

# Convergent content monitoring for broadcast and streaming services

In the heterogeneous world of broadcast and streaming services with its ever growing, fast moving standards, flexibility and cost efficiency are winning factors. The new R&S®PRISMON audio/video content monitoring and multiviewer solution helps service providers solve these challenges.



## Content monitoring: yesterday and today

In the past, classic content monitoring for TV and sound broadcasting services was virtually one-dimensional, with uniform and dedicated transmission technologies and media formats (Fig. 1). TVs and radios were tailored to these technologies and formats and featured no true intelligence of their own nor network connectivity. As a result, the requirements on audio/video content monitoring and multiviewing systems were more or less static. The architecture of these systems was largely hardware-based. Solutions of this type are usually inflexible and not able to cope with dynamically developing customer requirements and application scenarios.

Today's world of broadcast and streaming services, however, is multidimensional and heterogeneous (Fig. 2) – a fact that creates several trends and challenges. On the protocol side, IP technology is moving into the realms of production and contribution<sup>1)</sup>, with new standards such as SMPTE 2022-6/7, SMPTE 2110-20/30, AIMS (Alliance for IP Media Solutions) and ASPEN (Adaptive Sample Picture Encapsulation). Especially in the area of distribution<sup>1)</sup>, an increasing number and variety of intelligent end user equipment for media services (e.g. streaming) is driving an upswing in the number of over-the-top (OTT) protocols<sup>2)</sup> to be supported.

On the infrastructure side, migration from broadcast-specific equipment to standard, commercial off-the-shelf IT (COTS IT) equipment is underway to save costs in the transition phase and eventually enable virtualization and cloud-based delivery of playout, encoding and distribution functions. The broadcast and media services market as a whole is undergoing a paradigm shift toward IP technology. This, in turn, has an impact on how monitoring and multiviewing tasks are performed.

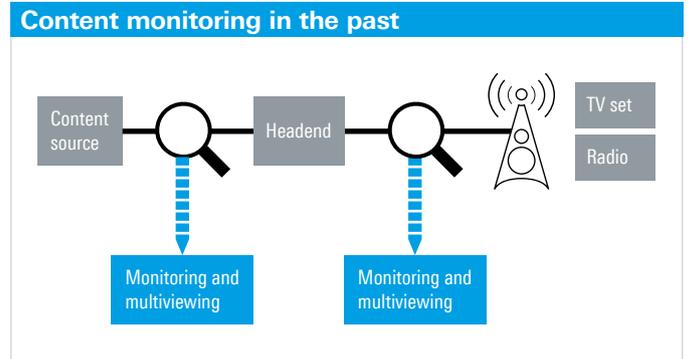


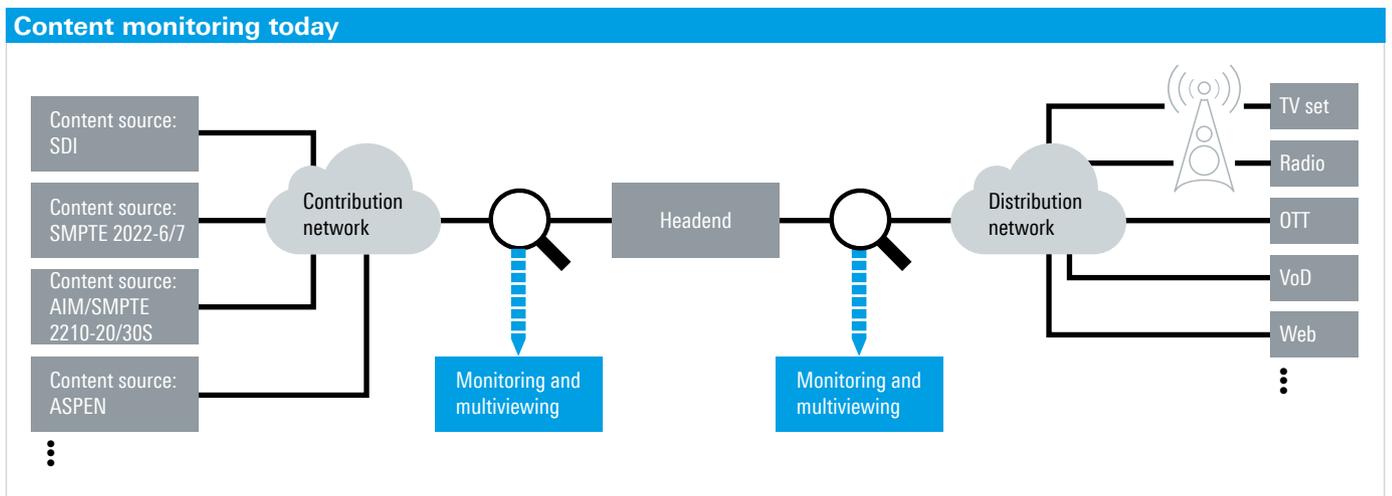
Fig. 1: Classic content monitoring in a one-dimensional, uniform TV and sound broadcasting world.

## The new R&S®PRISMON solution

R&S®PRISMON offers users a universal solution for automated monitoring of media content for broadcast and streaming services. It is fully software-based and takes an innovative multistandard, multiprotocol approach. R&S®PRISMON has evolved from the BMM-810 multiviewer and content monitoring system, which was developed by GMIT GmbH, a wholly owned Rohde & Schwarz subsidiary, and was launched in August 2010. Several hundred BMM-810 systems are still in use in over 20 countries. The capabilities of the BMM-810 were integrated into R&S®PRISMON and significantly enhanced while increasing the number and types of platforms available for hardware- and cloud-based deployments.

Unlike many competitor solutions, which involve various dedicated devices to cover specific contents and transmission formats, R&S®PRISMON offers next generation convergent audio/video monitoring and multiviewing for broadcast

Fig. 2: Content monitoring in the multidimensional, heterogeneous world of broadcast and streaming services.



and streaming services in a single product. R&S®PRISMON addresses the following target groups:

- Broadcast and OTT service providers
- Content providers
- Playout network operators
- Satellite network operators
- Terrestrial network operators
- Cable network operators
- Internet service providers and telecommunications network operators
- Mobile network operators

These target groups have for years been faced with a growing diversity of signals and protocols and with deploying the appropriate monitoring tools to match them. R&S®PRISMON drastically reduces the number of required monitoring devices and provides a convergent, service-centric monitoring workflow (Fig. 3). The system offers the following benefits and options:

- Combined, service-centric monitoring and output of status information for channels transmitted over several different distribution networks; some of these channels may employ variable resolutions and codecs

- Single-source solution for broadcast and OTT/streaming application scenarios
- Uniform, convergent system for both regular operation and training
- Transferable software licenses for subsequent, cost-effective cloud migration

### R&S®PRISMON technology in a nutshell

#### System design principles

R&S®PRISMON relies on state-of-the-art design principles, enabling it to meet present and future requirements:

- Fully software-based solution with hardware-agnostic programming for fast and flexible adaptation to changing requirements and for integrating new features, e.g. new media encoding and transport formats
- Platform operating on COTS IT hardware (Fig. 4) or on an open virtualization format (OVF) compatible hypervisor, generating CAPEX and OPEX savings over proprietary hardware platforms
- Extensive use of IP-based transport and signaling protocols to leverage the established TCP/IP protocol suite framework

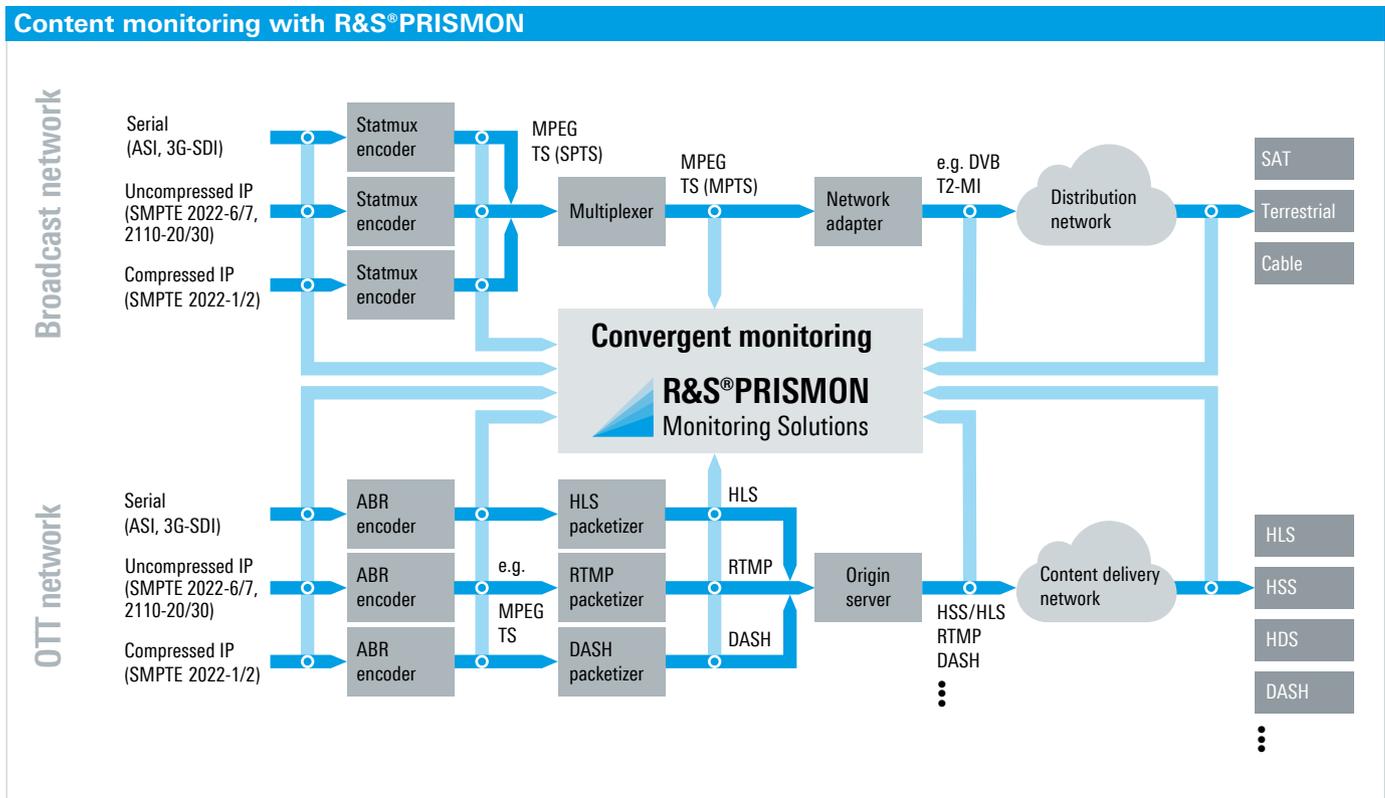


Fig. 3: Convergent, service-centric content monitoring across multiple, different networks using R&S®PRISMON.

- Integration of legacy formats and signals through interface cards to provide backward compatibility and investment protection for existing equipment
- Open, modular software architecture allowing flexible system modifications and extensions as well as agile development
- Scalable platform, allowing users to benefit from the steadily growing computing power of universal COTS multicore CPUs

Based on these design principles, R&S®PRISMON supports advanced streaming technologies in OTT scenarios (distribution) as well as new IP-based transport technologies and mezzanine compression methods<sup>3)</sup>, that are replacing classic SDI signals (contribution). Legacy technologies such as SDI and ASI can be integrated using dedicated interface cards to enable monitoring of hybrid scenarios with a mix of legacy signals and new, IP-based transport formats while migrating to IP.

### Key architectural building blocks

Fig. 5 illustrates the basic architecture of an extendable software framework and its key functional building blocks for convergent content monitoring. The R&S®PRISMON software operates as a standard application on a Linux operating system (Ubuntu).

R&S®PRISMON made its debut at the National Association of Broadcasters (NAB) Show in Las Vegas in April 2017. Right away, the product gained remarkable attention and recognition from both customers and industry. In particular, it won NewBay Media's Best of Show Award, presented at the 2017 NAB Show by TV Technology magazine. NewBay Media's Best of Show Award winners are selected by a panel of engineers and industry experts based on criteria such as innovation, feature set, cost efficiency and performance in serving the industry.



### R&S®PRISMON key features

- Multistandard, multiprotocol support for unprecedented flexibility (e.g. SDI, SMPTE 2022-1/2, SMPTE 2022-6/7, SMPTE 2110-20/30, AIMS, ASPEN, OTT protocol suite, DVB)
- Support of a broad range of application scenarios in playout/contribution and distribution environments on a single platform
- Fully software-based solution for future-proof expandability
- Cloud support via hypervisor platform, and orchestration<sup>4)</sup>-ready design for dynamic and flexible allocation of monitoring capacity
- Secure integration with cloud-based remote video wall service



Fig. 4: R&S®PRISMON installed on a COTS IT server.

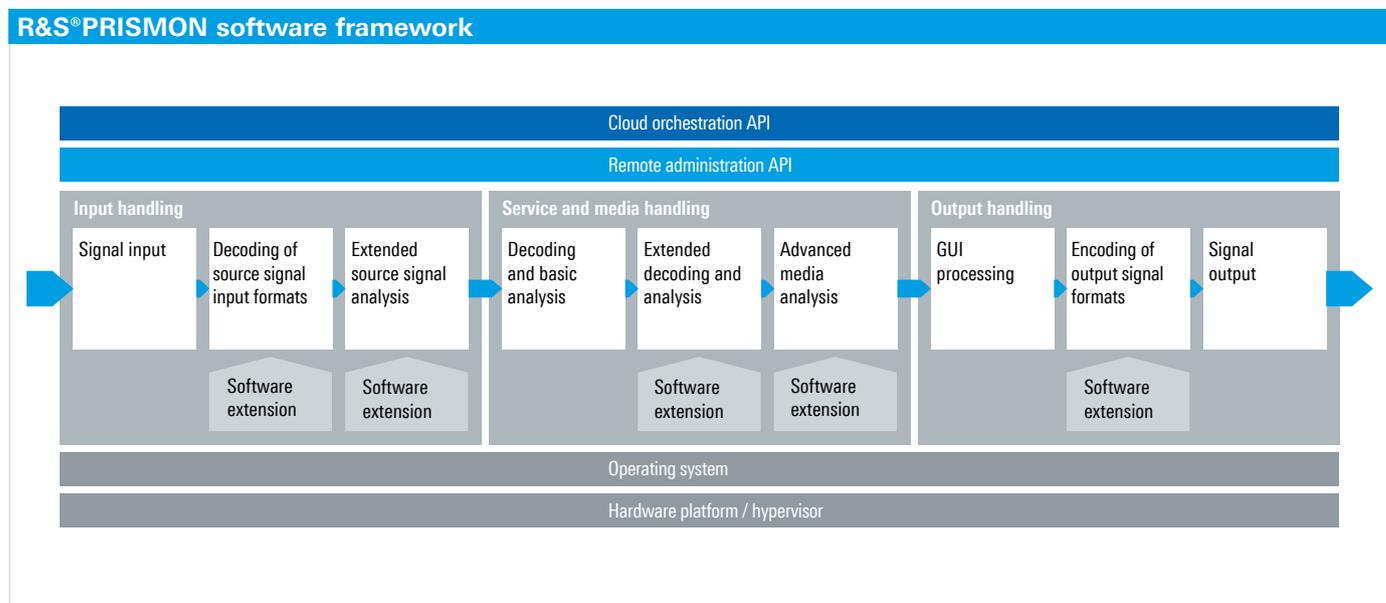


Fig. 5: Key functional building blocks of R&S®PRISMON solution.

The operating system can be installed on a COTS IT server hardware platform or on a hypervisor that supports the open virtualization format for portable virtual machines. OVF quickly and flexibly deploys hypervisor instances in a straightforward manner for private and public cloud installations.

The R&S®PRISMON software framework includes the following key architectural building blocks:

#### Input handling

The “signal” input module handles diverse physical media such as Ethernet as well as IP transport. It accepts media transport streams either as IP unicast or IP multicast. The “decoding of source signal input formats” module plays a key role in the Rohde&Schwarz approach to convergent content monitoring since it harmonizes the handling of an ever growing array of formats for IP-based media transport for all environments. It also provides interface drivers for handling legacy formats such as SDI and ASI. Future source signal formats can be incorporated via software plugins.

#### Service and media handling

The “decoding and basic analysis” module decodes received audio/video content and performs a basic check for signal defects and quality. The optional “extended decoding and analysis” module can process more complex or new (mezzanine) encoding formats such as HEVC, J2K, TICO, etc. When new decoders or even more powerful analysis functions are needed, the functionality of this module can be further extended by adding suitable software plugins. As computing

power in IT server platforms and clouds steadily grows, there is no need to develop costly specialized, often proprietary hardware to handle advanced coding formats.

#### Output handling

The “GUI processing” module handles tasks such as the layout and logic of the tiles for the multiviewer display. It also controls the output of any measured parameter values together with the monitored audio/video content in a given tile. The dynamically compiled image on the multiviewer screen can be further processed by the “encoding of output signal formats” module, for example to output the rendered image to a video screen via HDMI or to provide multiple IP-based video streams.

#### Remote administration API

R&S®PRISMON supports an HTTP-based application programming interface (API) for remote configuration and administration of monitoring instances and remote automation of monitoring tasks. This includes email notification of user-defined recipients in response to user-defined errors and alarms.

#### Cloud orchestration API

R&S®PRISMON will soon be equipped with an open API for integrating monitoring instances as software-as-a-service (SaaS) building blocks into a cloud-based end-to-end workflow, together with other functional instances such as playout, encoding/transcoding/decoding, insertion of ads and logos, digital rights management (DRM), etc. (see Fig. 5).

## Use case examples

R&S®PRISMON supports a broad range of application scenarios in playout/contribution and distribution environments – a fact well illustrated by the following two use cases.

### Video quality assurance and measurements

Video quality measurements are complex, expensive and time-consuming, yet indispensable for broadcast and streaming media service providers to ensure customer satisfaction. Delivering high-quality content to customers while optimally balancing bandwidth needs per channel is key to the commercial success of any service provider. R&S®PRISMON makes objective video quality measurements on video feeds a quick and easy task – both in the lab and in live network environments. It supports multiple parallel measurements using quasi-standard metrics such as peak signal-to-noise ratio (PSNR) and structural similarity (SSIM) index. These measurements can be used for video encoder benchmarking, video quality live monitoring and assurance, and video production and transport analysis and optimization.

Besides providing the measured video quality as a numerical value, R&S®PRISMON generates a heat map, highlighting

areas and intensity of poor quality in realtime. This is illustrated by the channel tiles with red pixel blocks in the middle of the multiviewer screen in Fig. 6. This monitoring function quickly reveals any encoding artifacts or other deviations – even if they only affect small areas. Even less experienced users can interpret results easily.

R&S®PRISMON can perform multiple video quality measurements in parallel, displaying results side by side on a single multiviewer screen. This makes sequential, one-by-one encoder benchmarking superfluous, dramatically reducing the time and effort required to improve video quality.

### Video content compare function to monitor the signal flow

The video content compare function is a unique selling point of R&S®PRISMON. It provides automated, simultaneous, convergent monitoring of multiple, heterogeneous media streams carrying identical content.

In heterogeneous environments, broadcast and streaming service providers are faced with the challenge of distributing identical content with different resolutions over different types

Fig. 6: Sample screenshot of a video live quality measurement with R&S®PRISMON.



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of networks. Due to the complexity of combined Ethernet switching and IP routing, there is a risk of transporting content over the wrong paths. In one potential critical scenario, adult-rated content could be erroneously delivered over a children’s TV channel. The ability to automatically monitor the content of an outgoing channel by comparing it against a known, good reference channel can prevent errors of this type.

Direct analysis focusing on individual pixels would be too inaccurate and would trigger a number of false alarms. The video content compare function employs a more objective method of content recognition. It automatically compares the media stream to be analyzed with a reference stream, using characteristic criteria such as moving objects, scene cuts and average luminance level (Fig. 7). Depending on the result of the comparison, the function can trigger a predefined action, e.g. in the example of inappropriate content being delivered over a children’s TV channel, program delivery could be stopped.

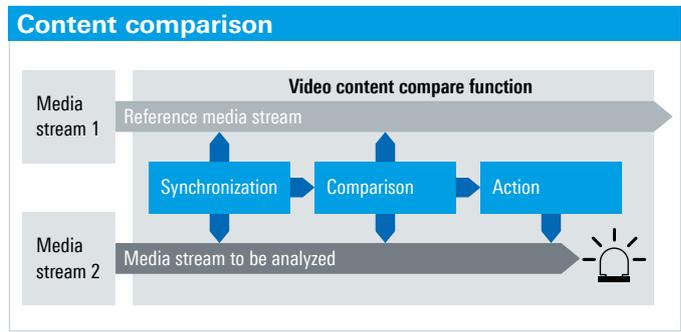


Fig. 7: Key steps of video content compare algorithm.

### Integration of cloud services for secure remote content monitoring

Broadcast and streaming service providers face yet another challenge – they must enable secure remote content monitoring performed by operating personnel from outside the traditional master control rooms. Rohde&Schwarz has developed a convenient solution to this problem (Fig. 8). A virtual multiviewer wall cloud service referred to as virtuWall centrally collects monitoring data from various R&S®PRISMON instances that act as probes for the local audio/video contents. Probes can be distributed across multiple locations, e.g. in master

control rooms at different sites of a service provider. They are linked to the central cloud service via IP connections. If necessary, these IP connections can be secured using IPsec encryption or a similar technique.

In the cloud, overall monitoring status information and a multiviewer image are generated from the monitoring data collected from the various probes. The central cloud service also acts as a proxy that distributes the consolidated monitoring information to the mobile monitoring clients.

Mobile clients can connect to the central monitoring proxy either locally via WLAN or remotely via a wireless, secure connection. Mobile clients must authenticate themselves with the central proxy to be granted read-only access. Once a mobile client is securely connected, the proxy pushes the

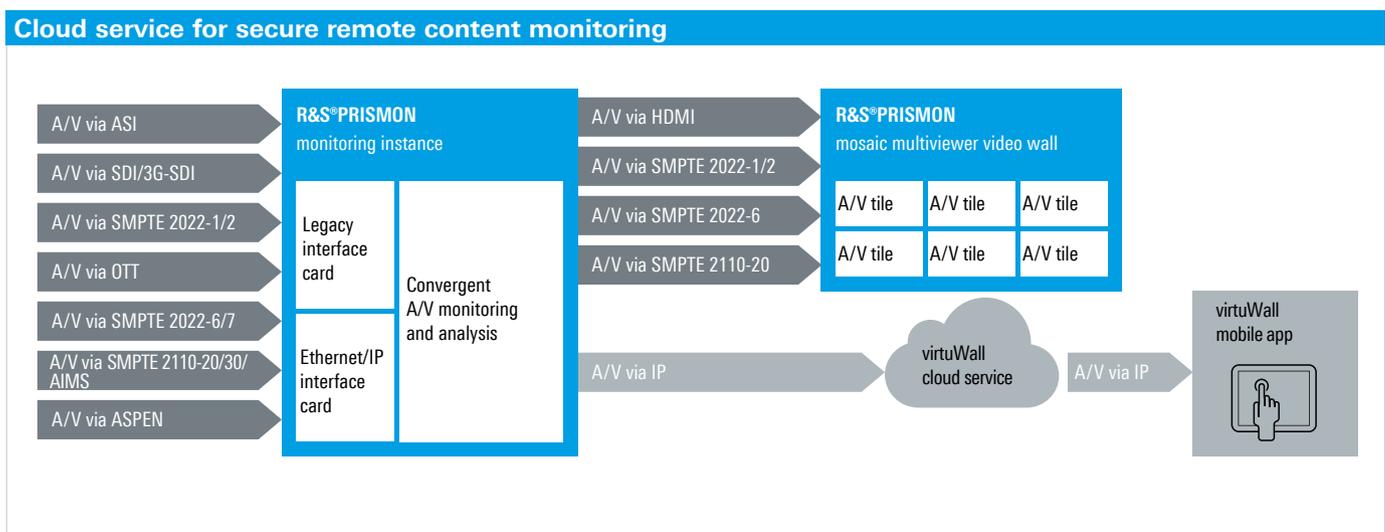


Fig. 8: Secure remote content monitoring – sample scenario with R&S®PRISMON and a virtuWall cloud server.

compiled information to the virtuWall app installed on the client, which can be a commercial tablet or smartphone. The virtuWall app provides monitoring/service personnel on or off a service provider's premises with complete information about all broadcast and streaming services and the transmitted audio/video contents.

Fig. 9 shows two sample screenshots with typical information delivered by the virtuWall app. The first page provides a quick overview of all monitored channels. Users can tap a channel group to display more detailed monitoring data together with an enlarged multiviewer image in mosaic style.

The innovative solution of combining R&S®PRISMON with a mobile cloud service lowers OPEX since fewer manned monitoring stations are required and some of the on-shift personnel can even perform their tasks off the service provider's premises.

Despite all security measures built into R&S®PRISMON and the virtuWall cloud service, implementation and operation of this solution requires ongoing consultation and close supervision by cybersecurity experts since new threats and attack vectors are constantly arising, posing a challenge for all existing security concepts. The Rohde&Schwarz subsidiary Cybersecurity GmbH provides customers with the necessary expertise from a single source.

### Summary

R&S®PRISMON responds to the increasing diversification of the audio and video protocol and format landscape by providing a convergent monitoring solution for all broadcast and streaming services. The solution offers content providers and network operators a simple and powerful tool for monitoring any number and type of transmitted audio/video contents irrespective of the distribution channel – using a single device.

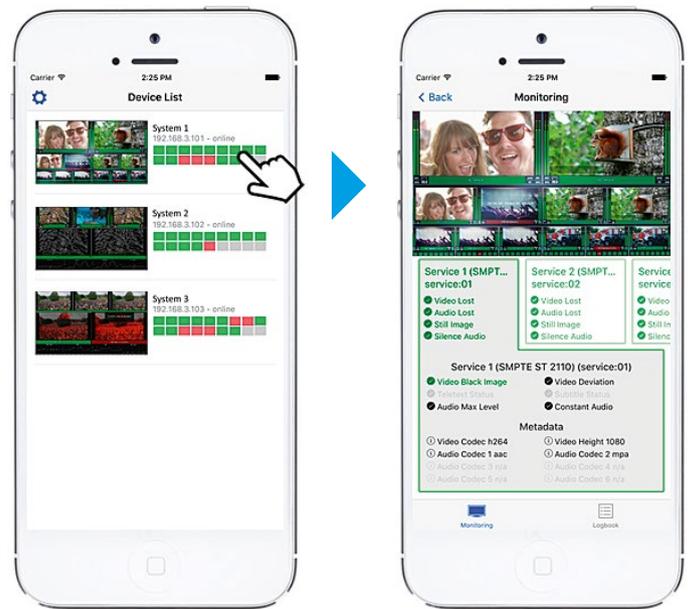


Fig. 9: Sample screenshots of the mobile virtuWall app for secure remote content monitoring from a mobile client (tablet or smartphone).

R&S®PRISMON is fully software-based. Its modular software framework and plugin approach ensure future-proof expandability so that new transport protocols and media formats can be included quickly and cost-effectively.

The R&S®PRISMON software can be installed on a COTS IT server platform that can integrate even legacy formats via I/O cards. Alternatively, the software can be virtualized in a cloud. The range of functions is identical for both options. A feature currently unique on the market is the R&S®PRISMON virtuWall extension that transmits monitoring information via a cloud service to mobile user equipment, enabling operating personnel to perform monitoring tasks from a remote location.

Dr. Markus Lautenbacher

1) Contribution refers to the transmission of media content between geographically distributed locations of a media network, e.g. between a content provider and a satellite operator. In contrast, distribution refers to the transmission of content to end user equipment.  
 2) Over-the-top (OTT) services transport data over an IP network without the network operator being involved in providing the service (YouTube, Skype, etc.).

3) Mezzanine compression methods (mezzanine: in between, in the middle) compress data sufficiently to achieve a significant reduction in required memory and transmission volume while generating a high-quality compressed product that is suitable for archiving and conversion to other data formats.  
 4) Cloud orchestration: technical and administrative measures aimed at integrating cloud applications into corporate environments in a secure and controlled manner.