

HIGH-SPLIT PLANT UPGRADE: HOW TO UNLOCK 1 GBPS UPSTREAM OVER HFC NETWORKS

Moving the Crossover Point Can
Make MSOs Upstream Woes Disappear



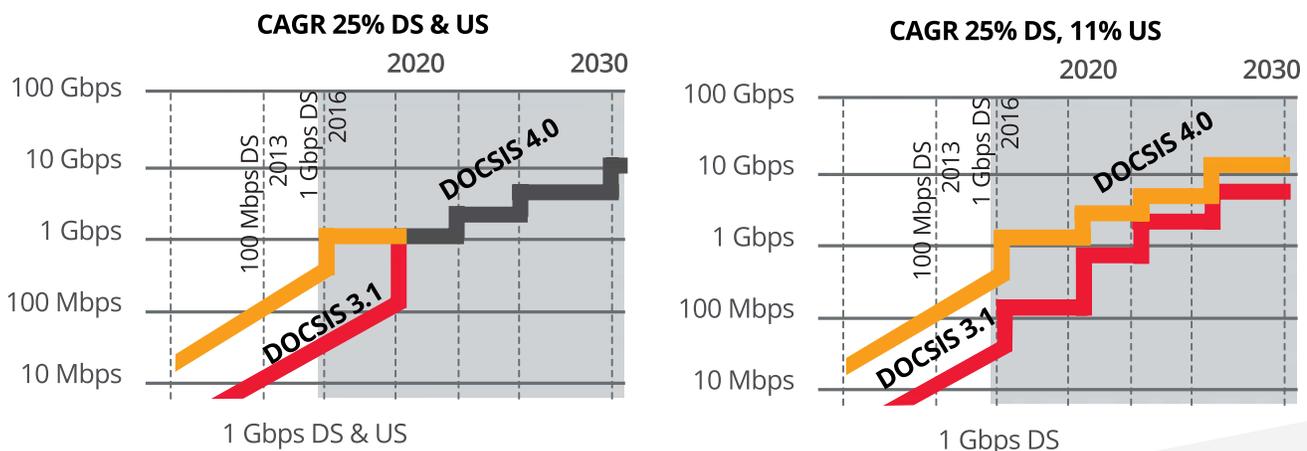
HIGH-SPLIT PLANT UPGRADE: HOW TO UNLOCK 1 GBPS UPSTREAM OVER HFC NETWORKS

Moving the Crossover Point Can Make MSOs Upstream Woes Disappear

While Multiple Service Operators (MSOs) have traditionally allocated more capacity to downstream data transmission, increasing upstream capacity is now a prerequisite for successfully competing with Telecom Providers. Where downstream capacity has been the MSOs' top priority for years, the growth in upstream demand now poses a significant challenge for hybrid fiber coaxial cable (HFC) networks. Just as video streaming revolutionized the delivery of content to the home, a similar revolution is happening in the upstream direction. It is driven by a host of activities including video chat, photo and video archiving, online gaming, file syncing, collaboration and telecommuting, data capture from IoT devices, cloud computing and data storage backups to the cloud. ARRIS has found that, because spectrum is limited in the U.S., some MSOs are realizing that more than 80% of node segmentations are being driven by congestion in the upstream.

The new competitive situation can be viewed in the context of a modified Nielsen's Law in which the compound annual growth rate (CAGR) for downstream peak rate runs at about 25% for the next decade with upstream CAGR matching it or running slightly behind.¹

MODIFIED NIELSEN'S LAW OF INTERNET BANDWIDTH



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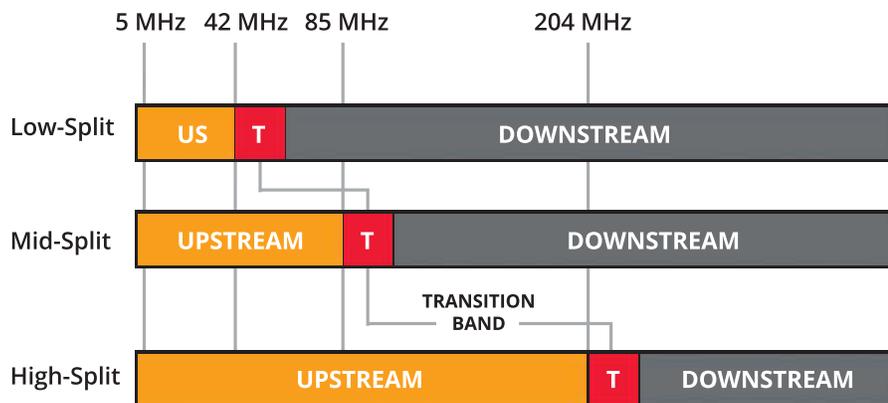
Many MSOs view fiber-to-the-home (FTTH) as their ultimate solution and are planning to evolve their network architectures in preparation for it. But competitive pressure from Telecom Providers has emerged in the form of billboard bandwidth. For leading MSOs, a near-term strategic response has crystalized around achieving 1 Gbps bandwidth both upstream and downstream on their existing HFC networks. Symmetrical 1 Gbps service is sufficient to transfer a 950 MB high-definition TV episode in eight seconds and a 3 MB MP3 file in less than one second. That’s enough to ensure the HFC plant handles consumer demand and defuses any Telecom advantage until technologies such as Soft Full Duplex DOCSIS® (FDX), Extended Spectrum DOCSIS and FTTH come into play.

Changing the spectrum split moves the needle on the upstream speedometer

Typically, MSOs have used three techniques to increase performance: improve their overall efficiency in utilizing spectrum (using multi-carrier modulation, improved error correction and going deeper with fiber), reduce the size of each service group dedicated to a node (node splitting) and allocate more spectrum to the upstream service by moving the crossover frequency higher (changing the spectrum split).

There are two main options for expanding the allocation of upstream spectrum beyond the traditional range of 5-42 MHz. Both reduce the use of low-end spectrum that contains more noise and interference. A mid-split HFC plant upgrade extends the spectrum allocated for upstream transmission to 5-85 MHz. A high-split strategy moves the crossover point up to 204 MHz or more.

SPECTRUM SPLIT OPTIONS TO INCREASE UPSTREAM CAPACITY



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Which split falls short?

The choice of which split strategy to use is based on factors ranging from technical challenges to operational considerations such as reallocating analog TV channels and potentially addressing conflicts in out-of-band (OOB) signaling of legacy set-top boxes.

Most Providers consider the mid-split to be a relatively simple approach to expanding the upstream spectrum and competing better with FTTH competitors. A mid-split plant upgrade, which makes use of existing DOCSIS 3.0 equipment and allows legacy set-tops to remain in use, generates the least network disruption and smallest impact from new equipment deployments. Moving the crossover point from 42 MHz to 85 MHz produces about a 2.5x improvement in upstream throughput. Greater efficiency is gained if DOCSIS 3.1 is utilized in this newly created spectrum.

Unfortunately, the mid-split HFC plant upgrade falls short of the goal of achieving symmetrical 1 Gbps service. To meet that anchor point for high-end residential customers and small businesses, MSOs must move to a high-split architecture.

Taking the high-split road to success

The high-split approach is a very attractive option. While high-split plant upgrades are more technically challenging, analysis by ARRIS indicates that moving the crossover point to 204 MHz can achieve 1 Gbps upstream for DOCSIS 3.1 devices and 330 Mbps for DOCSIS 3.0. On a cost-per-unit-of-bandwidth basis, ARRIS finds the high-split upgrade is often the most economical approach, delivering several times more upstream throughput than a mid-split strategy. Put another way, the high-split can achieve close to fiber-like performance at a fraction of the price.

Considerations:

- Executing a high-split upgrade requires the MSO to remove or reconfigure outdated equipment such as swapping out the diplexers and return hybrids in optical nodes and RF bridgers/line extenders. Moving the transition band to a higher frequency provides an opportunity to optimize the actives in the plant and improve plant performance by correcting impaired connections, cabling and signal levels.

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- In a high-split plant upgrade, legacy set-top boxes that use out of band signaling in the 70-130 MHz frequency range may need to be replaced with IP set-top boxes and DOCSIS set-top gateways (DSG). Alternative approaches include carving out an upstream exclusion area to accommodate OOB signals or up-converting OOB signals to higher frequencies, then down-converting at various amplifier locations. Most IP and DOCSIS set-top boxes do not require replacement.
- Because the high-split approach decreases downstream spectrum, MSOs that support a large number of video channels may decide to extend their downstream spectrum by swapping out older taps that do not support 1.2 GHz operation. ARRIS helps MSOs evaluate how many taps need to be replaced. For MSOs with fewer video channels and compact channels carried over DOCSIS, the system evaluation may find there is no need to swap out taps.
- Because the bottom part of the downstream spectrum is reallocated to upstream spectrum, some modifications to video channel assignments are necessary.

A trusted partner can make all the difference

When embarking on a journey toward the ultimate bandwidth solution, MSOs need to be confident that their decision-making is consistent with their unique business goals. Only an experienced, trusted partner can offer the level of real-world expertise in design, engineering, materials and resource management that ensures an HFC plant upgrade will go smoothly.

The two biggest differentiators in selecting a partner are people and expertise. ARRIS has the end-to-end consulting, program management and engineering resources to envision and implement a spectrum split solution based on proven methodologies that will extend the life of any HFC infrastructure. ARRIS teams designed and built many of the leading HFC networks operating in the world today. We have helped MSOs decide which steps to take to maximize and evolve their HFC plants without unnecessarily ripping out and replacing infrastructure. The ARRIS team can also provide deep insights into working with legacy equipment and emerging technology—knowledge gained from thousands of projects performed for Service Providers around the globe.

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Conclusion: A high-split plant upgrade is a near-term enabler for 1Gbps

For any MSO whose network covers diverse geographies, from urban to rural markets, the path to sustained excellence depends on executing a capital-efficient expansion of the HFC plant. ARRIS has unique expertise gained from helping a wide range of MSOs do everything from evaluating their plants to determining the speeds they need to offer, from assessing the business and technology challenges to identifying and implementing the optimal solution for those challenges. Our broad range of HFC products, from CCAPs to outside plant equipment to CPE devices, enables us to deliver an end-to-end solution that meets the needs of every MSO.

A high-split plant upgrade may be implemented in both centralized and decentralized architectures and is the logical next step in an MSO's **methodical network evolution** to FTTH. This strategy can be the most economical way to meet the growing pressure for delivering symmetrical 1 Gbps service demanded by business and residential customers, while staying competitive with the billboard bandwidth offered by Telecom Providers.

To learn more about the benefits of implementing a high-split upgrade, visit [arris.com](https://www.arris.com).

¹ "Nielsen's Law of Internet Bandwidth," Jakob Nielsen, Nielsen Norman Group, 1998, 2018.
<https://www.nngroup.com/articles/law-of-bandwidth/>