

R&S® DVM 400 Digital Video Measurement System

T&M equipment for IPTV

The Gigabit Ethernet interface option

for the R&S® DVM 400 digital video measurement system monitors and analyzes IP connections and makes the contained transport streams available for additional measurements.

IP-based networks distribute TV programs

IP-based networks already common in the telecommunications area are increasingly being used to distribute TV programs – not only for direct transmission to the consumer or TV transmitter / cable headend but also for local connections between transmission equipment. Rohde & Schwarz has taken this into account by its new Gigabit Ethernet interface option for the R&S® DVM 400 digital video measurement system (see box below).

Functionality

The new interface is a hardware option completely embedded in the monitoring and analysis application of the R&S® DVM 400. The system's entire signaling and alarm functionality has thus been made available including report entries, error counter, SNMP traps and visual representation. Various signal properties such as MDI (FIG 3), jitter and data rate are analyzed in realtime. The system automatically monitors all signals of a Gigabit Ethernet up to the full bandwidth and indicates the measured values in a table (FIG 4). In addition to monitoring IP connections, it graphically displays the measured values of a selected IP data stream (FIG 3).

IPTV – moving pictures via IP networks

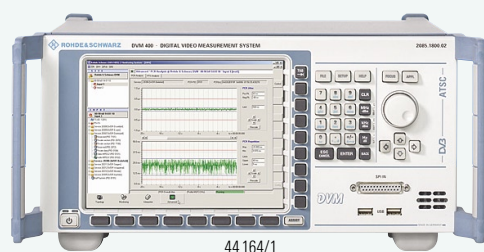
Numerous articles and specifications are dealing with the IPTV topic. However, an unambiguous definition or a commonly recognized standard is still missing although a heterogeneous variety of offers already exists: It ranges from streaming short low-resolution video clips to PCs over the Internet up to transmitting TV programs to Ethernet-capable set-top boxes via wideband DSL connections. In addition, network operators are using this technology in their backbones to provide TV signals to their transmitters or cable headends, for example.

Applications of the Gigabit Ethernet interface option

The new Gigabit Ethernet interface option as well as the R&S® DVM 400 monitor and analyze IP connections and the contained transport streams. The option is, for example, suited to monitor IP networks handling signal contribution (FIG 2) – i. e. the feeding of TV signals to distribution stations – or to analyze the signals at the IP interfaces of digital TV signal processing equipment (e. g. encoders or multiplexers).

R&S® DVM 400 digital video measurement system

FIG 1 The R&S® DVM 400 digital video measurement system is a portable instrument to measure MPEG-2 transport streams and their contents.



In addition to general transport stream monitoring and analysis, the R&S® DVM 400 (FIG 1) also supports the detailed analysis of elementary video and audio streams (MPEG-2, H.264 / MPEG-4, AAC and AC-3), of diverse data services and of DVB-H-specific properties including time slicing. Extensive additional functions such as recording, generation and playback of transport streams as well as video decoding and streaming are also provided. Various interfaces for the different digital TV standards including the new DVB-S2 satellite standard make it a universal measuring instrument for digital TV. Despite its great variety of functionalities the R&S® DVM 400 features compact size and low weight, which makes it also ideally suited for portable use. Its new Gigabit Ethernet interface now also allows you to perform measurements in IPTV systems.

FIG 2

An example of five typical DTV network test points at which the R&S®DVM 400 with its various interfaces and its capability of monitoring multiple signals in parallel can very well be employed. The IP data stream and the DVB-T signal are monitored at test points 3, 4 and 5. The DTV feeds are additionally monitored at test point 1.

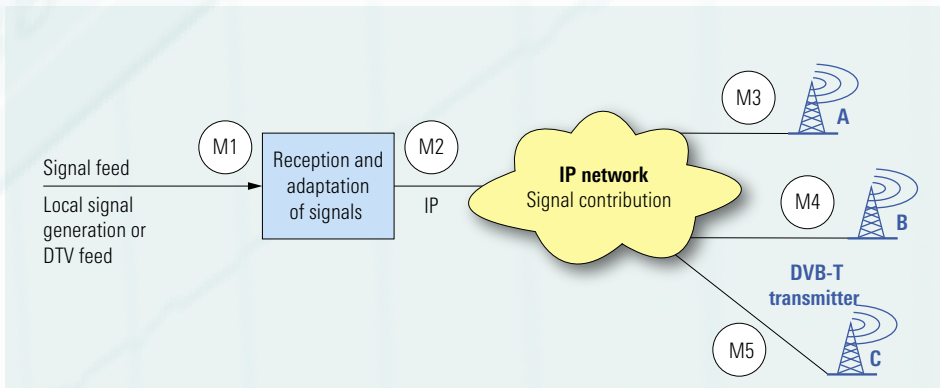


FIG 3 Detailed visual representation on the R&S®DVM 400 of the measured IP values for a selected connection. The MDI (delay factor and loss rate) versus time (upper part) as well as various other details (lower part) are displayed.

Measuring the media delivery index (MDI)

In the area of TV measurements, the MDI is measured in order to assess the transport quality of a network. It is represented by two measured values separated by a colon: MDI = DF:LR (delay factor : loss rate). The delay factor defines the maximum delay of a byte received in the receive buffer based on a constant output data rate in one measuring interval (compensation of the irregular transmission times of individual packets). The loss rate indicates the number of packets lost per measuring interval. The measuring interval is usually one second for the two values.

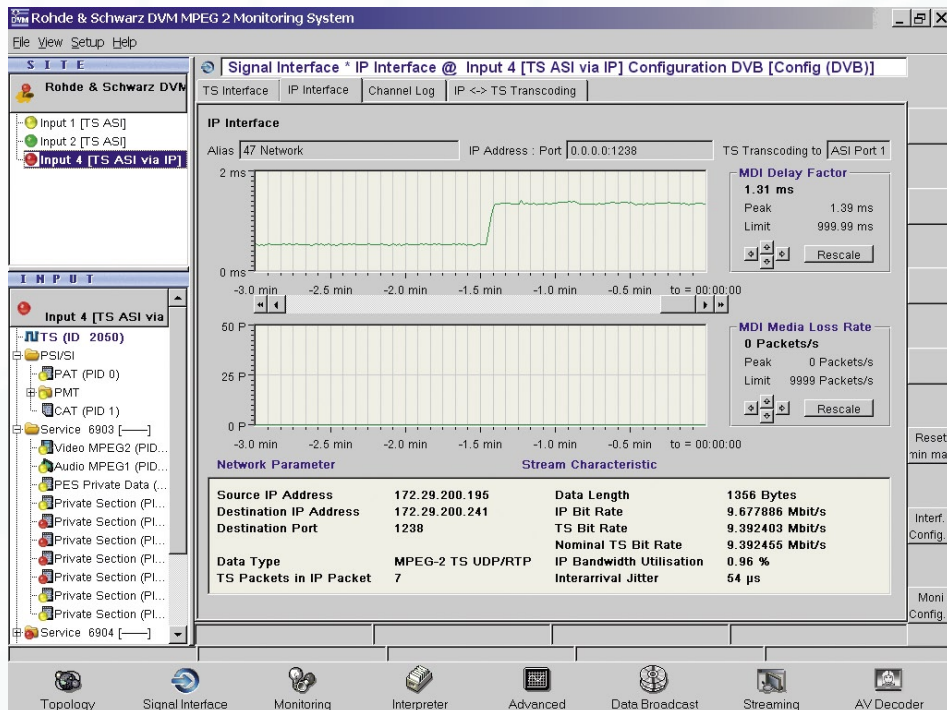


FIG 4 Tabular representation on the R&S®DVM 400 of the values measured on all monitored IP connections.

IP Channel Log	1 Channel 8	2 IP Channel	3 47 Network	4 Channel 52	5 Fast Network	6 Free TV
IP to TS Transcoding	to ASI Port 2	to ASI Port 1	to ASI Port 3			
Source IP Address	172.29.200.195	172.29.200.195	172.29.200.195	172.29.200.195	172.29.200.195	172.29.200.195
Destination IP Address	172.29.200.241	172.29.200.241	172.29.200.241	172.29.200.241	172.29.200.241	172.29.200.241
Destination Port	1236	1234	1238	1232	1230	
Protocol	UDP/RTP	UDP/RTP	UDP/RTP	UDP/RTP	UDP/RTP	UDP
Data Type	MPEG-2 TS	MPEG-2 TS	MPEG-2 TS	MPEG-2 TS	MPEG-2 TS	MPEG-2 TS
TS Packets in IP Packet	7	7	7	7	7	
Data Length [Bytes]	1356	1356	1356	1356	1356	
IP Bit Rate [Mbit/s]	3.252474	34.817886	9.679189	252474	34.817886	34.8
TS Bit Rate [Mbit/s]	3.156530	33.790810	9.393667	6.156530	33.790810	33.7
Nominal TS Bit Rate [Mbit/s]	3.156534	33.790808	9.392905	6.156534	33.790808	33.7
IP Bandwidth Utilisation [%]	0.32	3.48	0.96	0.32	3.48	
MDI DF (peak) [ms]	3.54 (3.56)	0.52 (0.53)	1.34 (1.39)	6.54 (3.56)	0.32 (0.53)	2.52
MDI MLR (peak) [TS-Pkt/s]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Interarrival Jitter (peak) [µs]	48 (6919)	488 (5659)	52 (626)	58 (3919)	88 (569)	38
Last Update	12:39:14	12:39:14	12:39:14	12:39:14	12:39:14	12

Abbreviations

DF	Delay factor
DSL	Digital subscriber line
IGMP	Internet group management protocol
IPTV	Internet protocol television
LR	Loss rate
MDI	Media delivery index
RTP	Realtime transport protocol
RTSP	Realtime streaming protocol
TCP	Transmission control protocol
TS	Transport stream
UDP	User datagram protocol
VoD	Video on demand

► The option can extract the transport streams of three IP connections at the same time and feed them directly to the R&S®DVM400 via the ASI interfaces for monitoring and analysis. A special feature of the option is its capability to “stream” the transport streams via the Gigabit Ethernet interface, i. e. to forward them to any location in the network for further analysis or for decoding the contained TV programs, for example. These transport streams may either

be received via the IP network or input locally via the ASI interface. Even transport streams that the R&S®DVM400 has received via the RF options (e. g. DVB-T or DVB-S2) can be streamed.

As the R&S®DVM400 can be equipped with a transport stream generator, it may also be used as a “TS over IP” generator. Both RTP via UDP and pure UDP are supported for this application.

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

Principles of transmission in IP networks

Transport

IP networks transmit data in separate packets. Usually data of different applications is transmitted on the same network so that it must occasionally share network sections dynamically. Moreover, single packets of a specific application can be transported through the network using different routes (via different nodes). It may therefore occur that the packets of a specific application transmitted through IP networks arrive at irregular times at their destination, that the sequence of the packets changes and even that some packets are lost in case of temporary local network overload. The intensity and frequency of these effects may fluctuate depending on network load and situation.

To transport data through IP networks in realtime, e. g. video or audio programs, the user datagram protocol (UDP) is almost exclusively used. This protocol has a short overhead, and because it is a connectionless protocol (unlike e. g. the TCP) it does not require control mechanisms such as packet retransmissions. On the other hand, it does not guarantee the completeness of the data packets arriving at the addressee. To counteract at least certain irregularities such as wrong

IP packets at the receiver end or highly irregular transmission rates, the application layer mostly employs an additional control protocol. This is usually the RTP, a protocol governing temporary buffering and, if required, sorting of data packets. FIG 5 provides an overview of the protocol layers.

Signaling

Current network technology allows each terminal to be provided with an individual signal; each consumer can therefore receive their own TV program. As a consequence, the network load increases in proportion to the number of viewers. Possible network overload is prevented by the multicast method that transmits programs designated for multiple consumers only once on common network sections. This, however, is only possible on the basis of uniform starting times (thus assuming that the viewers watch the programs at the same time). To receive such programs, the terminal must join a multicast group enabled by the IGMP.

The RTSP is used to control VoD applications in which every viewer receives his/her “own” signal. The respective programs are transmitted to the consumer as unicast.

FIG 5
 The protocol layers in IP networks.

