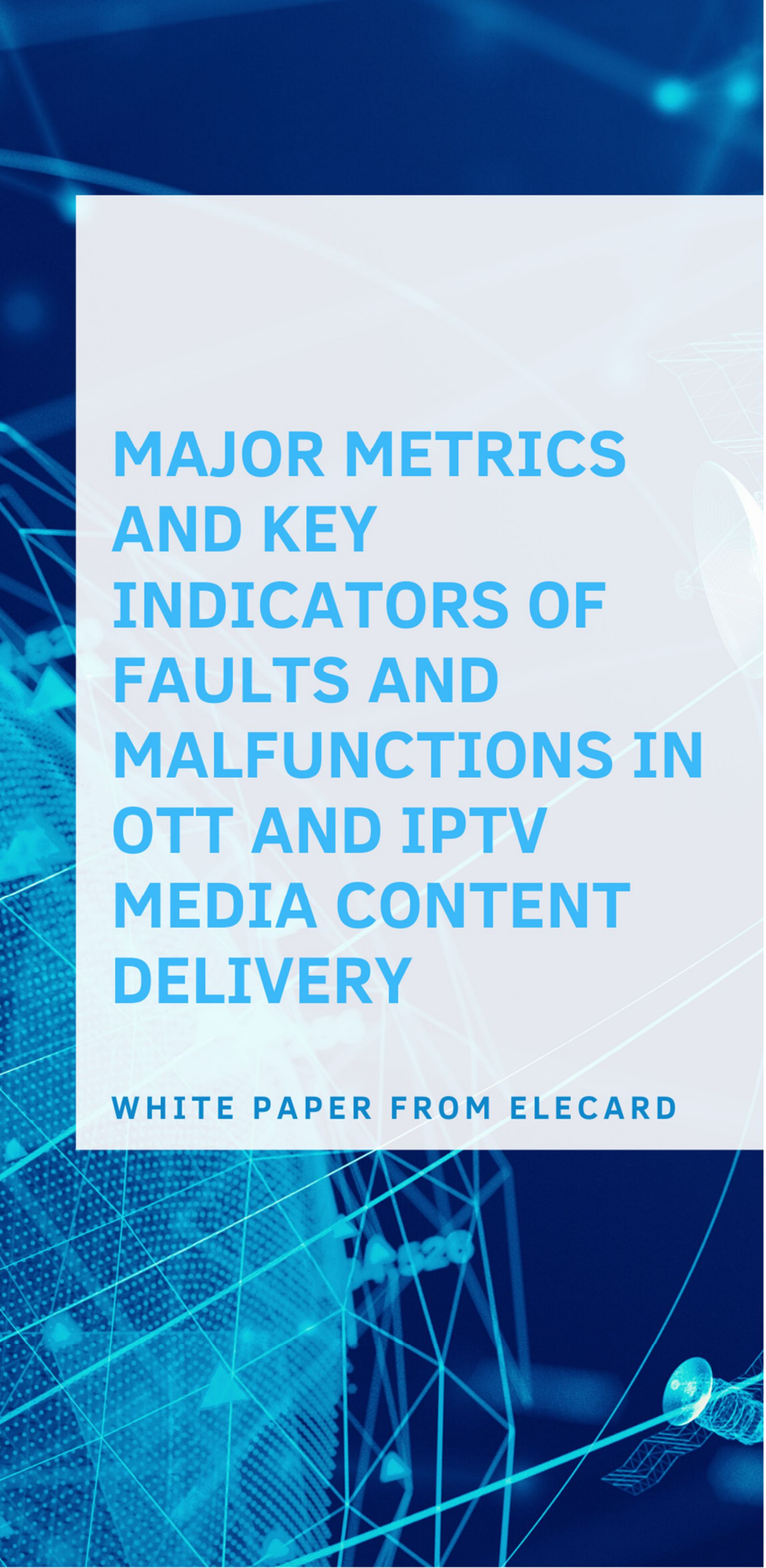

MAJOR METRICS AND KEY INDICATORS OF FAULTS AND MALFUNCTIONS IN OTT AND IPTV MEDIA CONTENT DELIVERY

WHITE PAPER FROM ELECARD

June 2020

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Company overview

9700 companies

150 countries

20M users

Elecard company, founded in 1988, is a leading provider of software products for encoding, decoding, processing, monitoring and analysis of video and audio data in various formats.

Elecard is a vendor of professional software products and software development kits (SDKs); products for in-depth high-quality analysis and monitoring of the media content; solutions for IPTV and OTT projects, digital TV broadcasting and video streaming; transcoding servers. Elecard is based in the United States, Russia, and China with headquarters located in Tomsk, Russia.

Elecard products are highly appreciated and widely used by the leaders of IT industry such as Intel, Cisco, Netflix, Huawei, Blackmagic Design, etc. For more information, please visit www.elecard.com.

Introduction

The task most operators face today is how to keep the subscriber base loyal. Stable high quality of broadcasting is one of the factors that helps address this challenge. To maintain high quality and detect violations in the stream, the monitoring system is required.

In this paper, we will explain how to interpret a variety of metrics and parameters of TS and ES that will serve for quick fault identification and proactive error fixation. Among them are IP jitter (IAT, delay factor), media loss rate, multiple broadcasters event, TR101290, SCTE 35 marks, DTS and PTS timestamps, audio and video decodability, loudness EBU R 128, EPSNR.

Metrics and parameters used for quick fault identification

All monitored parameters are divided into two types: relating to Quality of Service (QoS) and Quality of Experience (QoE).

Quality of Service

No signal (BadSource) error is the most critical parameter displaying the “red” state of the network delivery. This state occurs when the monitoring system cannot receive data for further analysis for some reason. To address the No signal error, it is required to investigate the cause of the issue and promptly define its location: streamer, switching equipment or network. This problem can be solved by using several analyzing solutions or multiple clients (probes) within the frame of a distributed monitoring system.

For IP streaming, two basic parameters should be primarily monitored and closely analyzed: packet loss and packet jitter; timely notifications help ensuring seamless audio and video streaming. If no packet loss is detected and packets are sent smoothly through the network, it corresponds to high quality of signal streaming and delivery.

Quality of Service

In case of packet loss and excessive jitter detection, problems with signal and packets delivery become obvious to a viewer. Therefore, packet loss and jitter measurements are of major importance for network monitoring and QoS assurance.

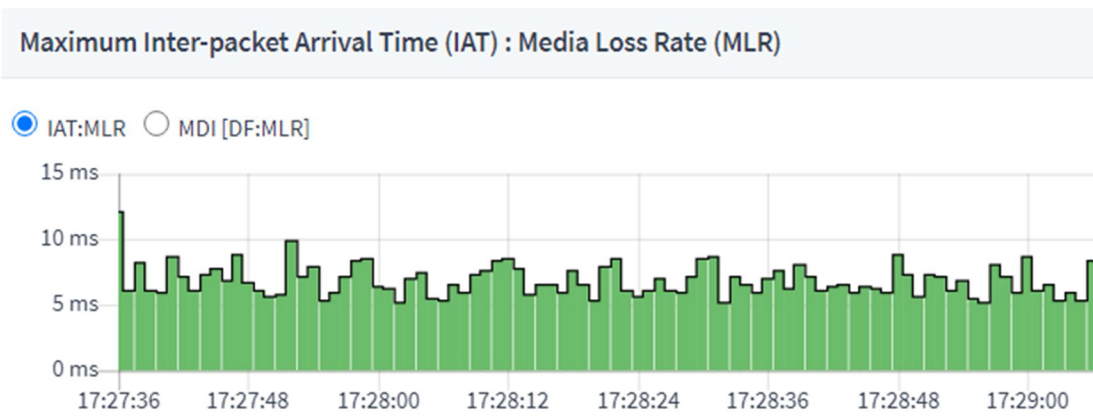
Packet loss can be estimated by checking TS packet headers by Continuity Counter embedded in TS.

Continuity Counter (CC) errors occur if incorrect packet order is detected or one and the same packet successively occurs more than twice, or packet is lost.

Media Loss Rate (MLR) is a metric that allows detecting packet loss values. It shows the number of transport packets lost per second.

Inter-packet Arrival Time (IAT) metric is used to measure a packet jitter by checking time intervals between arriving packets. Maximum IAT may be used as a measure of packet jitter.

Delay Factor is one of the most important parameters for the network quality monitoring as well. This is a time value that shows how many milliseconds of data buffers must contain to eliminate time distortions (jitter). To indicate the quality of video streaming delivery network, MDI (Media Delivery Index — DF:MLR) may be used.



Quality of Service

In addition to the primary metrics used for network signal monitoring and described above, the following parameters should be applied as well to assure comprehensive monitoring of QoS.

Multiple broadcasters event. Occasionally, when several broadcasters start streaming data in a single multicast group, erroneous situations occur and it becomes impossible to receive a good stream.

TR 101 290 is a standard that provides guidelines for measurement in Digital Video Broadcasting (DVB) satellite, cable and terrestrial and related digital television systems. It defines measurement techniques which allows comparing the obtained results with the reference values.

The standard provides thresholds, but strict compliance with the standard requirements is not mandatory for IPTV streams. Correspondingly, threshold configurations can be adjusted to exclude unwanted trigger actions. TR 101 290 analysis can be applied either for IPTV or for unencrypted OTT services (or for services that can be decrypted) based on fragmented TS technology.

In case of TR 101 290 errors detection, picture defects become visible to a viewer, such as: picture pixelization, noises and artifacts, audio and/or video freezes, loss of service, black screen etc.

Download rate/Multicast rate. Download rate over the HTTP/HTTPS protocol or total bitrate of incoming UDP/RTP stream. The monitoring system compares download/multicast rate with a segment length and its bitrate.

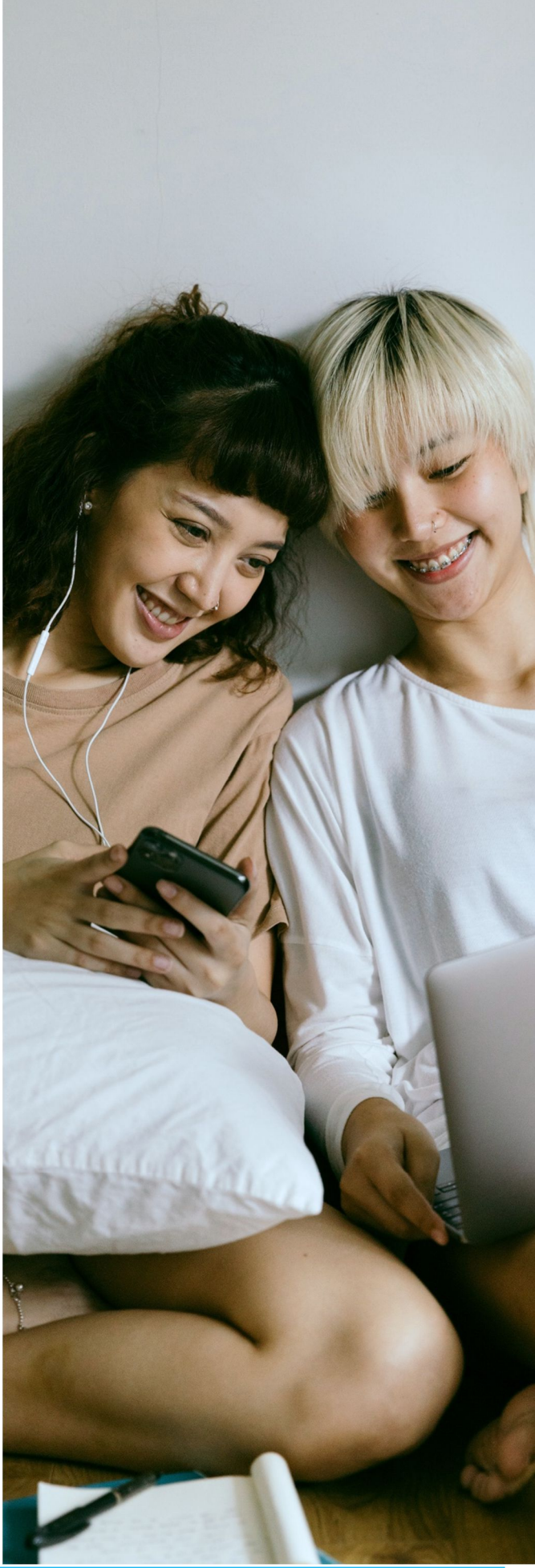
Quality of Experience

The following two parameters are essential for estimating the quality of experience, because lack of audio or video affect viewer experience dramatically.

Video decodability — the parameter estimates video stream decodability. The error state occurs if the number of correctly decoded frames is under the set threshold.

Audio decodability — the parameter estimates audio stream decodability. The error state occurs if bitrate of the decoded stream is under the set threshold.

Audio Track Missing and Audio Silence. To detect Audio Silence, the Audio Loudness Analysis algorithm is applied, that is implemented on the EBU R 128-2011 standard. If errors are detected, they surely affect user experience with the service. Timely notifications on occured errors help to quickly eliminate audio issues at the head-end station.



Quality of Experience

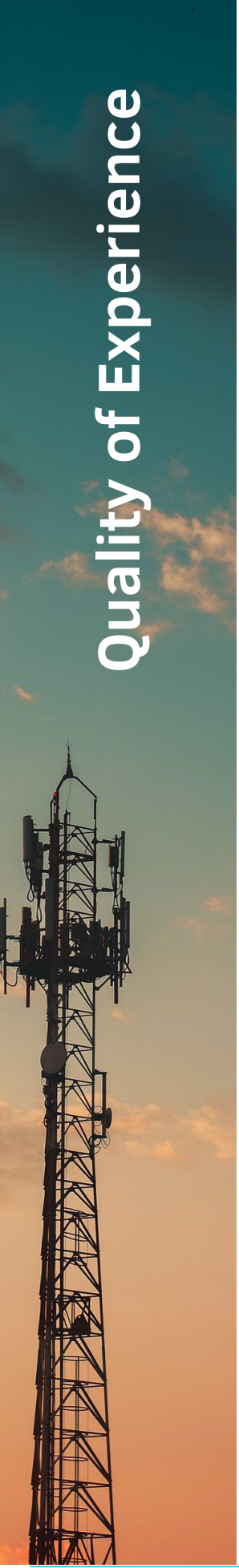
Synchronization continuity is one of the vital parameters for qualifying a high-quality broadcasting. Stream analysis based on **Timestamps Discontinuity** relates to the state when continuity of the **PTS/DTS timestamps** is broken, backward time shifts and sudden skips (packet loss and/or stream splicing) are detected in the stream. As a result, noize, pixelization, video freezes and black screen is shown to a viewer.

Audio/Video Information Changed and Program Specific Information Changed events describe changes in audio and video headers and in a stream structure. In some cases they may affect the viewer experience.

Encryption State Changed event allows swiftly detecting the case when an encoder accidentally starts producing encrypted streams, thought a decrypted stream is expected at the input.

In addition to the QoE parameters described above there are some valuable options that help in monitoring media data quality.

SCTE-35 messages related to advertisement insertion interval are detected and registered for further analysis (according to the standard ANSI/SCTE-35). These cueing messages can be used to activate more frequent capturing of thumbnails and/or to set the inserted ad recording when the event is triggered. This option can be useful for Playout Experts is charge for preparation of daily TV-programs with ads.



Quality of Experience

EPSNR is a metric showing a statistical estimate of the digital video content distortion during encoding. It is expressed in dB and defined as a ratio of peak mean square video signal to mean square deviation of the output signal from the original one. EPSNR (Estimated Peak Signal to Noise Rate) value estimation is based on encoded video stream data, so no source video is required. EPSNR is used to estimate encoders' performance quality. The following values may be used: 25-30 dB — low quality, 45-50 dB — high quality.

Audio Loudness Analysis measures program loudness and peak levels of audio signals according to the EBU R 128-2011 standard: Program Loudness, Momentary Loudness, Short-Term Loudness, Loudness Range, Maximum Permitted True Peak level.

There are some additional QoE parameters applicable for OTT only.

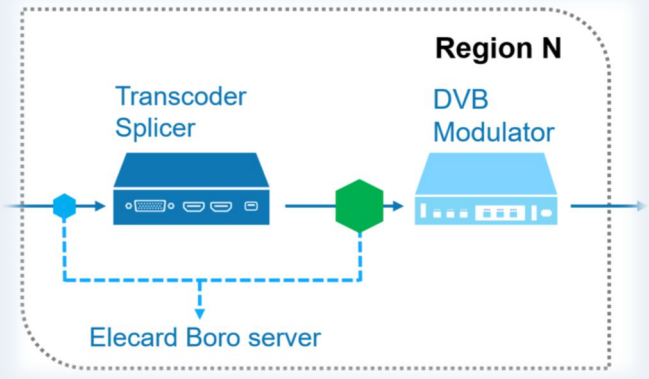
Start With non-IDR Frame error occurs if a segment starts with a non-IDR frame. It can result in playback delay and/or video freezes along with pixelization and picture artifacts.

Interlaced Video event is activated if a segment contains interlaced video. Some mobile devices do not support interlaced streams decoding or such streams cause interlaced artifacts in media content playback. That is why interlaced video cannot be used in OTT, so this parameter is important to monitor.

Use Cases

This section describes some common cases IPTV and OTT operators experience and parameters that reveal the problems cause. To analyze the issues, we have used the Elecard Boro monitoring system. Elecard Boro is a client-server application consisting of 2 parts: a software Boro probe and a Boro server designed to collect and process statistics (see p. 14 for more info).

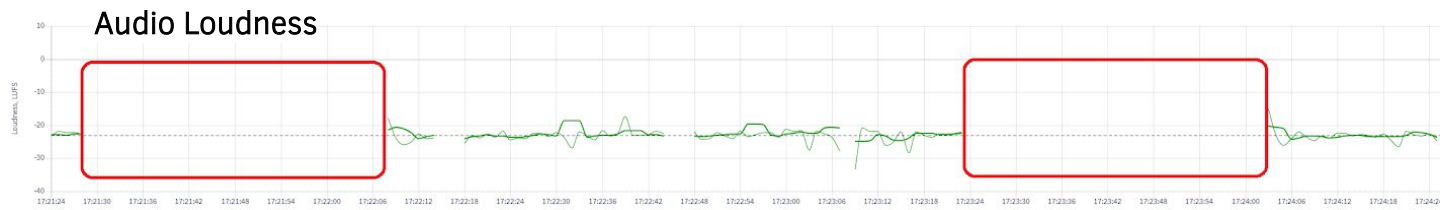
Case 1: Stuttering during ad breaks in region N



The probe detects the Video Information Changed event. This event happens quite often when inserting any kind of content. Parameters of regional advertising were different: aspect ratio was 16:9 instead of 4:3, and scan type was interlaced instead of progressive. Some other parameters can be different too, i.e. a codec or a frame rate. Some TV sets and STBs whose decoders cannot adapt to the dynamic change of parameters, stop decoding the picture and wait for the parameters to return to the previous values. Any changes on this level can affect proper decoding on the end-user device and significantly reduce the Quality of Experience for subscribers, especially if these changes are regular.

Case 2: Stream becomes unavailable for end-users

Probes were installed after the satellite demodulator and after the transcoder. The monitoring system registered **Program Specific Information Changed** events. Also during these events Boro couldn't decode audio (**Audio Decodability** event) and analyze loudness (**Audio Loudness** parameter). It was detected that descrambling module misbehaved from time to time and stopped descrambling. The scrambled stream resulted in faults of the transcoder.

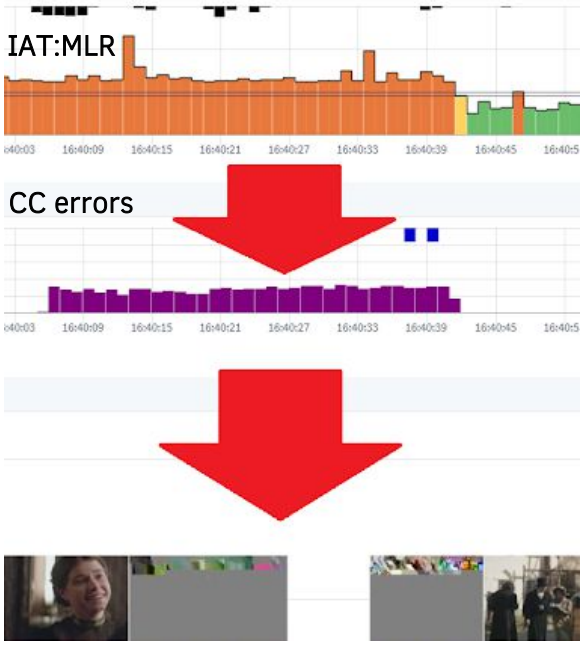


Case 3: Problems with OTT channels – players stop working

Probes were installed before and after the transcoder/packetizer, after origin and after dozens of CDN servers in regions. Probes detected problems for a few of regional CDN servers: segments were absent or **download rate** was too low for real-time playback. The problem was identified: bandwidth between origin and regional servers was not sufficient.

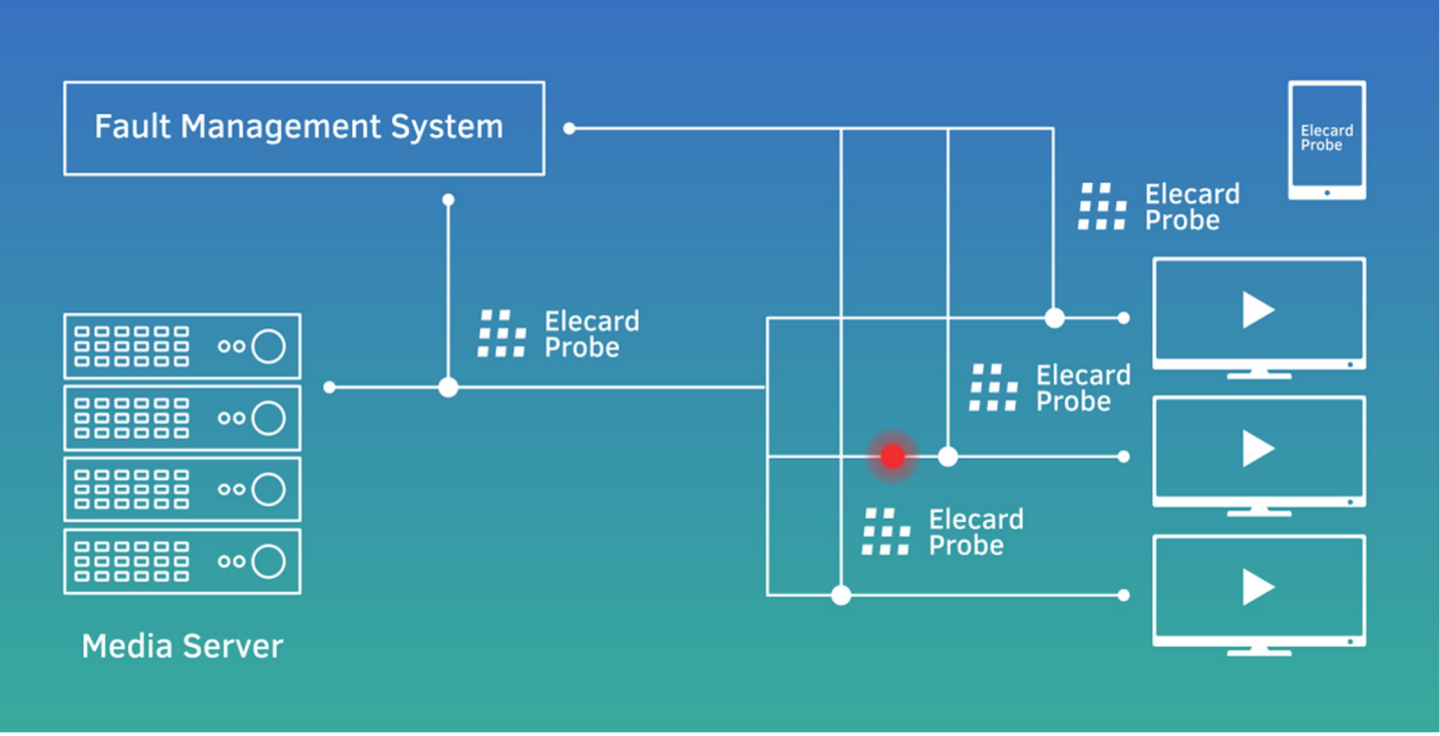
Case 4: TV channels become unavailable or highly distorted

Probes were installed at the headend before the satellite modulator and across regions after the satellite demodulators. Boro detected a huge number of transport issues such as **packet losses** and **CC errors** in evening time. These losses made it impossible to decode a video and audio. The problem cause was interference between satellites.



Case 5: Subscribers of OTT service experience video freezes

Probes were installed before and after the transcoder/packetizer and after CDN servers. Several issues on transport level were detected. When **CC errors** appeared, the transcoder switched into the static picture mode. Sometimes after input stream recovery the transcoder did not switch back and streamed a static picture. The transcoder had to be rebooted.

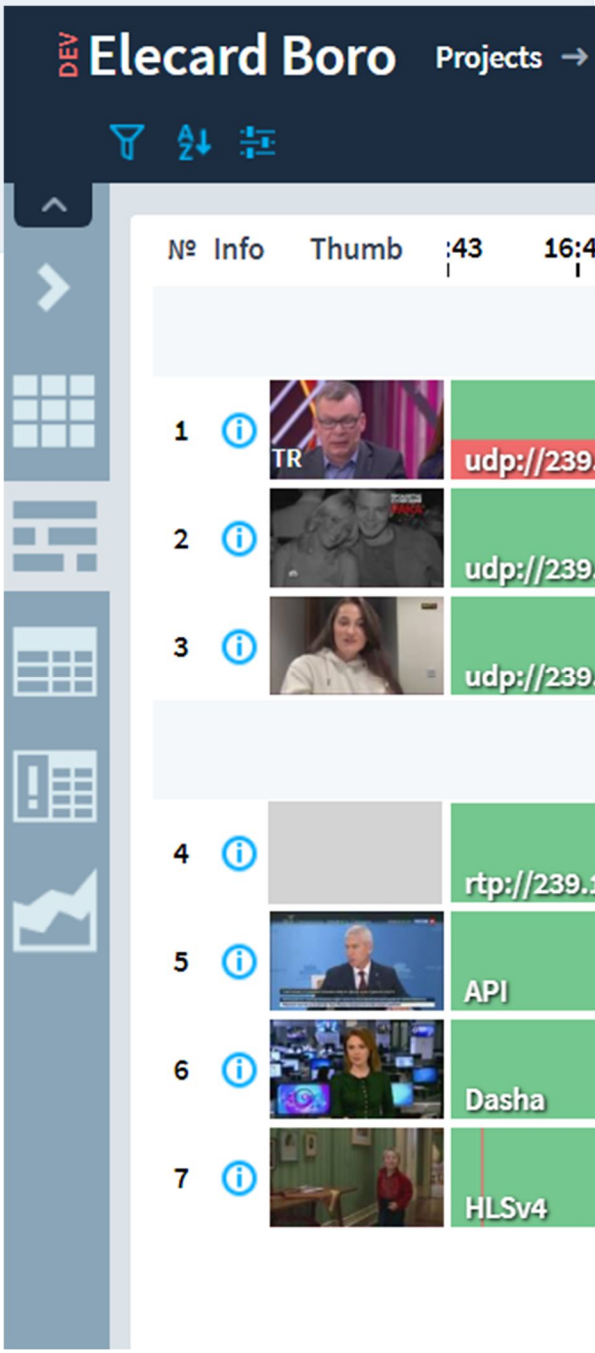


What is Boro monitoring system?

Elecard Boro is a client-server application consisting of 2 parts: a software Boro probe and a Boro server designed to collect and process statistics. Boro probes are distributed over the network: at the head-end station, at input streams monitoring points and after transcoding, multiplexing and encrypting modules; at end-points of main delivery networks, signal distribution points and last mile locations.

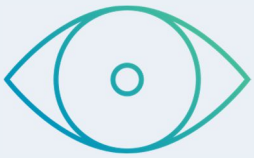
Boro probe detects violations in the stream and transfers the detailed statistical information to Elecard Boro server. The server aggregates the received data, provides reports in easy-to-understand graphic form, and ensures fast notifications about violations. Boro registers a great number of technical characteristics based on which one can make a conclusion on quality of TS streamed over the network. To make this information easy to read and understand, Elecard Boro offers different data layouts: events journal, graphs, multiscreen mode, Live View, tables etc.

Key tasks of Elecard Boro



- Provides timely up-to-date information about services in a real-time mode;
- Verifies stream compliance with internal technical requirements and TELCO standards;
- Ensures availability of all streams across the network;
- Timely localizes network issues;
- Sends immediate notifications about detected violations;
- Automates and optimizes existing monitoring routines;
- Generates reports about service availability and network errors;
- Checks performance, quality and helps adjusting settings of video equipment;
- Performs load and stress tests of Content Delivery Network.

Key advantages of Elecard Boro



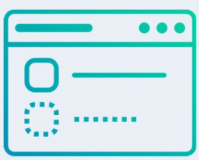
Real-time monitoring of IPTV, OTT, DVB. Probes operating 24/7: you have total control over the network

Multiple notification methods: e-mail, Telegram, SNMP, WebHook, PagerDuty

Friendly data layout and all the advantages of web interface

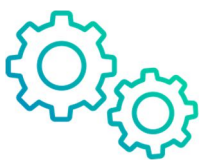
Quick start: less than 30 minutes to begin monitoring your streams

Low capex and opex: save on specific equipment, reduction of network maintenance expenses



Flexible licensing: available as a cloud service or stand-alone solution for local networks

Easy integration and scaling up



More than 50 parameters and triggers

Feedbacks

“Easy to install and understand”

“The Boro system demo was easy to install into my own network with no preparation required on my side. I was able to run the demo and learn functionality of the Boro system quickly. The graphical interface for Elecard Boro showed problems and the status in a fun and easy to understand way.

Once I had decided to deploy Boro within my local network, the Boro team was quick to advise me and confirm the prerequisites. The installation was performed remotely by Elecard within a few hours.

The ability to monitor using a remote probe at multiple remote locations at the same time became the main reason to choose Elecard.”

Steve Bretherick, Technical Director, Telemedia

TELEMEDIA

“Effective TV monitoring at a reasonable price”

“The Boro system demo was easy to install into my own “Elecard Boro solves a task of effective TV monitoring with sufficient functionality at a reasonable price. Integration process was fast and did not require significant efforts. It is important to mention that the interface of the product implemented as a web application is very convenient. We consider our collaboration to be fruitful and think about deploying additional probes after multiplexer and streamers.”

Artem Kurgun, Head of the Department of Network and platform management of Cosmos TV

COSMOS telecom

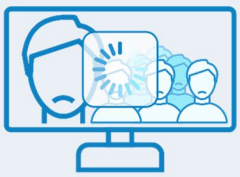
“High self-descriptiveness, easy setup and fast deployment”

"We were looking for centralized quality control over multicast streams to quickly detect malfunctions and promptly fix them. Several features were essential for us: multichannelling multiplexing support, real-time stream monitoring and logging statistics for each multicast within a specified period. Elecard solution stands out for its high self-descriptiveness, easy setup and fast deployment."

Sergey Panfilov, Technical Director in Ostankino Telecom

ОСТАНКИНО ТЕЛЕКОМ

For broadcasters



to monitor issues

to ensure
best quality

and have happy
subscribers

Conclusion

The monitoring system ensures immediate locating network or content violations due to the probes distributed in different points. It analyzes the detected events, determines the error causes and helps in addressing the violations before they become visible to end-users. Monitoring systems allow ensuring seamless high quality of broadcasting and keeping subscribers engaged.

It is important to track various parameters to ensure high Quality of Service and Quality of Experience. The most significant and indicative parameters are IP jitter (IAT, delay factor), media loss rate, multiple broadcasters event, TR101290, SCTE 35 marks, DTS and PTS timestamps, audio and video decodability, loudness EBU R 128, EPSNR.

We recommend to consider using the Elecard Boro monitoring system as it registers a large number of the main parameters of streaming (more than 50 parameters and triggers). Flexible configuration of parameters, quick deployment, friendly interface and other features make Elecard Boro a must-have tool for Telco operators.

Contact details

HEAD OFFICE	USA OFFICE	CHINA OFFICE
Address: 3 Razvitiya ave. Tomsk, Russia, 634055 **Phone:** +7 (3822) 488-580 Business hours: Monday-Friday 10.00 AM through 7.00 PM (local time GMT +07.00)	**Address:** 142 N. Milpitas blvd, #411 Milpitas, CA, 95035 **Phone:** +1 (323) 644-4063 Business hours: Monday-Friday 10.00 AM through 5.00 PM (local time PST) Corporate and OEM customers	**Address:** Vvyee halls, booth C06, 3rd floor, 96 Dong Hua Nan Lu street, YueXiu District, Guangzhou, China. **Phone:** +86-20-83717605

Email: sales@elecard.com
Website: www.elecard.com