Dimetis White Paper

Managing modern „ALL-IP“ based on Super Head-End

Dimetis GmbH

Justus-von-Liebig Strasse 9

D-63128 Dietzenbach

Germany

Phone: +49 6074 3010 0

Fax: +49 6074 3010 310

info@dimetis.de

www.dimetis.de

Summary

Telco industries traditionally have been concerned about transport layers. Broadcast business at this point is bringing an additional complexity to the whole equation.

It is about content, metadata and transport - all together. Here the traditional Operation Support System (OSS) has crucial shortcomings.

Traditional head-ends still carry the broadcast signals in the old-fashioned way, i.e. ASI/SDI signal to be multiplexed.

Modern IPTV head-ends are based on “ALL-IP”, which means that we now have to manage both - physical and logical entities - within our inventory. “ALL-IP” head-ends allow telecom operators to reduce OPEX and CAPEX on a large scale.

However managing IP networks as we know can be very complex. An IP switch will be crossed many times before the signal can be sent out. Here common broadcast tools are no longer able to manage the head-end and meet current and future requirements.

The Operation Support System (OSS) should be able to offer a solution consisting of a wide range of modules, which among other things can be combined in a deployment of an IPTV super head-end.

We believe that broadcast networks can hence be managed more efficiently, based on “ALL-IP” and adaptation of broadcast operations into telecom world.

Operators concerns

Dealing with many operators, we believe most of operators´ concerns nowadays are around:

- Rolling out new services i.e. HD, 3D, IP-TV, VoD faster
- To scale with customers´ growth
- Get data in-synch with dynamic changes of networks
- Get users and staff trained very fast with dynamic changes
- Control all resources and services within a network and beyond

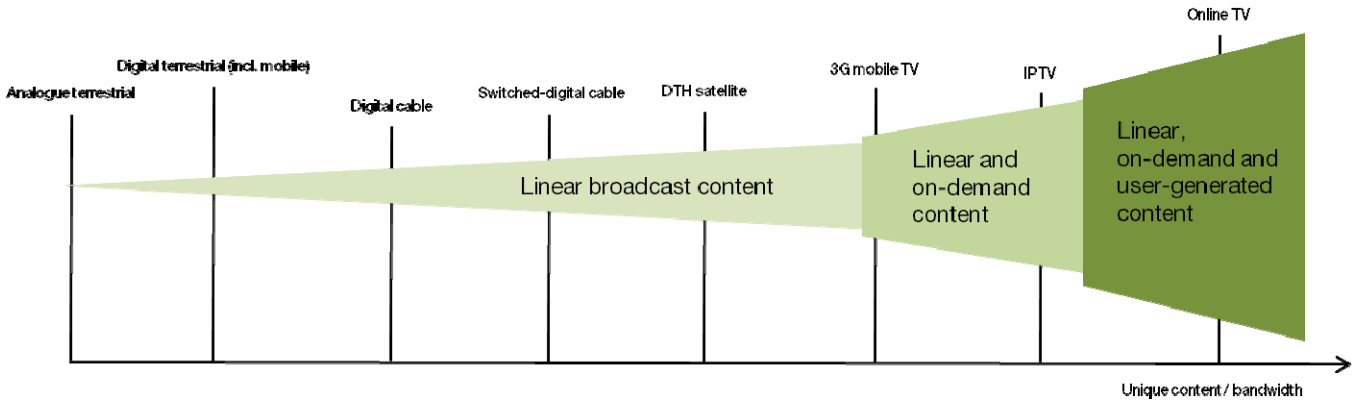

Figure 1: Development of content and bandwidth (Source: IABM)

In the broadcast market the life time of new technologies has shortened with every and each new TV generation, starting from black / white TV in 40-ties to colored TV in 70-ties to Digital TV in 90ties and now within years from HD to 3D. The industry as a whole is facing shorter life times of services and as a result, technologies.

Another consideration of new services such as HD is their bandwidth demands. Not only the number of services / channels will grow over time but also their respective bandwidth demands will increase over time massively.

The annual global IP traffic will exceed three-quarters of a zettabyte (767 exabytes) in four years. The sum of all forms of video (TV, video on demand, Internet, and P2P) will continue to exceed 91 percent of global consumer traffic by 2014. Advanced Internet video (3D and HD) will increase 23-fold between 2009 and 2014. IP-based video traffic is no longer just a concern of telecom operators anymore. Big companies like AT&T and Verizon are competing fiercely to take television viewers from satellite and cable in North American

market. More and more broadcasters are also planning an IP-Out headend or have already one in place.

Impact of "ALL IP"

Many operators go the extra step and implement an "ALL-IP" head-end. These head-ends are defining a new paradigm of head-ends and are characterized by:

- IP as main transport medium
- Introduction of newer services even faster than before
- Consideration of new entities such as IP addresses, VLAN ranges, multicast streams
- Physically easier technologies to connect / setup newer devices
- Management of both: physical and logical assets
- Many-to-many association of managed objects such as IP addresses / multicast to transport streams
- Bandwidth management

IP networks traditionally allowing for lower CAPEX as new devices can simply be hooked into the networks. The rather expensive devices which were typically deployed in traditional broadcast head-ends for ATSC/DVB-S/C/T such as video routers, encoder farms etc. can be collapsed into simpler network schemas. Another important aspect of an „ALL-IP" head-end is the OPEX reduction. IP networks can lead to a lower OPEX, assuming the case the Operation Support System (OSS) can streamline the processes and manage all above.

Within public and private broadcast facilities, the current method of operations can be summarized as follows:

- SD is currently still the main transport type
- Most processes heavily manual
- Most bandwidth usages are known in advance
- Archive / non-linear TV is still at low bandwidth
- Satellite video transport and distribution still considered the main media
- Separately managed distribution platform (DVB, ATSC, VoD, IP-TV)

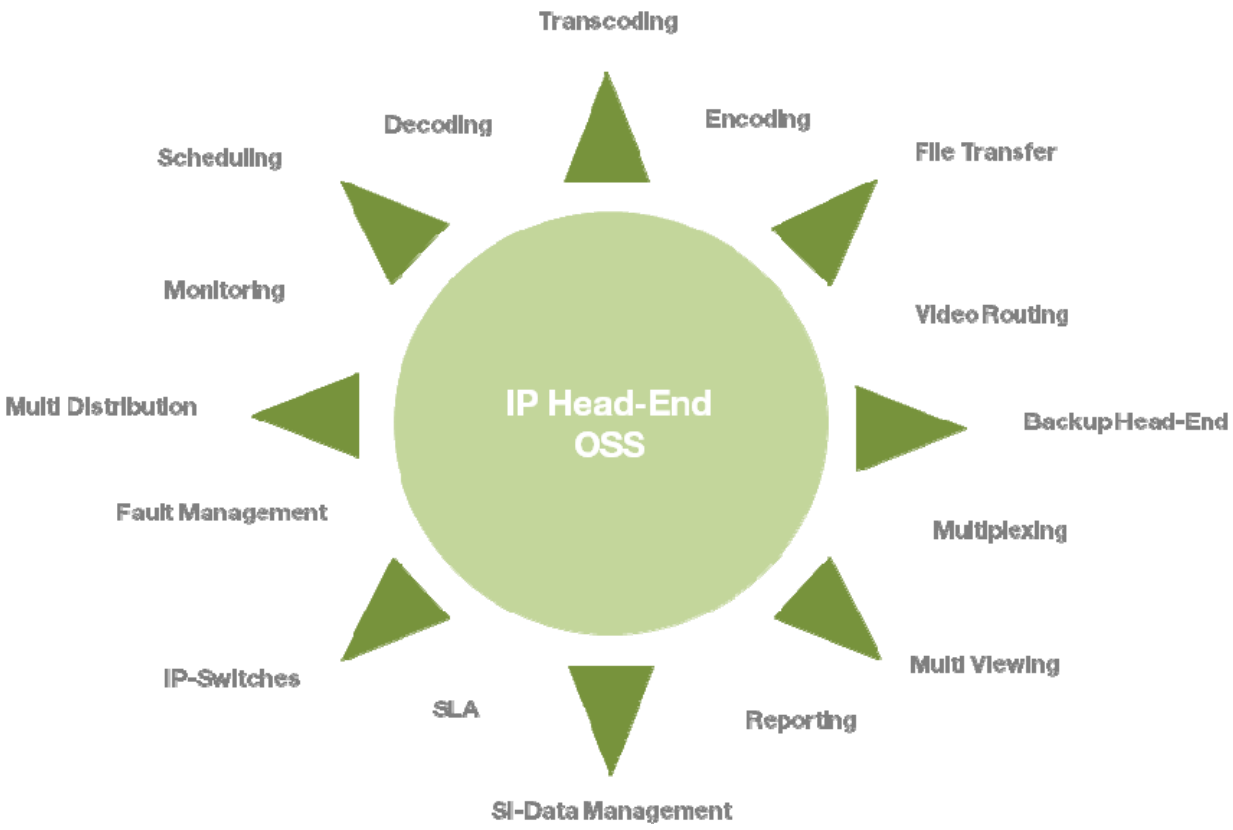

Figure 2: Impact on SI data management

Future methods of operations are mainly driven by IP based networks both in contribution and distribution site of the business:

- IP everywhere
- ROI saving by being able to support new technologies/devices
- Umbrella Management → One centralized Operation Support System (OSS)
- Multi-end-device platform support
- Standardized Interfaces → Integration of new technologies as well as legacy systems
- Service related fault management and SLA
- File based production and file transfer
- High degree of automation over multiple platforms and systems
- Multiple use of SI-information and metadata

Based on future method of operations, the “typical” operations to be carried out by Operation Support System (OSS) needs to be extended. As shown in the figure below, the future “ALL-IP” head-end has to

support the following functionality blocks:

- IP based backup switching
- Scheduling of non-traditional SDI/ASI resources
- Integration of file-based operations
- SLA measurement of IP signal flow
- Multi-Layer Fault Management
- Transcoding capabilities to support multiple distribution signal paths

The Operation Support System (OSS) part of the „ALL-IP“ head-end hence has to assume a more active role as oppose to a traditional head-end. Some of the important functionalities to explore are:

- flexible Inventory System
- HW and technology agnostic activation
- A Multi-Layer Fault Management
- SLA-Monitoring

The Inventory system plays a major role to glue the various applications within an IP-based head-end system.

- A comprehensive view of the network needed. IP based signal flows are non-linear. An incoming IP transport stream can be multi casted in different directions using the same and / or multiple outgoing ports. Often an IP switch within the same “ALL-IP” head-end will be crossed multiple times on the same signal flow. This typical IP behavior requires a flexible inventory system. The many-to-many association of the signal flow / transport stream to different objects, maintained within the same inventory system is one of the challenges of IP networks.
- Resource / Inventory Management within an “ALL-IP” head-end extends the traditional inventory system in old fashioned broadcast playout by keeping track of physical and logical asset management. A typical service would have to capture beside the logical and physical path elements of transport stream, the following data:

    - L-Band Matrix
    - Transcoding farm
    - SI Subsystem
    - Multiplexer
    - IP probes
    - Hierarchical encoder / decoder and audio blocks

- As oppose to traditional playouts with a unique and mainly point-to-point connection, IP-based networks, assuming non-linear and many-to-many association of managed objects. An IP switch is for instance

connecting many sources and destinations, often all at the same time based on the same port with different VLAN IDs.

- Backup switching was handled in the traditional playouts based on pre-defined schema, typically in a 1:n or 1+1 back switching, allowing operators to plan the backup paths in advance. In an “ALL-IP” based network and with a “many-to-many” relationship of different components, this approach has become obsolete. In the new “ALL-IP” based head-ends, backup switching shall be executed in most cases on-the-fly. This will require very extensive traffic engineering and a brand new approach of how transport stream can be routed throughout the head-end network. In order to avoid faulty or down devices, the backup switching has to reroute the transport stream based on a very complex many-to-many matrix. And yet the operation has to be fast, in order to minimize the transport stream down time. An even more complex scenario can occur if the newer IP-based multi-functionality blocks are used in such an “ALL-IP” head-end. Backup switching can then occur within the same chassis, the so called “micro switching” and / or within two physically separated devices, the “macro switching”. Both options have to be available to the end users to make the most benefit out of the IP-based infrastructure.
- Bandwidth management in IP networks is also a brand new concept. Whereas in old fashioned playouts the signal flow was always straight forward (“from left to the right”) and there was a unique signal to cable association, in IP networks, signal flows are non-linear and depending on swtich IP capabilities, a limited number of services can be provisioned at a specific time. Bandwith management needs to be considered for both scheduling as well as current running services, in order to avoid SLA violation.
- In order to achieve a better ROI, newer playouts are planned in such a way to accommodate the future needs. In order to support this, the respective Operation Support System (OSS) has to support also an expandable database schema, based on which any device and any technology can be added and maintained as part of the overall infrastructure.
- Because of the any-to-any association of various components within an “ALL-IP” head-end, the visualization of the signal flow / transport stream as well as topology view of IP networks need to be more tune toward a more “logical entity based” approach. A component such as IP switch may occur multiple times within the same path. In order to avoid any confusion, end users need to be able to look at both, physical and logical network schemas.

- The requirements for the configuration / activation engine within the Operation Support System (OSS) for an „ALL-IP“ head-end differ from the traditional playouts. More often the existing head-ends will be extended with additional hardware-based on „hardware and technology agnostic“ approach, with the following device categories:

  IP switches (VLAN)

  Video Routers

  StatMux

  IRD

  Streaming CODEC

  MHP

  ASI-Synch

  VPS Extractor

  EPG generators

  Stream recodring devices

  Monitoring walls

  E1/A1 converter

  Headroom Audio Mux

  Audio Decoder

  File server

As for fault management as part of Operation Support System (OSS), an „ALL-IP“ head-end with any-to-any association of components is a real challenge with its non-linear path and signal flow. As oppose to traditional playouts, where every and each signal is carried via a dedicated cable, services in IP networks are bundled into one single cable / IP transport switch.

The following multi-layer needs to be monitored for a comprehensive service monitoring in real time:

- IP transport layer. Typical Operation Support System (OSS) monitoring tools are concerned only with this layer, which is complex on its own but not sufficient for an „ALL-IP“ headend. Root-cause-analysis for IP based networks is a very complex scenario because of various logical and physical components such as VLAN, IP addresses, sub-interfaces, IRD, StatMux etc. The diversity of devices and the variety of OIDs lead easily to ten thousands of values to be monitored in real time. This number is equal to many traditional playouts combined together.

- Another layer of the overall fault management is the SI monitoring. Typical SI monitoring can be used here in order to unravel any irregularities at the metadata (SI) level. The metadata (SI data) needs to be mapped to the service / transport stream.
- In order to provide a comprehensive monitoring at the content level of the transport streams, following parameters need to be monitored and mapped to the transport stream:
  - Video Freeze-, Audio Silence-, PID No Data-, Signal Loss-
  - TXT-, EIT-, DD
  - Audio including but not limited to 5.1 Dolby

SLA (Service Level Agreement) - Monitoring

IP networks are prone to packet loss, jitter and delay. The combination of these parameters may affect the transport stream as well as individual services. As oppose to traditional playouts (linear playouts), the non-linear (IP based) needs a more comprehensive SLA monitoring in real time. Content, content type, metadata (SI) as well as the transport layer needs to be considered and measured individually. A simple packet loss in IP could lead potentially to a signal loss of up to 20 sec in case an I-Frame is affected. The sensible broadcast signal over IP is therefore a challenge for any „ALL-IP“ head-end operator. Based on customer requirements one and more of these measurements need to be weighted to reflect their importance in the transport stream. In order to conduct a very detailed analysis on transport streams, IP and streaming probes are used along the signal path. Often time head-end operators are obligated to proof of SLA compliance to their respective customers. In this case, daily reports have to be generated to measure the individual services against pre-defined SLA.

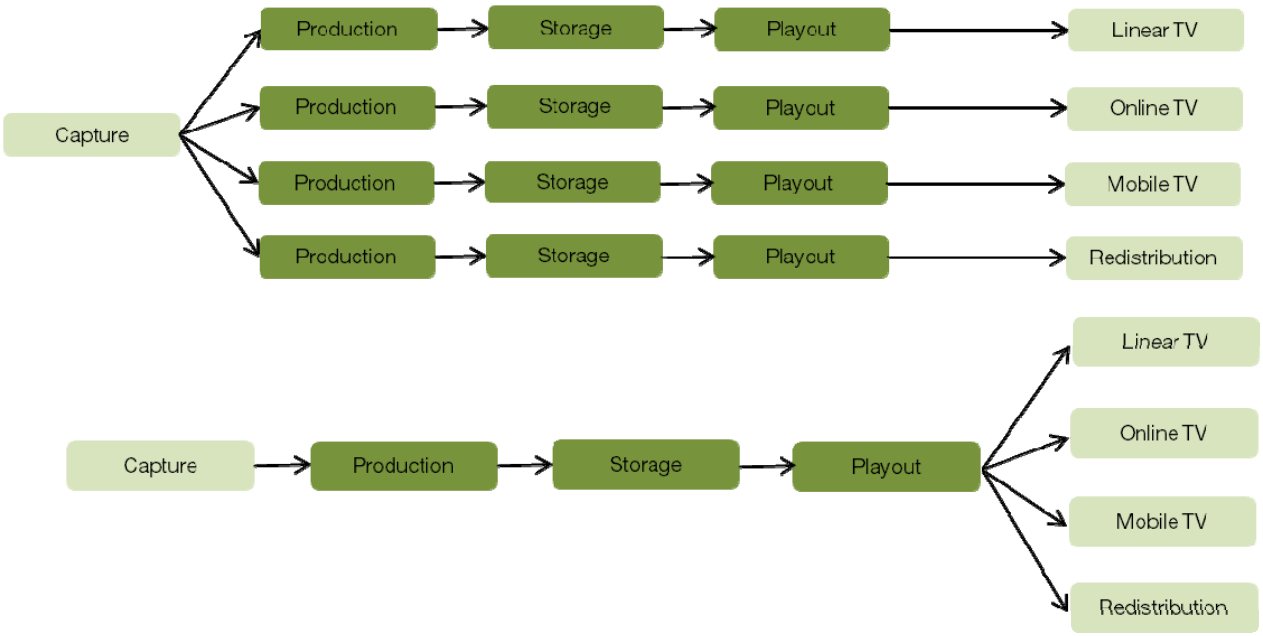

Figure 3: Digital Content Broadcast Chain

In order to reduce CAPEX and OPEX, many head-end operators tend to collapse the existing DVB/ATSC with mobile / OTT (Over-The-Top) platforms. For an effective and future proof head-end, the following signals and transport streams have to be supported simultaneously:

- IP (including OTT, HBB – Hybrid Broadband Broadcast)
- ASI
- SDI
- Digital audio (i.e. DAB+ in Germany)

The so called tri-medial playout is able to collapse not only 3 or more playouts / head-ends into one single platform, it streamlines also the processes, i.e. in a file based production workflow, following items are involved:

- Capture
- Production
- Storage
- Playout

This workflow has to be defined and executed for: linear TV / Online TV / Mobile TV each individually. In a complex playout more and more workflows can be combined.

With the entrance of IP into the broadcast market, many traditional workflows are undergoing massive changes. In the past the distribution path of broadcast signals were a very linear approach from L-Band matrix to i.e. the MPEG2 multiplex transport stream. The promise of
TV anywhere, anytime, with any device has fundamentally changed the way many operators have been carrying the broadcast signals. Non-linear IP based head-ends are emerging. Along with the shortened time-to-market for new services, operators are keen to streamline their business processes. In order to generate new revenue streams, global and premium contents are very attractive new business models for operators. ALL-IP head-ends are potentially the beginning of a new era to streamline not only the business processes. More and more carriers are moving away from traditional microwave or SDH/SONET based contribution networks to IP/MPLS technologies. In this case a lot of signal converting can be avoided and IP based signal can be handed over from studio / stadiums all the way to the distribution site. IPTV head-end can then become part of an overall streamlined supply chain from production to delivery. The premium content can be a part of an advertising model in which case ad-insertion can gain additional momentum.

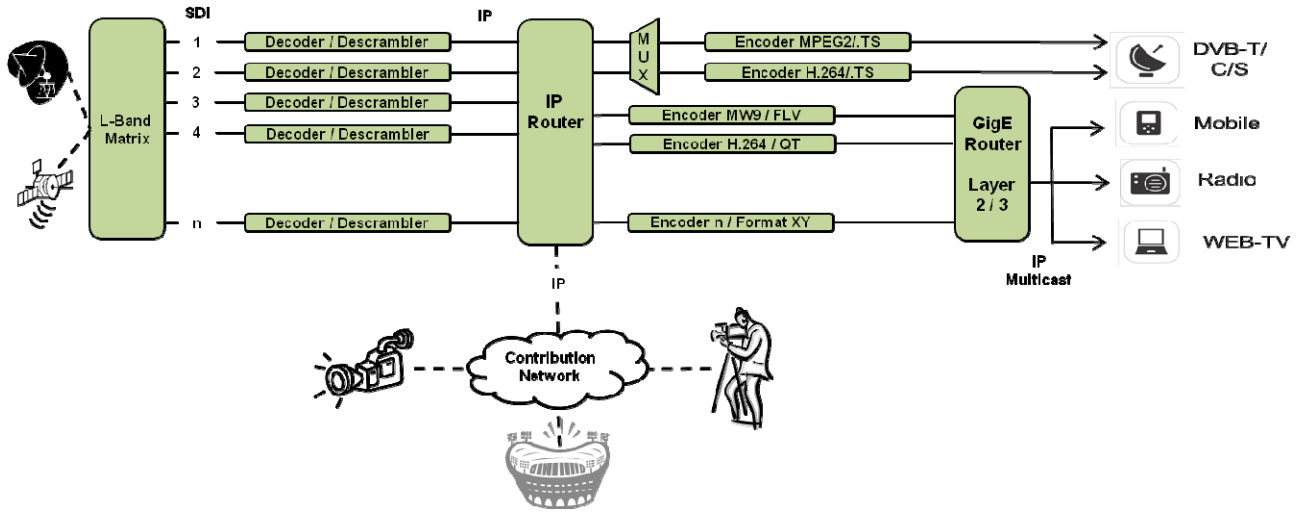

Figure 4: Scheme of ALL IP Headend infrastructure