

## DOCSIS 3.1 With AXIe

Submitted by [Agilent Technologies](#)

You can accelerate research and development and design verification test of DOCSIS 3.1 designs with a cost-effective, AXIe-based measurement solution that provides high speed, wide bandwidth, deep memory and flexibility.

### **Abstract**

The latest version, DOCSIS 3.1, of the Data Over Cable Service Interface Specification (DOCSIS) standard, has now been officially released. Designing DOCSIS 3.1-based transmitters, receivers and components, and verifying their performance against the new standard requires stringent testing - a process made more complex by the standard's adoption of new technologies and the need for backward compatibility with previous DOCSIS versions.

This document describes an AXIe test solution to meet the new requirements set forth in the DOCSIS 3.1 specification.

### **Introduction**

Over the years, the DOCSIS standard evolved to meet the needs of cable operators and their subscribers. Emerging applications like HDTV video streaming around the home and in-room gaming are driving demand for multi-gigabit data rates. The need for increased bandwidth led to the latest standard revision - DOCSIS 3.1.

DOCSIS 3.1 provides a way for cable operators to increase capacity and speed, with up to 50 percent more data throughput over the same spectrum than DOCSIS 3.0, and the ability to deliver 2.5 Gbps in the upstream and 10 Gbps in the downstream on an existing hybrid fiber-coaxial (HFC) network. Its efficient spectrum use enables a significant decrease in the cost per bit for data delivery. This provides cable operators a competitive advantage over satellite and wireless providers in the hotly contested battle for today's bandwidth-hungry broadband data subscribers.

### **Key issues faced by R&D engineers**

DOCSIS 3.1 achieves its increased speed and capacity through its use of orthogonal frequency-division multiplexing (OFDM) and low-density parity-check (LDPC) forward error correction (FEC) technology. The standard mandates the use of up to 4096 QAM modulation with a 24 to 192 MHz channel bandwidth in the downstream, and up to 4096 QAM modulation with up to a 96 MHz bandwidth in the upstream. It also supports pure IP payload data and can co-exist with legacy channels on the existing HFC infrastructure.

While these technologies enable needed capacity and speed improvements, they also pose a number of new challenges in design and test; namely the generation and analysis of wider bandwidth signals for DOCSIS 3.1's 192 MHz channel. Many generators simply do not have a high enough sampling rate to support the typical minimum 2x oversampling ratio needed for signal generation. Without this support, images can occur in the signal due to aliasing. Additionally, finding a test solution that can handle the complexity of OFDM and LDPC FEC, and supports legacy DOCSIS technologies, while also being cost-effective, fast, and flexible enough to accommodate future standard revisions can also be problematic.

**Solution overview**

Agilent's solution for DOCSIS 3.1 test, shown in Figure 1, features the AXIe high-speed digitizer, its PCIe version, and the AXIe arbitrary waveform generator (AWG). Agilent's VSA software (with OFDM demodulation option BHF) and SystemVue electronic system level (ESL) design software, generates fully coded DOCSIS 3.1 waveform files that can be generated using the AXIe AWG.

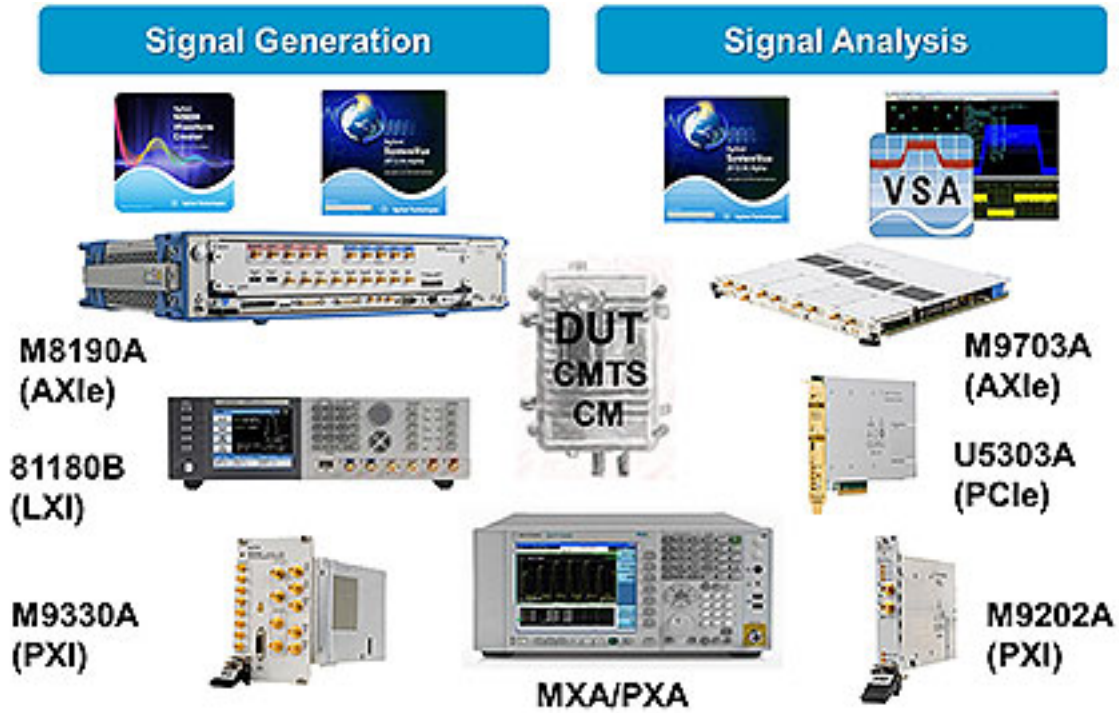


Figure 1. Agilent DOCSIS 3.1 test portfolio