MPEG-2 Monitoring System R&S®DVM

TV – just pictures and sound? Not with digital TV!

Digital data services enhance TV and are of great interest to viewers, network operators and TV program providers. With the Data Broadcast Analysis R&S®DVM-K11 option, the MPEG-2 Monitoring System R&S®DVM analyzes all transmission methods for data services that have been defined for DVB, including DVB-H.

Important abbreviations not explained in the text:

ACAP	Advanced common application platform
AIT	Application information table
ARIB	Association of Radio Industries and Businesses
ATSC	Advanced Television Systems Committee
BIOP	Broadcast inter ORB protocol
DDB	Download data block
DII	Download info indication
DSI	Download server initiate
DSM-CC	Digital storage media – command and control
INT	IP/MAC notification table
IP	Internet protocol
MAC	Medium access control
MHEG	Multimedia and Hypermedia Information Coding Experts Group
MHP	Multimedia home platform
PES	Packetized elementary stream
PID	Packet identifier
OCAP	Open cable application platform
UNT	Update notification table

Comprehensive analyses

With its error-protected transmission channels and high bandwidth, digital TV is opening up a broad scope of new data services that far surpass those known from analog TV, such as teletext or subtitles. Development of these services is rapidly progressing; however, standardization bodies and system groups such as MPEG, DVB, MHEG, ACAP, OCAP, ATSC and ARIB have defined standardized protocols and structures to ensure that services of different providers can be used with uniform hardware.

With the Data Broadcast Analysis R&S®DVM-K11 option, the MPEG-2 Monitoring System R&S®DVM analyzes all transmission methods for data services that have been defined for DVB, including DVB-H (FIG 3). It controls signaling as well as the syntax and timing of all protocol elements, thus allowing comprehensive testing of signal function and efficiency. The R&S®DVM tests the signaling of the data services, which ensures that set-top boxes can actually display the services received. With standardized signaling, the data service in the transport stream tree structure is shown in plain text. The R&S®DVM quickly detects any signaling not in line with the standard. To provide you with a concise overview, the data broadcast analysis option displays all references (descriptors) of this service in the Overview display. It also provides the table in which these descriptors are listed (FIG 1).

In addition to correct referencing in order to find the data service in the MPEG-2 transport stream, the receiver also needs additional tables with information specifying which section of the data is to be used in which way. This includes information about MHP applications, e. g. the name of the start program (Java Initial Class) in the AIT. There are also tables for DVB-H and IP services (INT) or the system software update of the set-top boxes (UNT). Using the table interpreter, all these tables can be clearly displayed and controlled.

Just as important are the applications or content a service provides. This appears to be quite complicated because the transmission protocols are not identical for all data services. For example, an MHP application (see also box on page 48) is transmitted via the object carousel, which is a complex structure of different DSM-CC sections (DSI, DII and DDB sections with BIOP messages). To provide a better overview, the R&S®DVM-K11 option graphically displays this structure in the form of a tree (protocol window in FIG 1). Apart from the elements for data transport, the structure of the actual data (application) is of interest. With an MHP application, the data consists of directories, files, stream references or timed references (stream events). To determine the content and to identify the transmission elements (protocol), the transmission structure must first be analyzed. The R&S®DVM automatically performs all of the above – and clearly displays all data – when a data service is selected.

If the content determined by the R&S®DVM does not correspond to the original application, problems in the receiver will occur. In such a case, the interpreter and raw data function in the R&S®DVM enables you to check and analyze the references (DSI, DII and

BIOP messages). FIG 2 shows a DII display as an example.

For other data services such as teletext, video programming service (VPS), wide screen signaling (WSS), or subtitling, a PES protocol is used. Although this structure is complex as well, it can be checked and analyzed down to the bit level using the interpreter. As a special feature with teletext and VPS, the content displayed is interpreted.

In addition to flawless data service structure, short response time (performance) is essential to gaining acceptance with viewers. By measuring timing, the performance of a data service can be optimized. Module loading time clearly shows how long it may take in the worst-case scenario until the corresponding part of the program or associated background image has been loaded in the receiver. These measurements make the testing and creation of measurement sequences (determination of the peak value) superfluous; together with the module-specific data rate measured, they enable efficient optimization of the data service in the carousel generator. FIG 4 shows the transmission time display of a module.

But timing also depends on the data rate, which is of crucial economic significance. Several program and service providers usually share a transport stream.

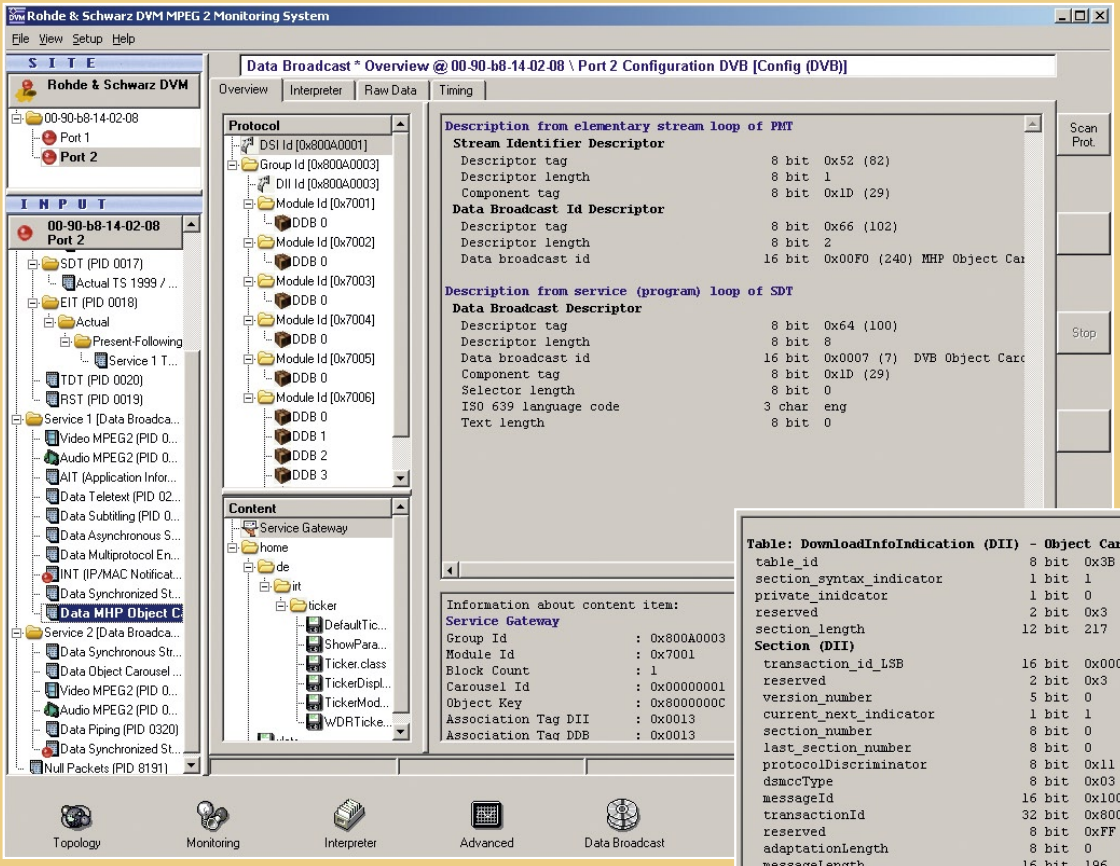

FIG 1
The R&S®DVM user interface with the data broadcast analysis option in the Overview view.

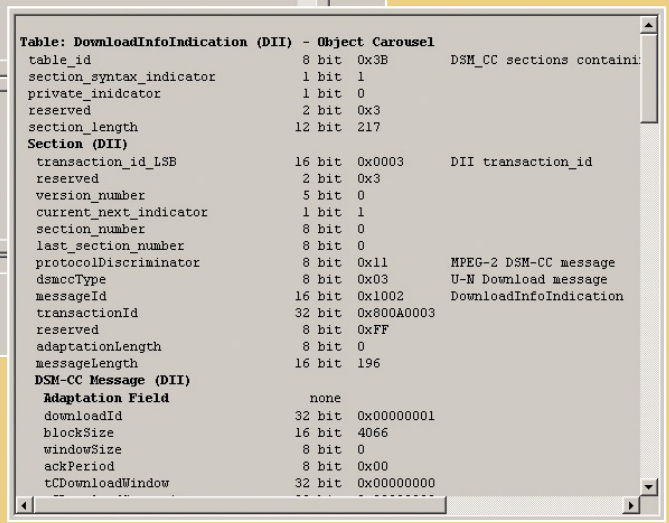

FIG 2
Interpreter function of the data broadcast analysis option.

Applications	Transmission method (protocol)
MHP / MHEG-5 application download	DVB object carousel
System software update (SSU)	DVB data carousel
IP data transmission DVB-H	Multiprotocol encapsulation
Teletext, subtitle, VPS, WSS, private data transmission	Data streaming
Private data transmission	Data piping

FIG 3
Overview of the applications and transmission methods specified for DVB.

The costs are allocated to the users in proportion to the individual data rate, which is why all users want to know the data rate of their service in the transport stream. Using the R&S®DVM, measuring the data rate of individual services is just as easy as measuring the data rate of all other elements of the transport stream.

Summary

The R&S®DVM family of instruments from Rohde&Schwarz already supports the analysis of current and future data services. Even in their basic configuration, these instruments recognize all data services listed in FIG 3, specify the basic parameters such as associated PID and type of data service and measure the data rates.

Moreover, the R&S®DVM-K11 option, which is available for all instruments of the R&S®DVM family, can perform all in-depth analyses and measurements described in this article.

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Data services with digital TV

This box provides a brief overview of the variety of data services that are conceivably – or already – available:

Information services (text, usually expanded by multimedia elements):
- Information about the program currently being broadcast
- Overviews of TV programs
- Any kind of news

Interactive applications, or applications linked to a TV program:
- Subtitles
- Integration of the viewer into the current program
- Games

Services requiring a back channel:
- Pay per view/video on demand
- Home shopping/home banking
- Prize games
- E-mail

Services that control the viewer hardware:
- System-based programming and controlling of video recorders, if required
- Automatic software updates of set-top boxes

To implement these services, a wide variety of platforms and protocols has already been created. For example, the **MHP data service** expands the TV receiver via the set-top box to create a multimedia console. It supports numerous functions such as games, home shopping, browsing the Internet pages of TV stations, TV program guides with a standardized layout that is independent of the set-top boxes, display of a sign language interpreter, etc. MHP is actually a standardized operating system for set-top boxes; the MHP applications transmitted with the transport stream are Java programs or HTML documents that run on this operating system; thus, the programs or HTML documents define the individual functionality.

FIG 5 shows an example of the interactive T-commerce TV application for MHP, ACAP and OCAP platforms. The application can be combined with TV ads and allows viewers to order

FIG 5 Example of an MHP, ACAP and OCAP application.

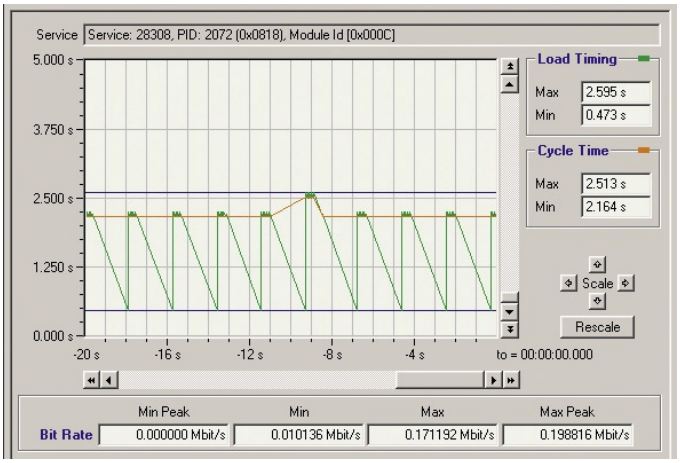
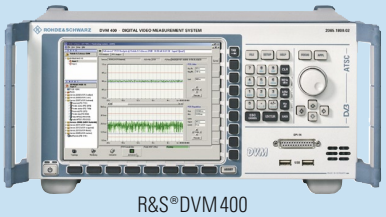


FIG 4 **Timing analysis of a module in the object carousel.**

More information and data sheet at www.rohde-schwarz.com (search term: DVM)

REFERENCES
Wehefritz, Karsten: T&M evaluation of protocols for data broadcasting. Fernseh- und Kinotechnik 57 (2003), No. 12, pp 565 – 572 (published only in German)



R&S®DVM400

an article directly via their TV set. This application was developed by the Nionex company and is based on their pontegra product. The program is transmitted via the object carousel protocol standardized for DVB.

The **SSU data service** (system software update) enables manufacturers of set-top boxes to update TV sets with state-of-the-art firmware directly at the customer's end and thus to expand functionality and to correct errors. For this purpose, the firmware is broadcast simultaneously with the TV program as a data service in accordance with a standardized method (data carousel protocol and signaling via UNT).

The **IP downstreaming data service** implements another type of firmware or program download. As an alternative to DSL, it uses the high capacity of the TV transmission channel for downloading large amounts of data (music or videos) to the Internet user (PC with DTV receive card). The back channel required for this purpose can be implemented via a telephone connection (modem), for example. This downstreaming occurs temporarily between client and server with fixed MAC and IP addresses. For this purpose, there is also the standardized **MPE transmission method** (multiprotocol encapsulation), which has been further expanded for DVB-H. This brand-new data service was specifically developed for mobile reception on portable, battery-operated equipment. DVB-H is already being broadcast in a test phase (detailed article on DVB-H on page 50).

All these services use protocols that can be checked for errors during transmission by means of a check sum (cyclic redundancy check, CRC). But there are also data services that do not require this protection and which use the PES protocol for transmission (referred to as data streaming), e.g. the **DVB subtitling system**. This system allows subtitles that are pleasing to the eye to be inserted into the picture. The data required is transmitted in its own data channel separately from the video signal; this is beneficial because subtitles for a film can be supplied in different languages without requiring the film to be recoded.

The **VBI data services** also have a PES structure. This designation refers to various applications that are transported in the case of analog TV signals in the vertical blanking interval (VBI). Digital TV transmits these signals in a separate data channel. The digital receivers/set-top boxes properly re-insert the signals into the analog video signal for the TV receiver so that the decoders in the analog equipment can be utilized. This method has the advantage that the existing infrastructures (editing tools, generators and decoders) can still be easily used for analog TV data services that are already well accepted, such as teletext. In addition to teletext, there are further examples:

- Video recorder programming system (VPS)
- Wide screen signaling (WSS)

Finally, there are **proprietary services** whose structures are not standardized. These services are transmitted via the **data piping protocol** (the data is embedded in MPEG-2 transport packets). FIG 3 provides an overview of all applications and transmission methods.