

DTV: transmission perfect – transport stream correct?

This is an important question for any operator of digital television transmission networks since the signals must be transmitted properly and the transported content must be error-free. As an all-in-one test instrument that is unique worldwide owing to its concept, compact design and wide range of measurement capabilities, the R&S® ETL TV analyzer with its new MPEG analysis functions provides answers to such questions.

DTV signal and TS analysis in one instrument

In digital television (DTV), an MPEG-2 transport stream (TS) is transmitted over the air or via cable using a digital modulation technique. The TS contains one or more programs (services) consisting of video, audio and auxiliary information. The stream's complex structure must conform to defined rules so that it can be properly processed by the receiver.

The R&S® ETL TV analyzer is prized by broadcasters and cable network operators as a reference receiver for in-depth investigation of the RF quality of DTV signals. Equipped with the new MPEG options, it can now also provide pinpoint monitoring of the MPEG-2 transport streams arriving at and leaving transmitters and cable headends and perform parallel analysis of the details in a way that was previously possible only with special, professional MPEG-2 analyzers (FIG 2). This compact, all-in-one test instrument is unmatched worldwide with its combined analysis of DTV signals and transport streams.

Options for TS analysis basic functions

The R&S® ETL-B280 MPEG processing board is the main module for MPEG analysis. It can also be installed in existing instruments (FIG 1). It has one internal and one external transport stream input. The external input can be defined as an ASI or SMPTE310M input. The board also has an additional ASI transport stream output as well as a DVB common interface.

The R&S® ETL-K282 MPEG analysis/monitoring software option enables users to access the basic functions for MPEG-2 transport stream analysis. The software provides a clear overview of the underlying structure of the transport stream under analysis. Individual TS elements can be selected quickly and easily for more in-depth examination. The software analyzes the conditions in accordance with DVB test specification TR101 290, which classifies errors into priority levels 1, 2 and 3 (FIG 3). This also applies analogously to the ATSC and SCTE standards, which the software can handle



The R&S® ETL TV analyzer is a versatile platform designed especially for commissioning, installing and servicing TV transmitters, performing coverage measurements for terrestrial television and testing cable headends.

Please refer to NEWS 198/08 (pp. 86–89) for a report on how the R&S® ETL TV analyzer with its extensive analysis functions can help ensure high transmission quality for both transmitters and DVB-T/DVB-H single-frequency networks.

This article presents the new MPEG analysis functions.

FIG 1 The R&S®ETL TV analyzer with the built-in R&S®ETL-B280 MPEG processing board.



as well. Besides the parameters of priority levels 1 to 3, the software also measures the repetition rates for the individual information tables (e.g. PAT, PMT) as well as the transfer rates for the individual services, and checks whether they comply with the defined limits. Each of these parameters can also be monitored separately. If an error occurs, the software enters a message into the report saved internally in the instrument or outputs the message via the R&S®ETL's LAN interface.

Detailed MPEG TS analysis

For more comprehensive analysis, the R&S®ETL-K283 in-depth analysis software option provides further information about the bits and bytes in the individual TS elements. The table interpreter provides a clear, easily readable overview of the table contents (FIG 4). This makes it simpler to identify faulty references between the different tables, for example. Another important test criterion is the presence of elementary auxiliary information such as the program clock

reference (PCR), decoder time stamp (DTS) and presentation time stamp (PTS).

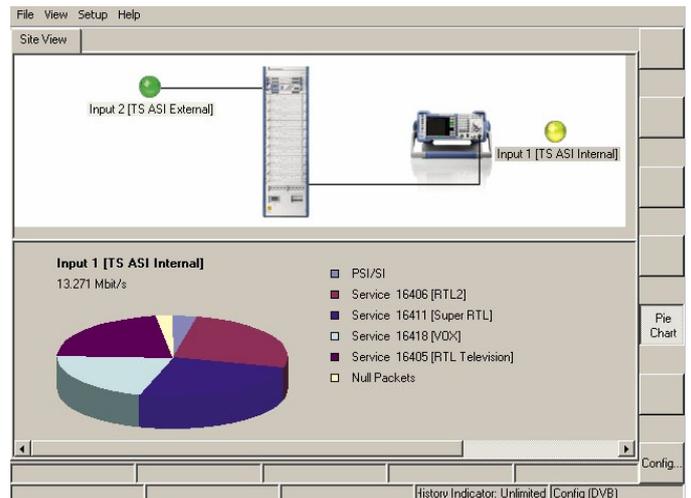


FIG 2 Parallel monitoring of two MPEG-2 transport streams.

FIG 3 MPEG analysis in line with TR101290.

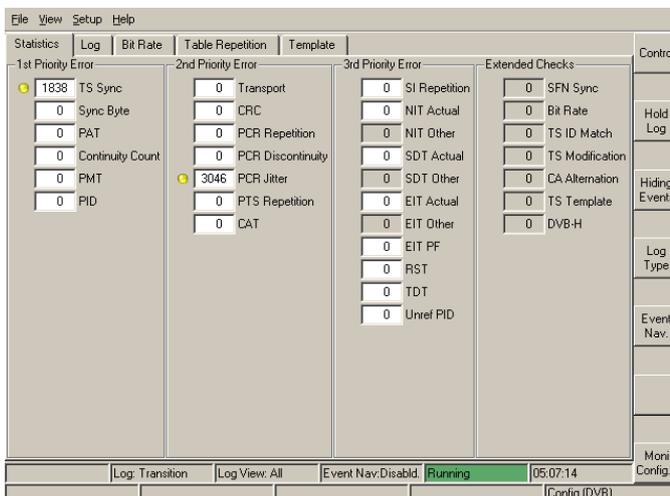
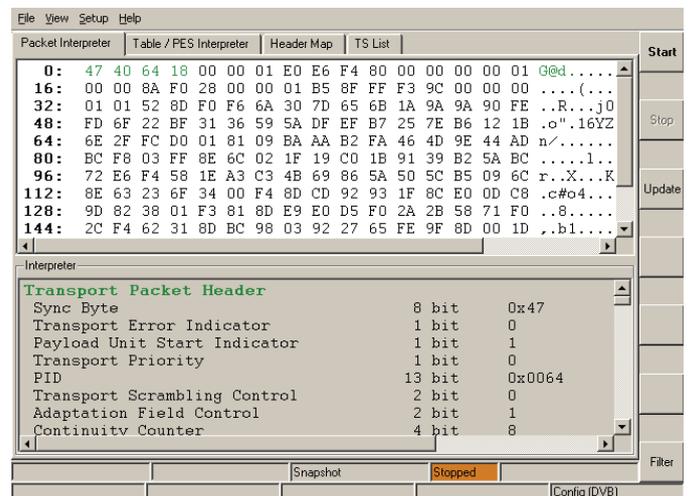


FIG 4 Table interpreter for analysis down to the byte level.



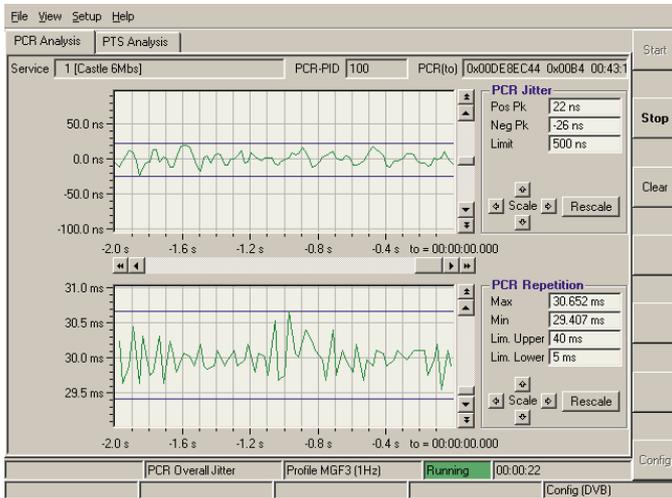


FIG 5 Tracking down PCR jitter.

The in-depth analysis option graphically indicates whether this auxiliary information is received regularly within the applicable limits (repetition) and whether the spacing is constant (e.g. PCR jitter, FIG 5) because tolerance violations can make it impossible for the decoders in receivers and set-top boxes to output video and audio. Such problems can also disrupt lip synchronicity.

A bit-by-bit look at data services and mobile TV

Viewers have come to expect today's DTV to provide video and audio as well as certain auxiliary services known from the Internet world. For example, this includes information about the current program, an electronic program guide and even firmware updates for receivers and set-top boxes. In recent years, mobile TV standards such as DVB-H that are customized for use with mobile user equipment have also come into play.

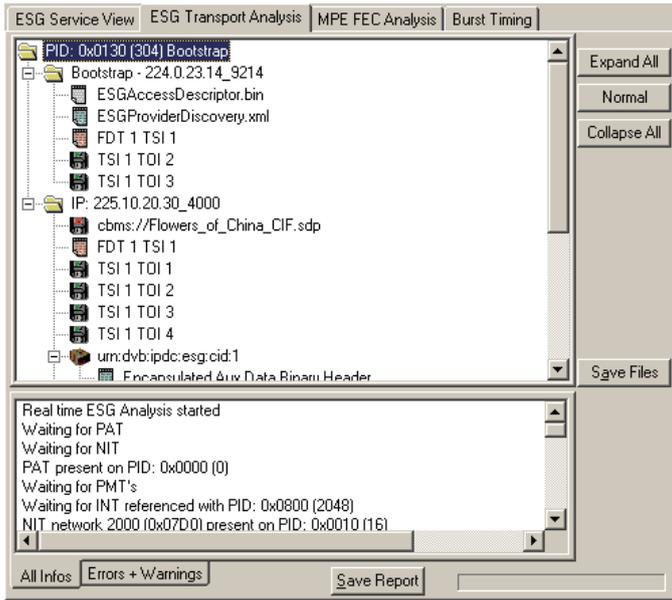


FIG 6 Structure of an electronic service guide (ESG).

Data services and mobile TV are both based on transmission of data packets using the Internet protocol (IP). The relevant mechanisms were developed early on and are referred to as data carousel and object carousel. The data to be transmitted is inserted into a special section within a transport stream known as digital storage media command and control (DSM-CC). The actual IP data inserted into the DSM-CC section is divided into packets using multiprotocol encapsulation (MPE) in accordance with the relevant protocols. One special feature of DVB-H is that the packets also undergo forward error correction (FEC).

The R&S®ETL-K284 data broadcast analysis software option can be used for analyzing data services and DVB-H content. This option allows presentation of the protocol structures and individual components of selected data packets using clear tree views. The interpreter presents the data in plain text, e.g. individual lines of the teletext. Of course, the option also allows a detailed look at the raw data. Operators can document individual data rates to prove their guaranteed data transfer rates for individual data services.

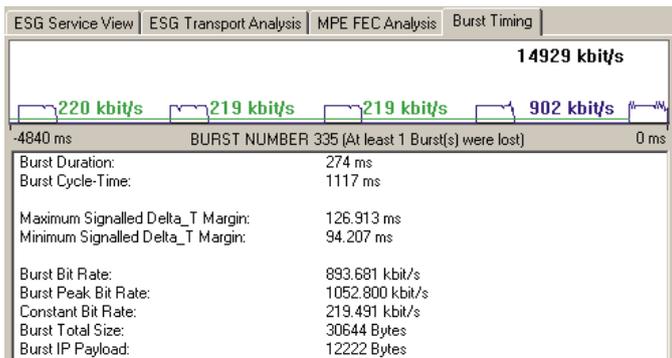


FIG 7 Burst timing for a DVB-H transmission.

For DVB-H, the R&S®ETL-K284 option offers a number of additional analysis functions. For example, all details of the electronic service guide (ESG) are analyzed for structural errors, and the structure is displayed (FIG 6). In the "MPE FEC Analysis" view, numerous parameters provide information about the transmission quality and bandwidth. The analysis functions for DVB-H are supplemented by a display of the burst timing (FIG 7). This view graphically presents the measured timing conditions for the TV programs that are distributed among time slices for transmission purposes.

Fast analysis through comparison

Using the [R&S®ETL-K285 TS template monitoring software option](#), it is possible to monitor the transport stream by comparing a currently selected transport stream with another one that was previously specified as the reference. The reference TS is known as the golden transport stream. The software compares the data and table structures, user-specific private tables, program names, and much more. Unlike conventional MPEG analysis, it also detects certain differences that would normally go unnoticed. For example, a change in the arrangement of programs in the transport stream would not necessarily generate an error message as long as the data is consistent. By contrast, a fast comparison of program names using the template function immediately triggers an error message before any viewers have a chance to complain.

TV picture in addition to analysis functions

Despite the availability of extensive, highly detailed analysis functions, many technicians prefer to just look at the TV picture. For displaying unencrypted TV pictures on the R&S®ETL's screen, a [software-based media player](#) is available to reproduce programs selected via the ESG in SD resolution. For reproducing programs in HD quality on an external monitor, the [R&S®ETL-B281 hardware decoder](#) can be added to the MPEG processing board. The HDMI interface of the R&S®ETL-B280 option is available on the instrument's rear panel for connection of an HD-ready display. Moreover, the picture is output in SD quality via the base unit's video output (CCVS) and the audio signals are output via two audio outputs.

Encrypted programs can be decoded using the hardware decoder in conjunction with a suitable CA module and smart card. The MPEG processing board includes a DVB common interface for this purpose.

Integrated TS generator/recorder

The R&S®ETL TV analyzer can also be extended to include TS generator and TS recorder functionality by means of the R&S®ETL-K280 software option, which requires the presence of the MPEG processing board and the [R&S®ETL-B209 hard disk](#). When equipped in this manner, the R&S®ETL makes installation and maintenance work significantly easier. Regardless of whether the work at hand involves testing the functioning of a transmitter or a modulator, the TS generator function provides suitable baseband signals without the need for an external signal source (FIG 8). For the TS generator,

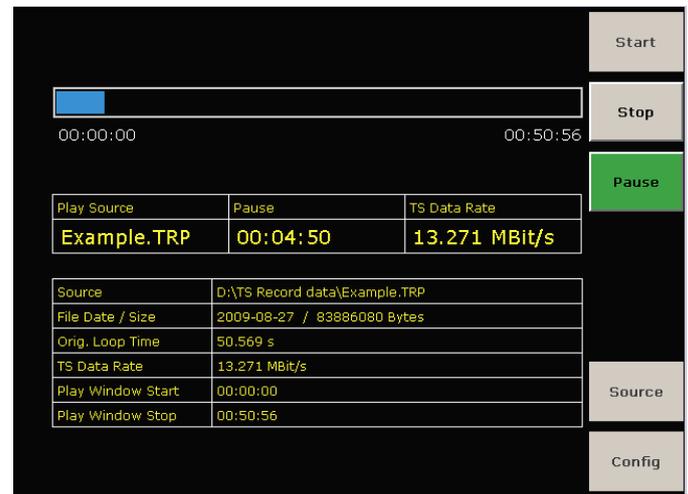


FIG 8 MPEG-2 transport stream generator.

Rohde&Schwarz offers a number of libraries that include transport streams for DVB, DVB-H, ATSC and ISDB-T in SD or HD quality and with different data rates and configurations.

The TS recorder is very useful during troubleshooting. An MPEG-2 transport stream from the demodulator or an external source can be recorded on the internal hard disk for documentation and analysis purposes and then replayed whenever required. In order to analyze the recorded transport stream by means of the MPEG analyzer provided in the R&S®ETL itself, the TS generator output just needs to be connected to the TS input.

Summary

The R&S®ETL TV analyzer has been enhanced to include important analysis and measurement functions for MPEG-2 transport stream signals. The instrument is now also capable of generating and recording MPEG-2 transport streams. This makes the R&S®ETL an ideal tool for operators of terrestrial or cable networks as well as for manufacturers of broadcasting equipment. The R&S®ETL is an all-in-one test instrument that is unmatched in the global marketplace thanks to its concept, compact design and wide range of measurement capabilities.

Werner Dürport