



DOCSIS 3.1 Technology Whitepaper

Ultra-fast download speeds, once a fantasy, are now a reality from your cable provider, thanks to the new breakthrough DOCSIS 3.1 technology

Movies. Videos. Music. Photos. Wouldn't it be great if you could download content from the internet faster over your existing cable connection? Incredibly faster? Well, you can. With new DOCSIS 3.1 it is now possible to get Gigabit Internet speeds on your existing Cable connection.

Cable providers have started rolling out DOCSIS 3.1 nationwide. Comcast has already started rolling out gigabit services in Atlanta, Chicago, Nashville and more cities are planned for the rollout. Other cable service providers are expected to follow soon.

What is DOCSIS?

DOCSIS is a technology developed by CableLabs for transfer of data over coaxial cable that are deployed and used for cable TV connection. Cable operators across the world have adopted DOCSIS standards for providing internet data, voice and video services using existing cable TV systems.

Over the last two decades, DOCSIS technology has evolved from the initial 1.0 version with top speeds of 42 Mbps, to DOCSIS 3.0, which can provide 100s of Mbps speeds for internet, telephony and video services.

| DOCSIS Speed Comparison | | | |
|-------------------------|-------------------------------|-------------------------------|-----------------------------|
| <i>Version</i> | <i>Specification Released</i> | <i>Maximum Download Speed</i> | <i>Maximum Upload Speed</i> |
| DOCSIS 1.x | 1997 | 42.88 Mbps | 10.24 Mbps |
| DOCSIS 2.0 | 2001 | 42.88 Mbps | 30.72 Mbps |
| DOCSIS 3.0 | 2006 | 1372.16 Mbps | 245.76 Mbps |
| DOCSIS 3.1 | 2013 | 10,000 Mbps (10 Gbps) | 2,000 Mbps (2 Gbps) |

To meet the demand of higher data rates and to compete with *Fiber* technology, CableLabs has now developed DOCSIS 3.1 standards, which can scale up to 10 Gigabit/sec.

What is the key advantage to DOCSIS 3.1?

One of the key advantages of DOCSIS 3.1 over *Fiber* is that it uses the same 'last mile' technology - the coax cable - to support the higher Gigabit speeds. *Fiber* requires a completely new infrastructure and new cable layouts to the home, making deployment costs much higher. DOCSIS 3.1 technology is a much more cost effective technology for cable internet providers to implement.

DOCSIS 3.1 offers a huge jump in download and upload internet speeds, supporting up to 10 Gbps download and 1 Gbps upload speeds. Using DOCSIS 3.1, Comcast is offering Gigabit and Gigabit Pro Internet service with 1 and 2 Gigabit download speeds. As DOCSIS 3.1 is backward compatible with DOCSIS 3.0, operators are still using DOCSIS 3.0 for upstream connection. This backward compatibility

allows operators to make a gradual and seamless transition to DOCSIS 3.1 standards. Consumers who purchase DOCSIS 3.1 cable modems are ensured that their device will work on the existing network and is ready for upgrade to higher internet speeds as the DOCSIS 3.1 is rolled out in their region.

DOCSIS 3.1 defines new certificate based security features that strengthen security of cable modem authentication and secure software download to the modem. Enhanced security features further reduce the risk of malicious firmware being loaded on the cable modem.

DOCSIS 3.1 supports improved packet queueing mechanisms which help reduce packet latency over the cable network. Reduced latency helps improve voice quality for VoIP calls and improves online gaming experience by minimizing the probability of lag during online game play.

DOCSIS 3.1 additionally supports light sleep modes during idle time. This helps reduce overall power consumption of the devices and makes it a more environmentally friendly technology.

What technologies make DOCSIS 3.1 so special?

DOCSIS 3.1 achieves higher throughput by using advanced signal process techniques to better utilize a frequency spectrum and by increasing the available spectrum for upstream and downstream data transfer.

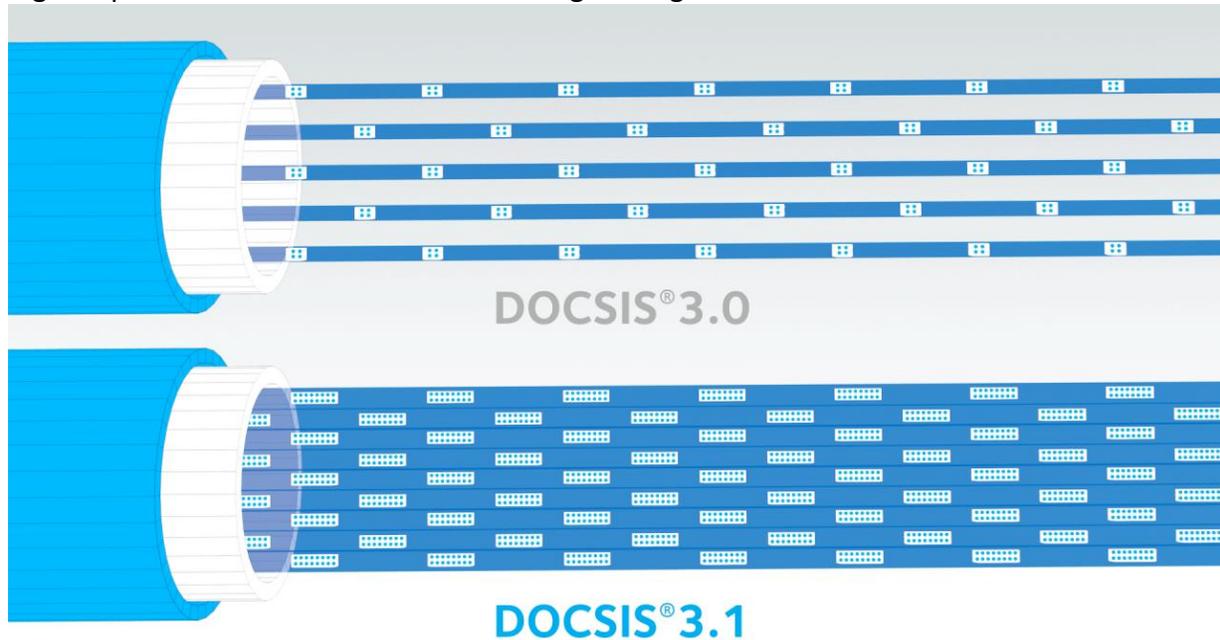
Using the improvements in error correction technology, DOCSIS 3.1 standard is able to utilize higher order modulation for data transfer. DOCSIS 3.1 supports 4096 QAM¹ with the future option of scaling up to 16384 QAM, whereas DOCSIS 3.0 is limited to 256 QAM. This translates into more efficient transmission of data. To illustrate this, you can use a comparison between the differences of carrying passengers in a car versus the great capacity of a bus on a highway, where the bus is more efficient due to the capability of caring more passengers.



Another major improvement in DOCSIS 3.1 is the use of Orthogonal Frequency Division Multiplexing (OFDM). OFDM allows for a lot more data to be packed in the same frequency spectrum than the currently used Single Carrier Quadrature Amplitude Modulation (SC-QAM) in DOCSIS 3.0. OFDM is a proven technology used in WiFi and LTE cellular networks and is now adopted for DOCSIS 3.1 cable network. Using OFDM, a stream of data is split into multiple streams and transmitted simultaneously on multiple frequency sub-carriers, allowing more data

¹ QAM is a digital cable standard used in a variety of communications systems, it is the format by which digital cable channels are encoded and transmitted via cable television providers.

to be transmitted on the same frequency band. You can compare the DOCSIS 3.0 to a highway with spacing between the lanes to avoid interference, as compared to DOCSIS 3.1 which has more tightly packed lanes without the need for spacing, allowing for more traffic to pass through at a higher speed without interference from neighboring lanes.



In addition to using enhanced signal processing techniques like 4096 QAM and OFDM, DOCSIS 3.1 allocates higher frequency spectrum for downstream and upstream data transfers. DOCSIS 3.0 used frequency band 5 MHz to 65 MHz for upstream and 85 MHz to 1002MHz for downstream, whereas DOCSIS 3.1 allocates 5 MHz to 204 MHz for upstream and 252 MHz to 1788MHz for downstream traffic.

NETGEAR DOCSIS 3.1 products

NETGEAR is first to have a CableLabs and Comcast certified DOCSIS 3.1 modem-NETGEAR CM1000 Cable modem available in US retail and online stores. CM1000 is certified for Xfinity gigabit service by Comcast.

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