Mastering Convergent Content Monitoring in a Diverse World of Broadcast and Streaming Media

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Contents

- Evolution of content monitoring
  - The past: a linear world
  - Present & future: multi-dimensional diverse world

- Technical solution: fully SW-based architecture
  - Design principles
  - Architectural building blocks of software framework
  - Selected examples for benefits of software-based monitoring

- Future trends and challenges & relation to SW-based monitoring
  - Secure remote monitoring
  - Flexible license models
  - Virtualization & migration into the cloud

- Summary & conclusion
The Past:  
One-Dimensional World of Linear TV and Radio Broadcasting

- Uniform, specialized technology
- Limited protocols/formats
- Limited device types
- Relatively ‘dumb’ end devices
- Limited diversity in content & channels
- Monitoring Solutions
  - relatively static requirements & features
  - HW-oriented & appliance-like

→ net effect on monitoring solutions:  
limited flexibility to deal w/ highly dynamic application scenarios
The Present & Future: Multi-Dimensional Diverse World of Broadcast & Streaming

Content Source
SDI/ASI

Content Source
2022-6/7

Content Source
2110 / AIMS

Content Source
ASPEN

Contribution Network

Headend

Distribution Network

Monitoring & Multiviewing

Monitoring & Multiviewing

TV Set
Radio
OTT
VoD
Web

...
The Present & Future: Key Challenges to Monitoring Solutions

- Mixture of legacy & IP-technologies
- Explosion of device types
- Babylonia of protocols/formats
- Explosion of content & channels
- Linear vs on-demand
- Call for COTS IT equipment
- Trend to cloud-based deployments

→ proposal: purely software-based approach to monitoring for flexibility, versatility and convergence
Purely Software-Based Monitoring Solution: Key Design Principles

- Purely software-based with HW agnostic programming in HLPL
- Platform based on COTS IT HW or OVF-Hypervisor
- IP-based transport and signaling protocols where possible
- Interworking to legacy formats/signals through i/f cards
- Open, extensible and modular software architecture
- Scalable
Architecture of an Extensible Software-Framework for Convergent Content Monitoring

Input Handling
- Signal Input
- Demux of Source Signal Input Formats
  - Plugin API
  - Software Extension
- Extended Source Signal Analysis
  - Plugin API
  - Software Extension
- Decoding & Basic Analysis
  - Plugin API
  - Software Extension

Service & Media Handling
- ETSI TR 101 290
- Audio
- Periodic Video Snapshots
- Continuous Video (SD/HD/UHD)
- MPEG-2
- H.264
- HEVC

Output Handling
- Content Compare
- Whitelisting
- Live QM
- MV layout ctrl
- MV tile rendering
- HDMI
- TSoIP
- 2022-6/7
- 2110
- AIMS
- ASPEN
- ...
Purely Software-Based Content Monitoring
Selected Benefits

- Convergent monitoring for broadcast and streaming Media
- Convergent multi-Layer KPI monitoring
- Fast implementation & evolution of new advanced monitoring functions
  - Content Compare
  - LiveQM
- ...

Nov 2017 Mastering Convergent Content Monitoring
Benefit I:
Single Convergent Monitoring for Broadcast and Streaming Media

**Broadcast Network**
- Serial (ASI, (3G-)SDI)
- Uncompressed IP (SMPT 2022-6/7, 2110)
- Compressed IP (SMPT 2022-1/2)

**OTT Network**
- Serial (ASI, (3G-)SDI)
- Uncompressed IP (SMPT 2022-6/7, 2110)
- Compressed IP (SMPT 2022-1/2)

**Monitoring Solution**
- Statmux Encoder
- Statmux Encoder
- Statmux Encoder
- Network Adapter
- e.g. DVB T2-MI
- Distribution Network
- Sat
- Terrestrial
- Cable

**Conversion to Convergent Monitoring**
- MPEG TS (SPTS)
- MPEG TS (MPTS)
- Broadcast Network
- Terrestrial
- Cable
- Distribution Network
- OTT Network
- Origin Server
- CDN Network
- HLS
- HSS
- HDS
- DASH

**Conversion to Un-converted Monitoring**
- ABR Encoder
- ABR Encoder
- ABR Encoder
- DASH Packetizer
- RTMP Packetizer
- HLS Packetizer
- Origin Server
- CDN Network
- HLS
- HSS
- HDS
- DASH
<table>
<thead>
<tr>
<th>Layer</th>
<th>Protocol 1</th>
<th>Protocol 2</th>
<th>Protocol 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Layer</td>
<td>Physics &amp; Mechanics</td>
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</tr>
<tr>
<td></td>
<td>(voltages, wiring,</td>
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<td></td>
<td>connectors, …)</td>
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<tr>
<td>Data Link Layer</td>
<td>MAC</td>
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<td></td>
<td>(Media Access Control)</td>
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<tr>
<td>Network Layer</td>
<td>IPv4/v6</td>
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<tr>
<td></td>
<td>(Internet protocol)</td>
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<tr>
<td>Transport Layer</td>
<td>RTP</td>
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<tr>
<td></td>
<td>(Real-time Transport</td>
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<tr>
<td></td>
<td>Protocol)</td>
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<tr>
<td>Application Layer</td>
<td>SDI</td>
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<td></td>
<td>(Serial Digital Interface)</td>
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<td>HBRMT</td>
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<td>(High Bitrate Media</td>
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<tr>
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<td>Transport)</td>
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<td>SDIoIP</td>
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**Multi-Layer KPI Monitoring**

→ single, consistent end-to-end picture of complete state of broadcast & streaming media services
Benefit III:
New Advanced Monitoring Functions, e.g. ‘Content Compare’

Principal algorithmic steps of ‘Content Compare’ function:

- Automatic Latency Alignment & Content Comparison
- Scene Cuts
- Luminosity Levels
- Moving Objects
- Finger Printing
Benefit III: New Advanced Monitoring Functions, e.g. ‘Content Compare’
Benefit III:
New Advanced Monitoring Functions, e.g. ‘LiveQM’
Future Trends and Challenges in Content Monitoring

- Secure remote monitoring
- Flexible license models
  - Evolution of License Models
  - On-demand assignment of SW-licenses (floating licenses)
- Virtualization & migration into the cloud
  - On-demand allocation of monitoring resources (Saas)
  - Orchestration of service workflows in the cloud

All of these challenges are much easier to address & solve with a fully software-based solution architecture
Future Trends & Challenges I:
Secure Remote Access to Monitoring Information

Software-based extension to local monitoring device for
secure remote access to monitoring information
Future Trends & Challenges I: Secure Remote Access to Monitoring Information

Possible deployment scenario w/ several distributed monitoring servers and single cloud-based monitoring proxy.
Future Trends & Challenges I: Secure Remote Access to Monitoring Information

Customer Key Benefits

- Enhanced productivity and unprecedented mobility of monitoring personnel
- Dash-board style and in-depth monitoring information combined on a mobile device

Sample screenshots of mobile app ‘Virtual MV-Wall’ for ‘Secure Remote Monitoring’
https://itunes.apple.com/de/app/virtuwall/id1098657816?mt=8
Future Trends & Challenges II
Flexible License Models - Evolution

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<tr>
<th>Past</th>
<th>Presence</th>
<th>Short-Mid Term</th>
<th>Long Term</th>
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<tbody>
<tr>
<td>Monitoring appliance</td>
<td>Separation into HW (COTS) and SW (as separately orderable items)</td>
<td>Term/subscription licenses with selectable SW options (for a specific time period)</td>
<td>Pay-per-use license (SaaS) (metered via time, # of users, resource usage,...)</td>
</tr>
<tr>
<td>(fixed bundle of HW and embedded SW)</td>
<td>Perpetual licenses with selectable SW options (for a particular release)</td>
<td>Licenses for SW transferable to cloud environment (IaaS)</td>
<td>continuation of license models</td>
</tr>
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</table>

**Customer Key Benefits**

- Flexible & dynamic adaptation of SW-capabilities
- Optimization of SW costs

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**Future Trends & Challenges II**

**Flexible License Models - Evolution**

- **Past**: Monitoring appliance (fixed bundle of HW and embedded SW)
- **Presence**: Separation into HW (COTS) and SW (as separately orderable items), Perpetual licenses with selectable SW options (for a particular release)
- **Short-Mid Term**: Term/subscription licenses with selectable SW options (for a specific time period), Licenses for SW transferable to cloud environment (IaaS)
- **Long Term**: Pay-per-use license (SaaS) (metered via time, # of users, resource usage,...)
Future Trends & Challenges II
Flexible License Models – Floating Licenses

Customer Key Benefits
- Flexible & dynamic relocation of capabilities within an ensemble of monitoring instances
- Cost effective use of expensive or rarely used licences
- Prerequisite for deployments in the cloud
Future Trends & Challenges III: Virtualization & Migration into the Cloud - Workflow

Provider Premises
- Service Content Generation
- Broadcast/Media Services

SaaS Cloud Infrastructure
- Data Storage
- Data Processing

SaaS Cloud Services
- Hosted Customer Services
  (e.g. broadcast workflow w/ content storage, encoding & monitoring,...)
Future Trends & Challenges III: Virtualization & Migration into the Cloud - Orchestration

Customer Key Benefits
- Dynamic ramp-up & tear-down of resources
- Fast & flexible creation and modification of workflows
Summary & Conclusion

- Past: ‘static’ & linear world → HW-oriented ‘monitoring appliances’
- Today & future: highly dynamic & divergent requirements → fully SW-based
- Fully SW-based solutions for content monitoring are
  - Flexible
  - Versatile
  - Future-proof
  - Convergent
  - Key to virtualization & orchestration in the cloud
Thank You
- questions welcome -