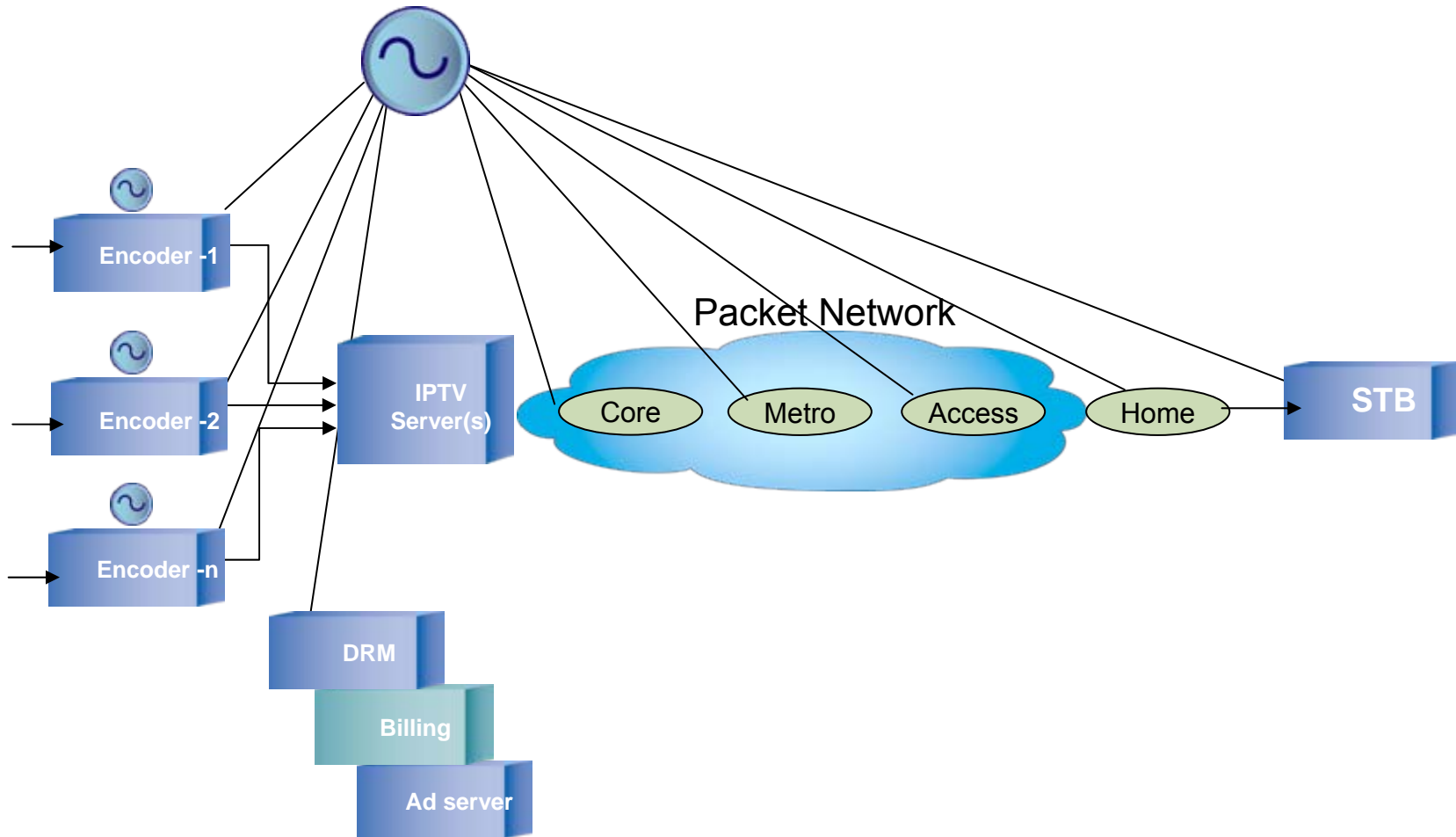
► Measurements

- IP/Transport Layer
 - Well known e.g. packet loss, packet delay, jitter
- Media/Service Layer
 - being defined in standards bodies – IETF, ITU, ATIS
- IPTV is an asymmetric service
 - One way delay measurements

► Measurement points

- Many points between headend and the end device
- Measurement points require precise time reference
- Key Metrics
 - Packet Loss
 - Packet delay
 - PCR Jitter
 - Channel Change Delay
 - DRM Key Arrival

Timing in IPTV Delivery



- ▶ All elements in IPTV delivery system need to be synchronized
- ▶ Synchronization granularity varies
- ▶ However, synchronization implementation must support high transaction volumes and availability

Timing In IPTV Deployment

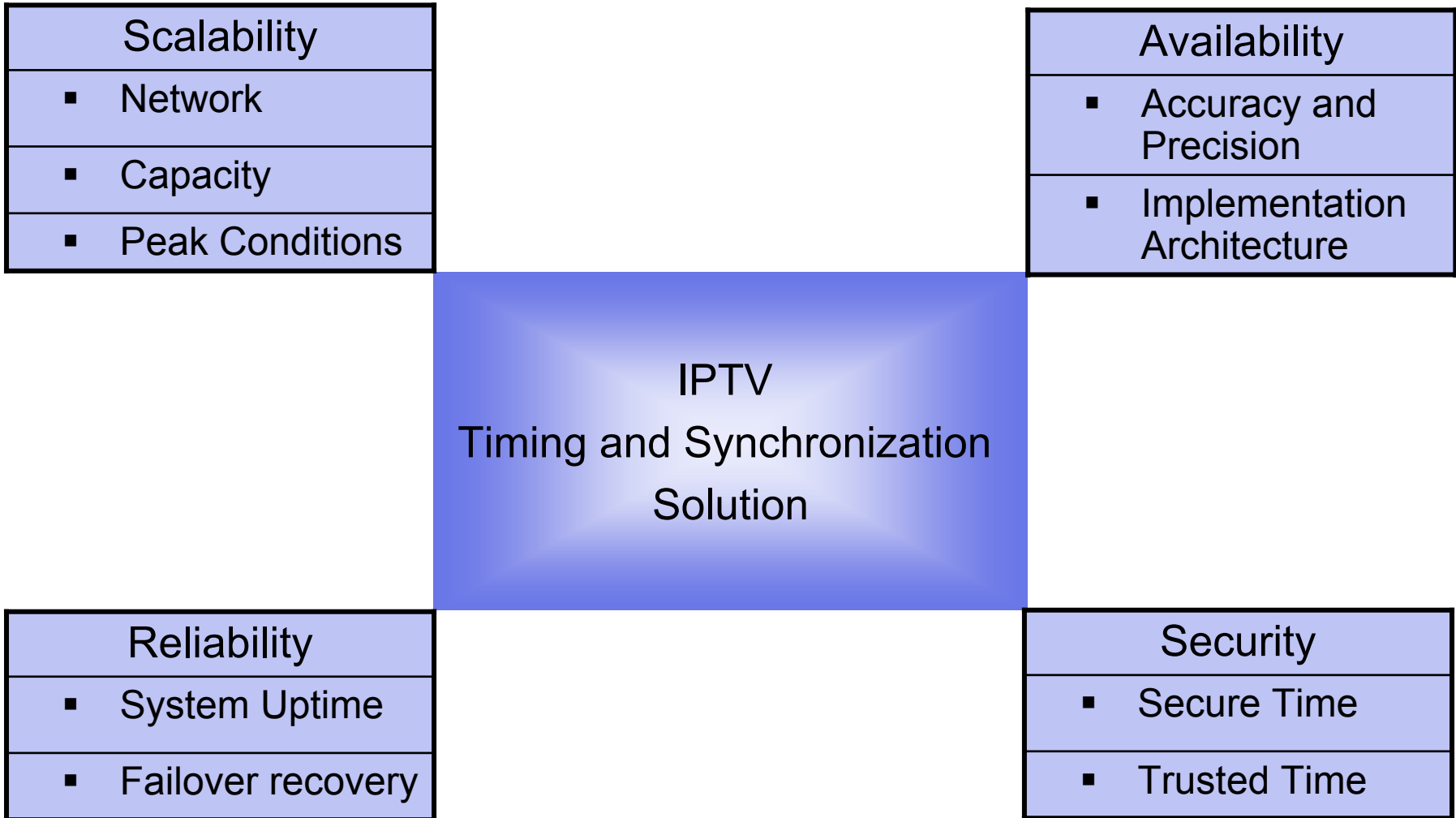


| | Timing Parameter | Timing Distribution Protocol | Purpose | Where |
|--------------------|--------------------------------|--|---|--|
| Transport | - Frequency | - BITS Signals - Packet Based Protocols | Network Synchronization | - C.O. - Access Network – PON, DSLAM, etc. |
| Management | - Time of Day - Time Stamps | - NTP - NTP | - Service Management - DRM, Program Guide - QoS Measurement | - Video Headend - Video Serving Office - CO |
| Application | - Time Stamps - Time of day | - NTP - NTP | - Video encoding - Ad insertion | - Video Headend - Video Serving Office / CO - STB / Res. Gateway |

- ▶ Timing implementation depends on
 - Middleware implementation and features
 - STB Specifics
 - Network architecture

- ▶ Standards
 - Effort underway – ATIS IIF, ITU FG IPTV

Engineered solution for each Implementation



- ▶ ITU FG IPTV

- ▶ ATIS IPTV Interoperability Forum(IIF)
 - Primary standards development organization
 - Service Provider Focus

- ▶ IEEE/IETF

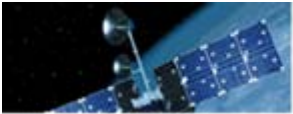
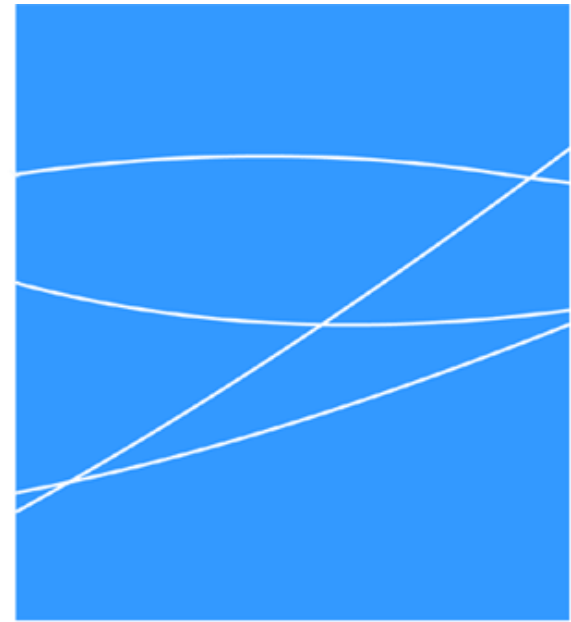
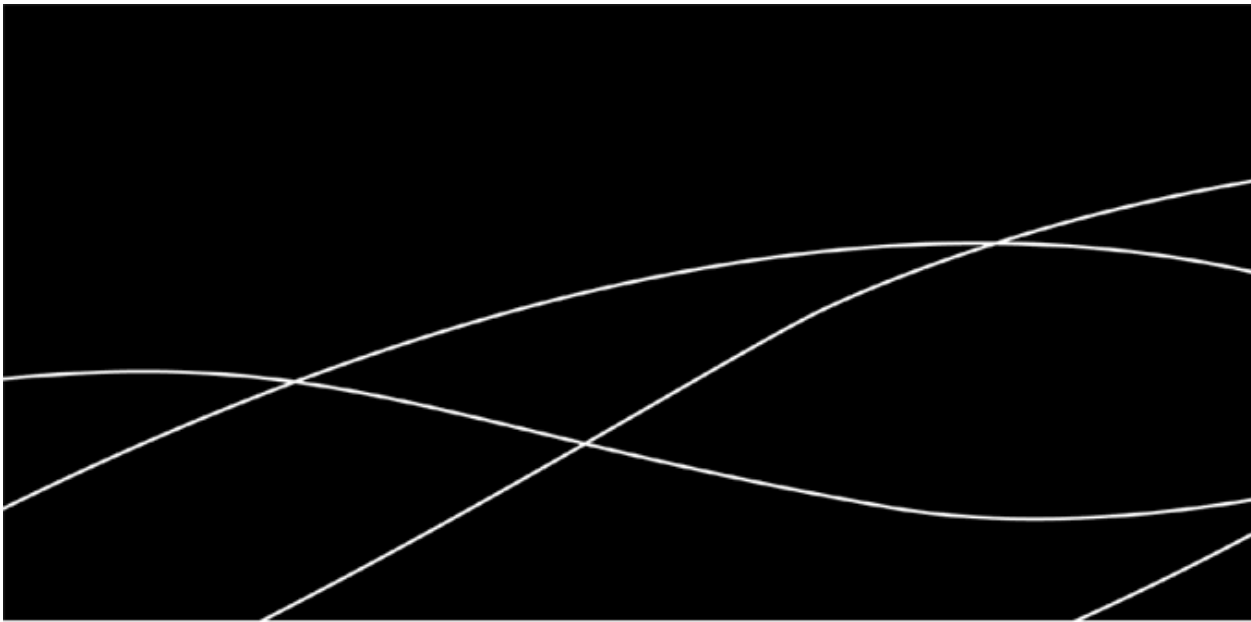
- ▶ **ATIS is Association of Telecom Industry Solutions.**
 - North American Telecom Standards Body. Represents North America in ITU
 - Appointed lead standards body by GSC
 - ITU FG IPTV following ATIS IIF

- ▶ **Requirements**
 - Common stable frequency reference traceable to national frequency standards required for delivering content from different sources
 - Stable time reference required for service aspects such as DRM, billing, ad insertion
 - The IPTV security solution to provide mechanisms to support secure accurate time on the IPTV Receiving Device
 - QoS Metrics Measurement e.g. one way delay

- ▶ **Implementation**
 - Time and frequency reference needs to be provided to the IPTV Terminal and the headend
 - Non service affecting provisioning of Time and frequency distribution, particularly in the last mile

- ▶ **Areas of Further Work**
 - Ensuring MPEG Timing Model in high jitter environment
 - Accuracy and precision specifications for various functions

- ▶ Developing Fundamental Technology to address requirements
- ▶ Testing at Symmetricom NGN Lab and with operators/vendors
- ▶ Development of recommended practices in collaboration with IPTV infrastructure and middleware vendors
- ▶ Standards
 - ATIS IPTV Interoperability Forum
 - Co-chair, Quality of Service Metrics Task Force
 - Working with the industry(service providers and vendors) to define Timing and Synchronization standards for IPTV



Thank You

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