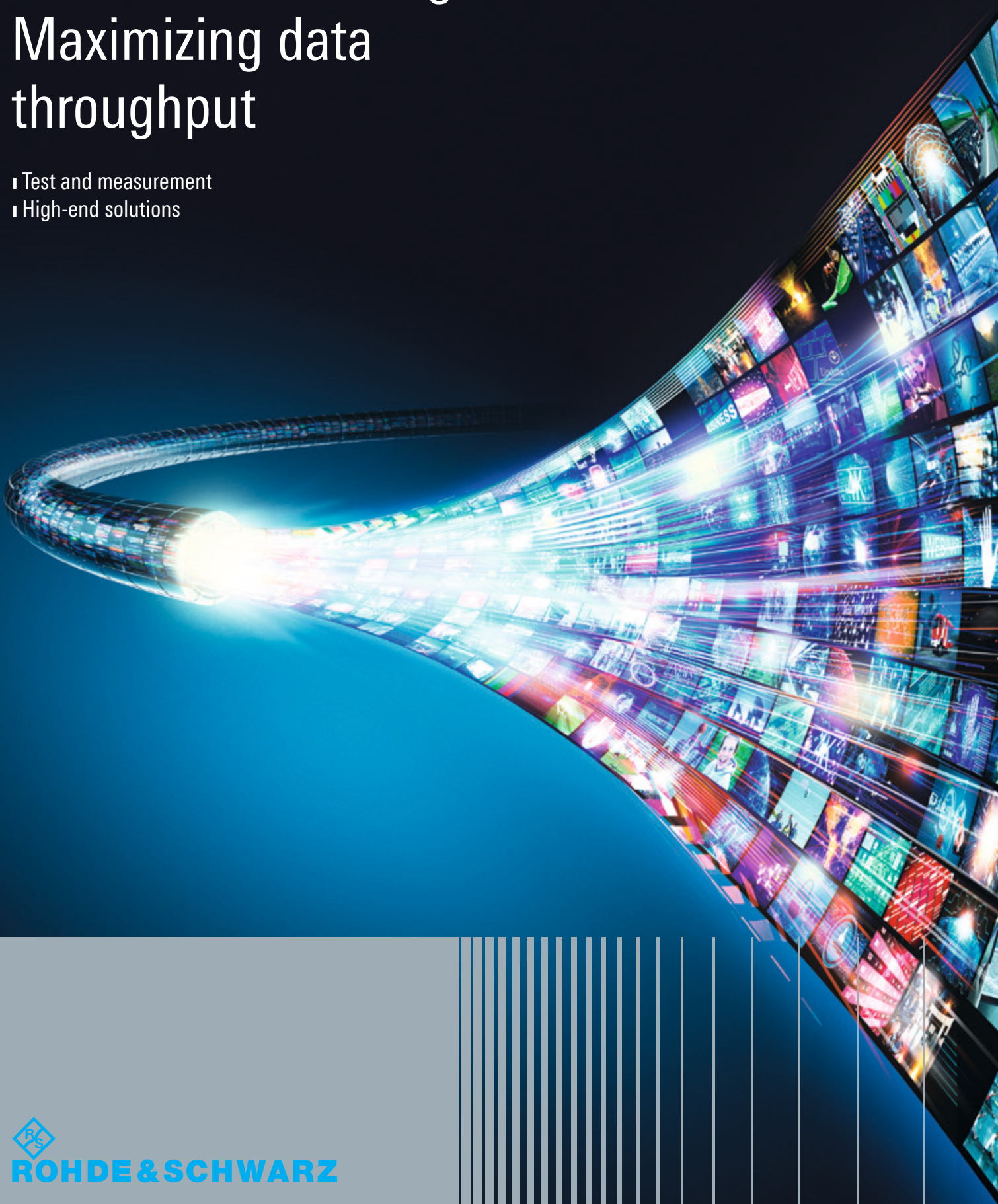


# DOCSIS 3.1

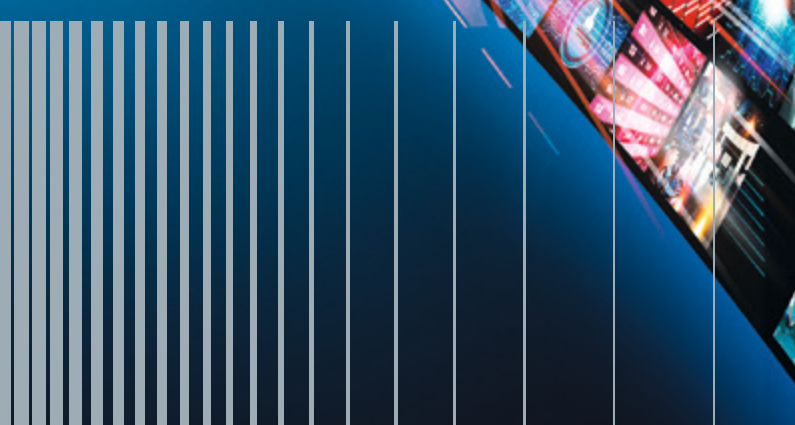
## Full channel loading

## Maximizing data throughput

- ▮ Test and measurement
- ▮ High-end solutions



**ROHDE & SCHWARZ**



# Introduction

With over 80 years of experience in the field of RF test and measurement, Rohde&Schwarz can offer its customers outstanding expertise in RF signal generation and analysis, providing state-of-the-art T&M solutions to the industry. With more than 70 subsidiaries and representatives around the world, Rohde&Schwarz has built up long-lasting relationships within the global cable TV and broadband community.

Driven by our commitment to technical innovation and continuous improvement, we are constantly expanding this network of relationships, offering our expertise and cutting-edge solutions to our partners. Our global presence and extensive service and support network are decisive assets, bringing local expertise and on-site support to our customers.

Our global reach and technical competence make us a reliable partner in today's international programs and worldwide projects, no matter where your challenge lies:

- Cable modem and RF tuner development and testing
- CMTS development and testing
- CATV amplifier and cable network components testing
- Cable network quality analysis and monitoring

Rohde&Schwarz is your reliable long-term partner with proven solutions to address all of these highly sophisticated T&M requirements. Go to the next pages to find out more about our advanced T&M solutions focusing on DOCSIS 3.1.



# R&S®CLGD DOCSIS® cable load generator

The R&S®CLGD is the first generator that simultaneously produces signals for DOCSIS 3.1, DOCSIS 3.0, digital cable TV in line with J.83/A/B/C and analog cable TV.

Its downstream frequency range is 108 MHz to 1794 MHz for DOCSIS 3.1 and 47 MHz to 1218 MHz for TV. Within the specified range, the R&S®CLGD generates multiple DOCSIS 3.1 channels with up to 192 MHz bandwidth each. The RF power level, frequency, forward error correction (FEC) and constellation can be set independently for each channel. At the same time, the R&S®CLGD produces a large number of digital and analog TV signals that can be placed anywhere below or between the DOCSIS 3.1 signals.

The DOCSIS 3.1 channels and digital TV channels are implemented in realtime. The data to be transmitted can be fed in via IP or internally generated by the R&S®CLGD. The upstream frequency range is 5 MHz to 204 MHz. Within this range, DOCSIS 3.1 orthogonal frequency division multiple access (OFDMA) signals can be freely combined with DOCSIS 3.0 TDMA or CDMA signals.

The flexible multichannel signal generation capabilities of the R&S®CLGD enable it to simulate network loading in a reproducible manner, making it ideal for testing tuners, cable modems and upstream CMTS receivers. The influence of QAM and TDMA/CDMA signals in adjacent channels on DOCSIS 3.1 signal reception is a research topic of great interest. The R&S®CLGD makes such simulations realistic by adding different types of impairments such as noise, reflections and narrowband interference.

The generator comes in a 19" housing that takes up a mere two height units. The complex signal generation process can be conveniently controlled from a PC or via a web interface. Remote control through SCPI commands enables the generator to be used in automatic test systems. The R&S®CLGD can be adapted to various application requirements thanks to its software option concept.

**For more information, see the following document on our website:**

R&S®CLGD product brochure (PD 3607.0123.12)

## Key facts

- Downstream frequency range:
  - 47 MHz to 1218 MHz, extendable to 1794 MHz
- Upstream frequency range: 5 MHz to 204 MHz
- DOCSIS 3.1, DOCSIS 3.0, J.83/A/B/C, analog TV
- Up to eight channels with 192 MHz signal bandwidth for DOCSIS 3.1
- Arbitrary waveform generator bandwidth up to 200 MHz
- Impairment simulator as required for SCTE 40 and DOCSIS 3.0/3.1 PHY ATP testing
- Embedded transport stream player for easy TV tuner testing
- Two SFP+ inputs for connection to IP data packet generator



R&S®CLGD DOCSIS® cable load generator.

# R&S®SFD DOCSIS® signal generator

The R&S®SFD produces signals for DOCSIS 3.1, DOCSIS 3.0, digital cable TV in line with J.83/A/B/C and analog cable TV. Its downstream frequency range is 47 MHz to 1794 MHz for DOCSIS 3.1 and 47 MHz to 1218 MHz for DOCSIS 3.0 and TV. Within the specified frequency range, the R&S®SFD generates a DOCSIS 3.1 channel with up to 192 MHz bandwidth. The level, frequency, forward error correction (FEC) and constellation of this channel can be set. The R&S®SFD can alternatively produce a digital, QAM-modulated or analog TV signal. The DOCSIS 3.1 channel or digital TV channel is modulated in realtime. The data to be transmitted can be fed in via IP or internally generated by the R&S®SFD. The upstream frequency range is 5 MHz to 204 MHz. Within this range, a DOCSIS 3.1 orthogonal frequency division multiple access (OFDMA) signal can be generated in realtime. A DOCSIS 3.0 TDMA or CDMA signal can be produced in realtime in the 5 MHz to 85 MHz range. Thanks to its digital signal generation capabilities, the R&S®SFD is ideal for testing tuners, cable modems and upstream CMTS receivers in R&D and production and also for simulating DOCSIS 3.1 signals in real cable segments.

For realistic signal generation, the R&S®SFD can add impairments such as noise, phase noise, hum, tilt and even a defined bit error rate. The generator comes in a ½ 19" housing that takes up a mere two height units. The complex signal generation process can be conveniently controlled from a PC or via a web interface. Remote control through SCPI commands enables the generator to be used in automatic test systems. The R&S®SFD can be adapted to different application requirements thanks to its software option concept.

**For more information, see the following document on our website:**

R&S®SFD product brochure (PD 3607.3751.22)

## Key facts

- Downstream frequency range:  
47 MHz to 1218 MHz (extendable to 1794 MHz)
- Upstream frequency range: 5 MHz to 204 MHz
- DOCSIS 3.1, DOCSIS 3.0, J.83/A/B/C, analog TV
- Up to 192 MHz signal bandwidth for DOCSIS 3.1
- Arbitrary waveform generator bandwidth up to 200 MHz
- Signal impairment simulator



R&S®SFD DOCSIS® signal generator

# R&S®FSW Signal and spectrum analyzer

Developers of future, wideband communications systems and users in the aerospace and defense (A&D) sectors will find plenty of reasons why the R&S®FSW is the right solution for their T&M requirements. With phase noise unparalleled among signal and spectrum analyzers, the R&S®FSW facilitates the development of oscillators intended for use in radar systems, for example. The R&S®FSW offers up to 2 GHz (with DOCSIS 3.1 up to 512 MHz) analysis bandwidth for measuring wideband-modulated or frequency agile signals.

Previously, signal and spectrum analyzers measured different standards such as DOCSIS 3.1, DOCSIS 3.0, LTE, GSM, CDMA2000® and WCDMA separately. The R&S®FSW takes analysis to the next level, providing capability to measure multiple standards simultaneously. Users can quickly and easily detect and eliminate errors caused by interaction between signals, e.g. between DOCSIS and digital TV signals. Featuring a touchscreen user interface, a flat menu structure and straightforward result representation, the R&S®FSW offers exceptional ease of operation.

Various measurements can be displayed simultaneously in separate windows on the large 12.1" screen, which greatly facilitates result interpretation. The R&S®FSW also scores top marks when it comes to measurement speed. Providing 1000 sweeps/s in remote operation and delay-free switching between instrument setups, the R&S®FSW ranks top among the signal and spectrum analyzers on the market. Equipped with the R&S®FSWK70 vector signal analysis option, the R&S®FSW can also analyze J.83/A (DVBC), J.83/B and J.83/C signals.

**For more information, see the following document on our website:**

R&S®FSW product brochure (PD 5214.5984.12)

## Key facts

- Frequency range from 2 Hz to 8/13.6/26.5/43.5/50/67/85 GHz (up to 500 GHz with external harmonic mixer from Rohde&Schwarz)
- Low phase noise of  $-137$  dBc (1 Hz) at 10 kHz offset (1 GHz carrier)
- Residual MER of 57 dB (nominal) with DOCSIS 3.1
- DOCSIS 3.1 signal autodetection function for downstream and upstream
- Up to 2 GHz analysis bandwidth (up to 512 MHz with DOCSIS 3.1)
- Adjacent channel filter for higher MER performance
- $< 0.4$  dB total measurement uncertainty up to 8 GHz
- Realtime analysis up to 512 MHz bandwidth
- High-resolution 12.1" (31 cm) touchscreen for convenient operation
- Multiple measurement applications can be run and displayed in parallel



R&S®FSW Signal and spectrum analyzer

# Your challenge...

The DOCSIS 3.1 standard was created to address two primary needs for cable network operators: higher data throughput to meet consumer demand for high data rate applications and the flexibility to support a variety of applications. DOCSIS 3.1 must be backward compatible with previous DOCSIS generations and also work with TV signals within a cable network. DOCSIS 3.1 meets these challenges by using wider bandwidths and a different modulation scheme than earlier versions. Downstream channels can be up to 192 MHz wide, upstream channels up to 96 MHz. OFDM/OFDMA was chosen as the modulation technique to increase data throughput and provide

configuration flexibility. Many DOCSIS 3.1 parameters can be varied. For example, up to 16QAM can be selected, or a subcarrier spacing of 25 kHz or 50 kHz with up to 8192 subcarriers.

In addition, Rohde & Schwarz offers a broad portfolio of instruments specifically designed to meet the test requirements encountered in R&D applications.

## More information at

[www.rohde-schwarz.com/docsis](http://www.rohde-schwarz.com/docsis)

## Cable modem and RF tuner testing

With the latest release of the DOCSIS specification, current cable modems (CM) will have to handle both DOCSIS 3.0 and DOCSIS 3.1 signals. DOCSIS 3.1, for example, utilizes 192 MHz bandwidth channels with OFDM modulation, delivering high data throughput in the downstream. The Rohde & Schwarz signal generators and analyzers provide the following test capabilities:

- DOCSIS 3.1 CM PHY signal testing
- DOCSIS 3.0 CM PHY signal testing
- SCTE 40 testing
- TV tuner testing (channel scanning, TV program switching)

## Cable modem termination system (CMTS)

With the latest release of the DOCSIS specification, current CMTS will have to handle both DOCSIS 3.0 and DOCSIS 3.1 signals. DOCSIS 3.1, for example, utilizes 192 MHz bandwidth channels with OFDM modulation and constellations as high as 16QAM. This could become a challenge for CMTS since the modulation error ratio (MER) must be higher than 50 dB. The Rohde & Schwarz signal generators and analyzer address this challenge, providing the following capabilities:

- DOCSIS 3.1 CMTS PHY signal testing
- DOCSIS 3.0 CMTS PHY signal testing
- Emulation of data traffic from multiple cable modems
- Ingress and impairment simulation

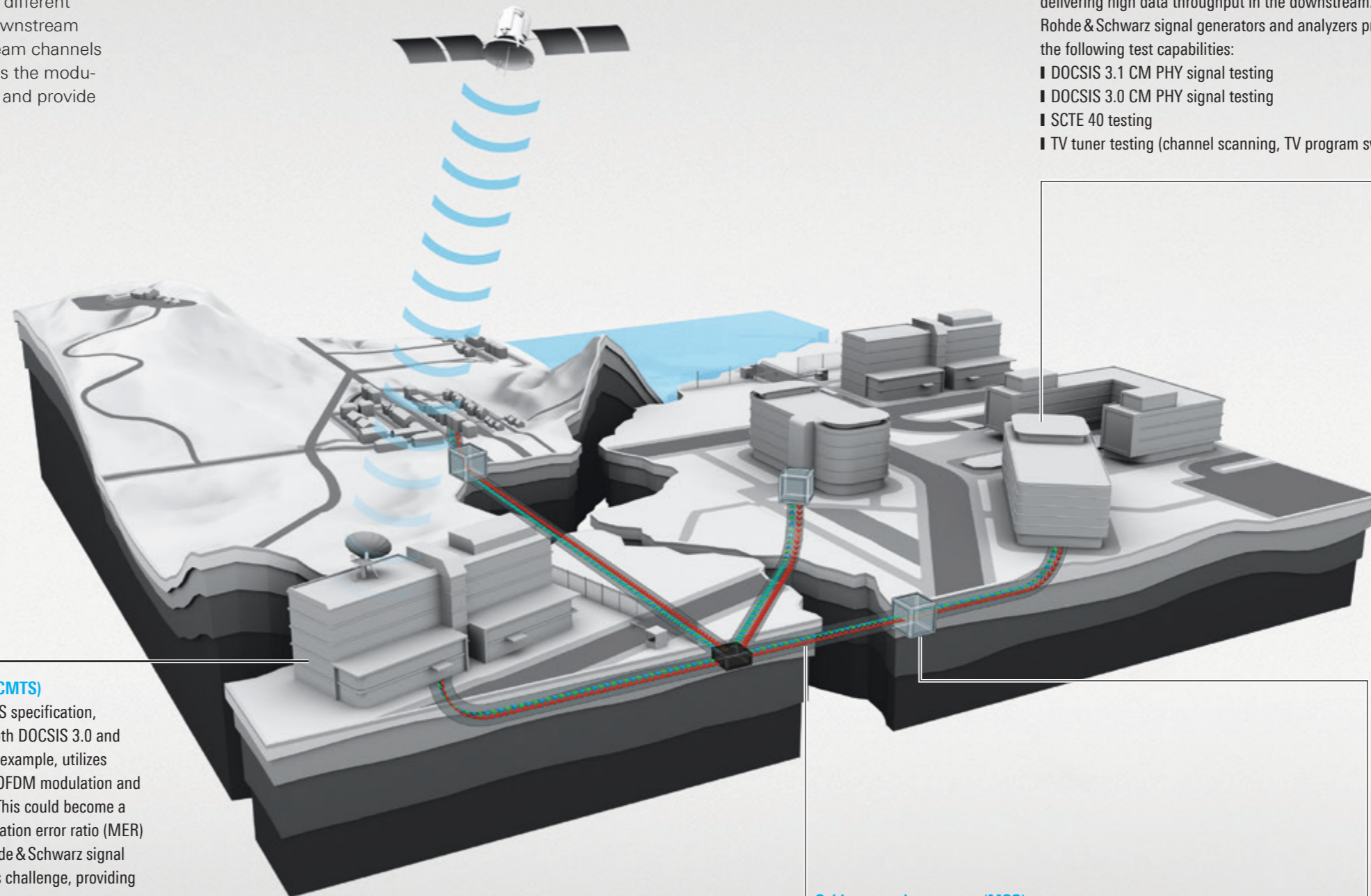
## Cable network operators (MSO)

- Installation and maintenance of CMTS at headend site
- Service quality analysis
- Analyzing effects of impairments
- Generating complex test scenarios with ingress and noise

## HFC equipment, CATV amplifier, analog/digital laser, optical transceiver testing

With the addition of DOCSIS 3.1, the operating frequency will initially extend to 1.2 GHz and then to 1.8 GHz. Current DOCSIS infrastructures might or might not be able to support the extended frequency ranges, so the individual components need to be tested as follows:

- CATV amplifier testing (NPR and CINR performance testing)
- CSO/CTB measurements
- BER measurements



## Service that adds value

- | Worldwide
- | Local and personalized
- | Customized and flexible
- | Uncompromising quality
- | Long-term dependability

## About Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

## Sustainable product design

- | Environmental compatibility and eco-footprint
- | Energy efficiency and low emissions
- | Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

## Rohde & Schwarz GmbH & Co. KG

[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

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PD 5214.9750.32 | Version 01.00 | February 2017

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