FTTH or Next-Generation HFC:

Myth vs. Reality

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Introduction

Cable networks are already the preeminent platform for transmission of data services for both residential and business customers. Lately, however, there is speculation that new networks, perhaps driven by next-generation wireless advances, will be required to fulfill anticipated needs.

How can cable be ready for this transition? One way might be through what I will call “Next-Generation Hybrid Fiber Coax” (NG HFC), which includes the up and coming technologies of Distributed Access Architecture (DAA), Node+0, Full Duplex Data Over Cable Service Interface Specification (DOCSIS) (FDX), Extended Spectrum DOCSIS (ESD), and Virtual Cable Converged Access Platform (vCCAP). Another way could be via Fiber-to-the- Home (FTTH) technology (including Fiber to the Business) involving Passive Optical Networks (PON). How is an operator to decide which is best, and what should they be doing now to be prepared for that decision?

MSO Legacy Architecture

Most Multi-Service Operators (MSOs) have an HFC infrastructure serving 500 homes per node today. (Figure 1) Maximum cascades typically range from three to five amplifiers beyond the node. Speed peaking close to 1 Gbps downstream is possible if enough downstream spectrum is devoted to DOCSIS. No major operators, however, have changed their upstream split to permit speeds higher than about 100 Mbps. The reasons behind why the upstream split has not changed offer a clue into the future challenges of Next-Generation HFC (NG HFC). However, before analyzing the reasons, let us first examine the different network options.

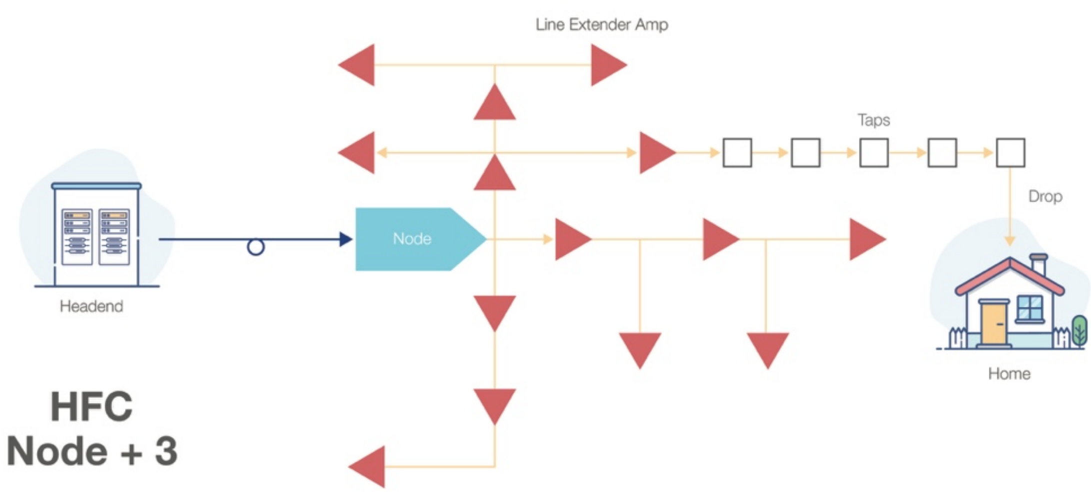

Figure 1

New Network Options

HFC Networks

Node + 0 (Node+0)

To take speeds significantly higher than possible with 500-home nodes, dropping the service group size to numbers similar to PON (32, 64, or 128 homes) is required. (Figure 2)

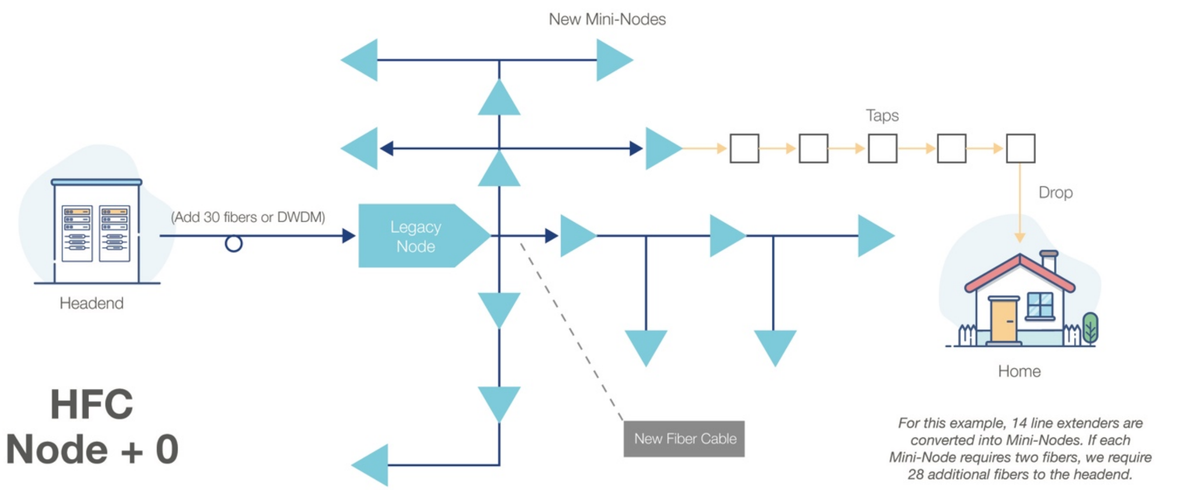

Figure 2

Further, current lab implementations of FDX and ESD require Node + 0. FDX or ESD will permit the upstream speeds to rise to 1 Gbps symmetrical service and beyond.

Distributed Access Architecture (DAA)

Remote Physical Layer (Remote PHY) or Remote Media Access Control and Physical Layer (Remote MAC-PHY) define the Distributed Access Architecture (DAA). DAA solves many MSO challenges. By putting the majority of headend equipment into the field, space and power in the headend become available for other purposes. Indeed, without DAA there would probably be insufficient space and power in the headend to support the number of new nodes required for Node + 0.

Combining DAA and Node + 0

With DAA, Quadrature Amplitude Modulation (QAM) signals are generated at the node. They need not pass through amplifiers before or after hitting the coaxial network, and therefore when combined with Node + 0, higher-order modulation can be used than would be possible with a conventional analog fiber system. Going from 1024 QAM to 4096 QAM can produce a 30 percent increase in throughput!

MSO Provisioning

MSOs have a well-established DOCSIS infrastructure. This allows not only easy flow-through provisioning, but in many cases customer self-provisioning of modems available via retail outlets. The servers in the background that permit modems to come online, receive walled-garden services, obey lawful intercept orders, etc., are part of the network. Future DOCSIS iterations, such as FDX, promise to maintain this infrastructure's utility.

Virtualization

Virtualized Converged Cable Access Platform (vCCAP) has the potential to replace the computing systems contained within Cable Modem Termination System (CMTS) equipment with generic off-the-shelf "blade server" technology. This could enable new players to enter what had been an exclusive club of CMTS vendors while also shrinking the size of the CMTS equipment required in the headend. It can also help enable third-party suppliers of plant equipment through standardized interfaces with those servers.

Fiber Networks

Passive Optical Networks (PON)

PON allows service to many (32, 64, or up to 128) homes over a single fiber. The fiber is brought to a neighborhood where a passive splitter network is used to feed the homes or businesses. (Figure 3)

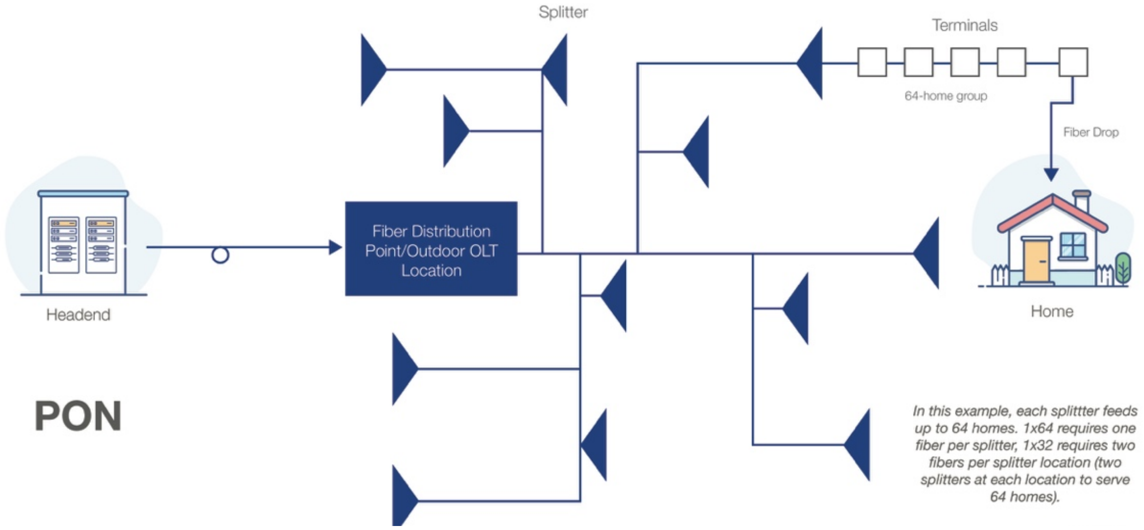

Figure 3

Variations of PON standards permit speeds of 10 Gbps or more to be delivered. PON, in one form or another, is the standard method of delivery for FTTH networks today.

DOCSIS Provisioning of EPON (DPoE) leverages MSO Provisioning to render the Optical Network Unit (ONU) a facsimile of the DOCSIS cable modem.

Radio Frequency over Glass (RFOG)

RFOG places what amounts to an analog fiber node at each serviced home. RFOG has lost favor lately: Not only is analog transmission of optical signals not typically able to accommodate the optical loss required to serve service groups of more than 32 homes, but if cable modems transmit simultaneously their optical carriers could interfere with one another when transmitting on the same wavelength. A limited RFOG overlay to a PON is still used, however, to achieve compatibility with an installed base of RF-QAM video set-top box equipment.

A Tier-2 MSO with over 35,000 RFOG customers is now beginning the process of converting customers to PON.

Similarities between FTTH and NG HFC

Whether a network is FTTH or NG HFC, signals must travel from the headend to the neighborhood being served. In the case of a PON, each service group has a splitter that must be fed by the Optical Line Terminal (OLT). In an HFC network, each service group requires a node output.

If the legacy fiber to the neighborhood does not contain enough fibers to feed all of the service groups, either more fiber must be installed or a Dense-Wavelength Division Multiplexing (DWDM) system or Remote OLT is required. The network architecture up to this point is identical between the PON and NG HFC networks.

Transport Plant

Let us consider the transport requirements for a typical area served by a legacy 500-home fiber node. If we convert this area to a 32-home per splitter PON, we will require at least 16 fibers. If instead we replace typical 12-line extender amplifiers fed by that node with new DAA nodes, including the legacy location, we require 26 fibers (separate upstream and downstream).

To be ready for 5G, a pro-active MSO may wish to add fibers to feed future small cell locations. If we assume that each splitter or DAA node location will have one fiber-fed 5G radio location, the number of fibers required could double versus just feeding the new Node+0 nodes. The only practical way to solve this problem is with DWDM.

A field-mounted DWDM multiplexer could serve one or more legacy node locations, depending on factors including the number of wavelengths available, locations available, and the amount of fiber desired to be constructed from the multiplexer to the new node or Remote OLT locations.

The transport problem is the same for both NG HFC and FTTH installations – **too few fibers to a neighborhood is corrected via DWDM networks or additional fiber construction**. If FTTH is used, the DWDM network must feed remote OLTs to generate the PONs.

Differences between FTTH and NG HFC

From the distribution point to the home is where FTTH and NG HFC networks differ. With PON, splitters are deployed between the OLT and PON neighborhoods of typically 32 to 128 homes. A high-density splitter is adjacent to the remote OLT or multiple small-scale splitters working in cascading fashion accommodate both greenfield and brownfield applications. In an NG HFC system, fibers feed each node location and then a coaxial network feeds a tap near each home. Coaxial drops are installed from the tap to the home.

The coaxial network requires power to operate the nodes, and if amplifiers beyond the node are used those require power too. Power supplies are installed that transform local utility power into a lower voltage and apply this to the coaxial plant. If the FTTH network uses remote OLTs, these devices require utility and standby power.

Drops

FTTH networks require optical drops to each customer premise. At each premise, a gateway device terminates the fiber and enables digital service for customer equipment via Ethernet, Multimedia Over Coax Alliance (MOCA), or Wi-Fi.

While NG HFC networks use existing coax drops, numerous component upgrades may be needed to move from legacy HFC to NG HFC (details forthcoming).

Active electronics in field for DAA/Node + 0

NG HFC and PON can serve relatively close customers from the head end and hub and relatively distant customers from the remote cabinet or remote node. The geography of a particular application will determine whether NG HFC (node, amplifiers, taps) or Node+0 (node, taps) are more efficient.

Limitations imposed by FDX echo-canceling operation may require Node+0.

If a remote OLT PON is used, that is active electronics in the field for FTTH.

RF delivery unavailable for FTTH unless an RFOG overlay is employed

While RFOG networks carry existing RF services as-is, in PON networks, RF services are not available. Any service previously delivered via RF, such as QAM TV, would need to be replaced by IP TV service (IPTV). RFOG overlays can be used to get around this problem but at the cost of additional equipment and significant design complexity. A VP of Network Architecture and Strategy at a Tier 1 MSO noted “RFOG needed groups of 16, in some cases, due to lower loss budget.”

RF services, such as those used to feed legacy video set-top boxes with QAM signals, are anticipated to continue as-is in NG HFC networks. This may or may not be the case in reality, as a gateway approach in the home may be required to enable some of the new technologies planned.

Whether FTTH or NG HFC, operators should prepare to invest heavily in their networks to both compete with 5G operators and to attract those same operators as their customers. The fiber transport network required for either option is basically the same, and construction of it should begin now, even if the operator has not decided whether their future access network will ultimately be coax- or fiber-based.

FTTH or Next Generation HFC: Myth vs. Reality

FTTH has held the promise of high bandwidth, reduced plant operations and maintenance cost, superior reliability and quality, and, more recently, comparable construction costs.

Despite all of the advantages of FTTH, few major MSOs in the United States have fully embraced it. The premise that FTTH networks are far costlier than HFC network upgrades is widely accepted. Why is this? Let us examine some of the long-held beliefs about FTTH relative to NG HFC versus the facts.

Here are the factors to consider, in order of importance:

1. Maintenance
2. Disruption of Service
3. Construction
4. Terminal Equipment
5. Apartments
6. Training
7. Provisioning

Since the life expectancy of these networks is in excess of ten years, these factors have been prioritized based on their comparative importance over a fifteen-year period.

1. Maintenance

<u>Fiber Network</u>
Fiber networks require no routine or preventive maintenance. "HFC maintenance was running about $1,100 per mile per year, with over half being for power alone. In areas we converted to FTTH, our budget dropped to $100 per mile per year", according to the Tier 1 MSO VP of Network Architecture and Strategy.

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VP of Network Architecture and Technology, Tier 1 MSO

The cost of ongoing maintenance over a ten- or twenty-year period for a coaxial system can negate the capital cost savings of constructing one when compared to a FTTH system where maintenance costs approach zero.

Coax Network

Coaxial networks require routine preventive maintenance and require ongoing power expense. Signal leakage must be detected and measured, and any leaks repaired. Higher plant bandwidth makes it necessary to detect leaks at multiple frequencies, exposing the plant to ingress from new sources such as small-cell radios. Connectors, if damaged or installed improperly, can allow water intrusion and corrosion, which will impair performance and can cause outages. Power supply batteries must be maintained. Signal levels must be carefully monitored and maintained, and may involve status monitoring networks or manual field checks.

Advantage FTTH. FTTH is far easier and less costly to maintain than NG HFC. Over time the financial advantages are very significant.

2. Disruption of Service

It is important to not only consider the cost and difficulty of deploying a network in terms of equipment dollars and man-hours of labor. Customers are connected to the legacy network! Their service must be disrupted as little as possible.

Myth: *I can upgrade my coaxial network with minimal disruption to my customers by doing so out-of-hours and carefully scheduling replacement of plant equipment.*

Reality: When an HFC network is upgraded, network interruptions are required. These can be minimized through careful planning. However, they will still happen. Each service interruption annoys customers and makes them more likely to switch to a competitor.

Changing to a Node + 0 or DAA network requires equipment replacement that will cause all subscribers to lose service during the equipment change.

Changing to a high-bandwidth (ESD) network will involve changes in the passive outside plant. Subscribers could lose service multiple times if taps are changed and might need to have their property visited when drop cables are replaced.

Changing terminal equipment is the most disruptive activity of all, because each customer must be visited, which means an appointment must be made often requiring the customer to miss work. FDX may require terminal equipment changes even for homes not using FDX services.

Advantage FTTH. FTTH networks can be overbuilt alongside an existing HFC network with no disruption to existing customers. When terminal equipment must be changed, it is for customers taking the new FTTH service only. Eventually, all customers on the HFC network could be changed over at their convenience.

3. Construction

Myth: *Building FTTH networks requires not only replacement of all Outside Plant (OSP) coaxial cable with fiber cable, but also replacement of cable drops to each home with fiber drops. Inside the home, fiber must be brought to the optical terminal equipment location, and that location* *requires power and access to any in-home wiring required to service the devices. Because all OSP coaxial cable must be replaced by fiber, there is no opportunity to reuse expensive portions of the coaxial network, such as areas of underground construction and apartment building wiring.*

Reality: New types of fiber cable minimize construction costs by being able to be handled with little regard for overstressing through pulling or bending. There are systems available to remove coaxial cable dielectric and core, and use the remaining shield as a duct for air-blown fibers. If the coax was installed in conduit, new techniques for adding flexible subducts and using microsize fiber cables can sometimes allow installation of fiber in an occupied duct.

The difference in underground construction cost varies with the amount and complexity of the particular network. An operator with mostly aerial cable will be less concerned than an operator with mostly underground cable, particularly if the underground cable is buried in an urban environment.

A CTO from a Tier 2 MSO using FTTH for years said, "The things you're doing for FTTH or Fiber Deep are the same until the drop to the house, and starting 2 years ago, we future-proofed [that concern] with Siamese coax/fiber drop. Going to Node + 0 would have similar construction challenges without the ability to use microfiber where coax is required."

"Going to Node + 0 would have similar construction challenges without the ability to use microfiber where coax is required."

CTO, Tier 2 MSO

Within a building, very small fiber cables designed for use in hallways are available, eliminating the need to penetrate apartments not subscribing to the fiber service. "Invisible" fiber is available to allow running fiber within apartments in the corners between walls and ceilings making "wall fishes" unnecessary.

A VP of Engineering from another Tier 2 MSO stated that in their case of building Node + 1 and DAA, that cost is lower than FTTH. In greenfield cases, costs are comparable.

What about the construction cost for NG HFC networks? It is true that when upgrading the network, the hardline plant cable itself will remain intact in most cases. The RF amplifiers may be replaced by new DAA fiber nodes for conversion to a Node + 0 architecture. These new fibers must be constructed back to a distribution point, typically located at the original node location. This is the construction that operators anticipate. If the network bandwidth is increased during the NG HFC upgrade, however, (And who doesn't want to increase network bandwidth during an upgrade?), unanticipated additional construction may be required. The upcoming DOCSIS 4.0/Extended Spectrum DOCSIS (ESD) specifications will likely include bandwidth expansion options to 1.8 GHz and beyond along with FDX.

Tap Plates

Chances are at a minimum the values of tap plates will need to be changed to accommodate high-output RF levels from NG nodes (and perhaps NG amplifiers) and

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new plates will be required to pass the new ESD frequencies. Tap changes to accommodate FDX echo cancelation are not anticipated but are a possibility.

Tap Housings

Will the existing tap housing be able to perform adequately at the new frequencies? The entire housing may need to be replaced at each tap location. This is huge both in terms of expense and the outages it will create during construction.

Drop Cables

Will an existing RG-6 drop running 100 feet be adequate to deliver a top frequency of 1.8 GHz? If the network is changed to a "Home Gateway" architecture and splitters at the home are not a concern, the answer is likely yes. What about 3 GHz? What if the drop is 150 feet? If this is the case, larger, more expensive and harder to handle RG-11 may be required.

Power

The coaxial network, before an upgrade, has power to feed the existing amplifiers. What happens if the amplifiers are replaced by DAA nodes, typically with a high-level RF output? The power consumption, and thus the need for power supplies and the electricity that feeds them, will likely increase.

Amplifiers

Most existing amplifiers in the legacy network cannot accommodate the high level output of a DAA node (because of the high tilt required for ESD frequencies). Considering a Node + N infrastructure may only be possible without a significant bandwidth extension.

Fiber Trunk Infrastructure

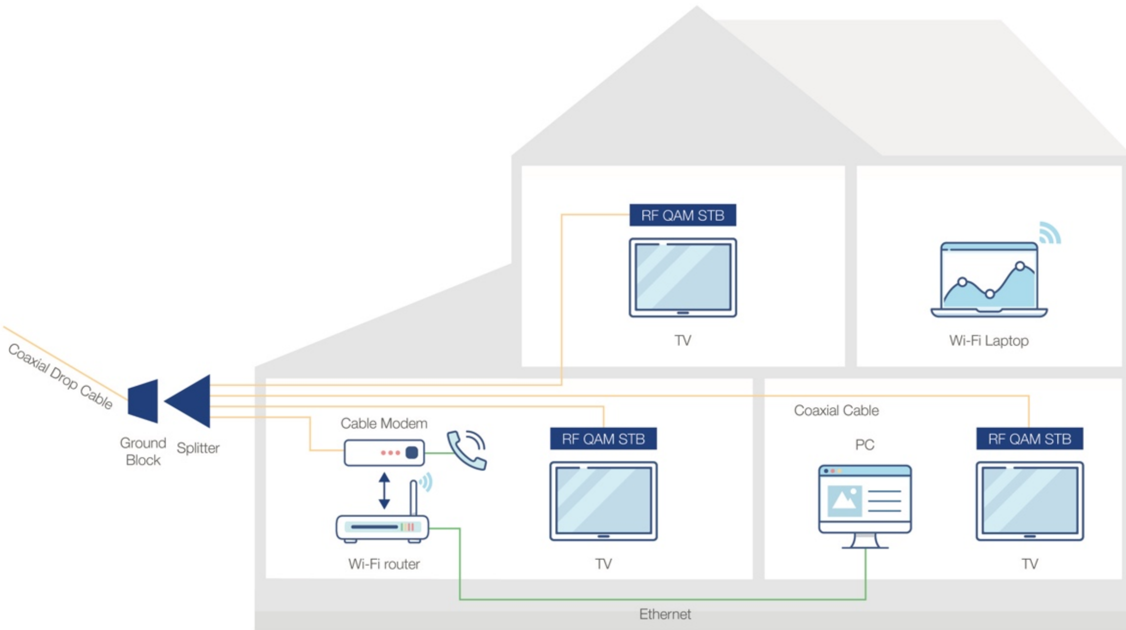
The amount of spare fibers at the legacy node locations is usually quite limited. There simply are not enough spares to feed more than a dozen new nodes to replace existing amplifiers.

Either a new trunk from the headend with new fibers must be built, or a DWDM infrastructure must be constructed using the limited available spare fibers. The new DWDM network would then be used to feed the new nodes. The need for new fibers is well known for FTTH networks, but it is just as important for NG HFC networks involving Node + 0.

Advantage FTTH. FTTH is easier to construct than NG HFC in most cases. In particularly expensive areas, such as urban underground, if the coax is already in place, NG HFC would be preferable when the buried plant can be reused. On the other hand, the hidden costs of upgrading NG HFC networks for DOCSIS 4.0/ESD technologies such as 1.8 GHz, 3 GHz, or FDX can make it very expensive.

4. Terminal Equipment

Myth: *With a PON, there is no RF infrastructure; the only means to deliver video service is via IPTV. Most currently deployed set-top boxes only support RF-delivered QAM video and would require replacement. This replacement is not necessary with NG HFC. (Figure 4)*



In-Home Coaxial Cable Wiring for Legacy HFC

Figure 4

Reality: The popularity of Over-The-Top (OTT) services illustrates that operators and customers alike are already coming to terms with IPTV. Many operators have created IPTV facilities to serve video to tablets, laptop computers, and phones. The IPTV network can be expanded to serve IPTV set-top boxes. IPTV set-top boxes cost far less (generally speaking) than RF-QAM set-tops, and could even be provided by the customers in the form of software available with "Smart TV" sets or the Amazon Fire TV Stick.

Replacing terminal equipment in the form of TV set-top devices is not only a fiber network requirement, it may be a side effect of an NG HFC deployment as well. (Figure 5)

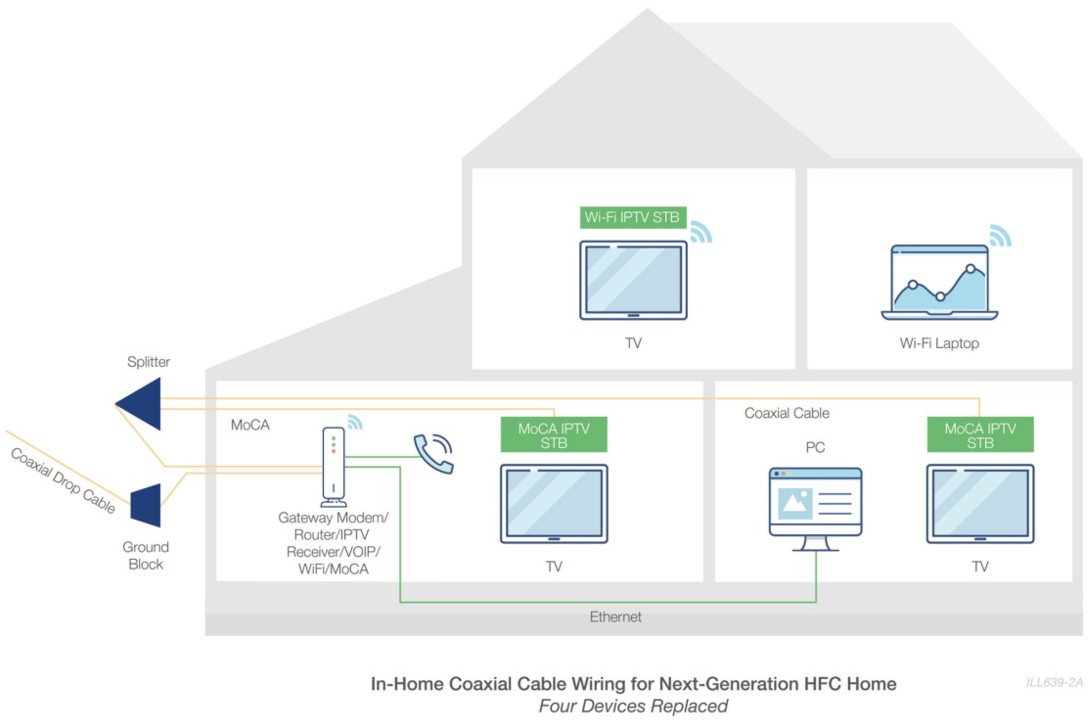


Figure 5

When bandwidth is expanded, most NG HFC upgrades will require that the home be converted from an extension of the cable network into a stand-alone network fed via a home gateway. This is because legacy equipment in the home tied in to the cable network would not function properly with an altered downstream/upstream split in the plant or other equipment in the home operating in Full Duplex DOCSIS mode. All of this existing equipment must be isolated or replaced. Once isolated, how would the legacy box receive its signals? Most legacy RF set-top boxes cannot function without pilot signals from the plant.

In an isolated network, Home Video Gateways terminate data and video services. They then feed “mini” boxes at other TVs in the home via Multimedia over Coax Alliance (MOCA), Ethernet, or Wi-Fi. In other words, new set-top boxes. It may not be necessary to change equipment in homes that are NOT receiving upgraded services; however, this is not certain.

To take full advantage of the extra upstream bandwidth made available by NG HFC, terminal equipment must be replaced just as it must be with FTTH. Blaming the cost of terminal equipment replacement on fiber is a red herring. **Don’t ignore the hidden costs of NG HFC.**

In an FTTH network, it is expected that terminal equipment will be required. (Figure 6)

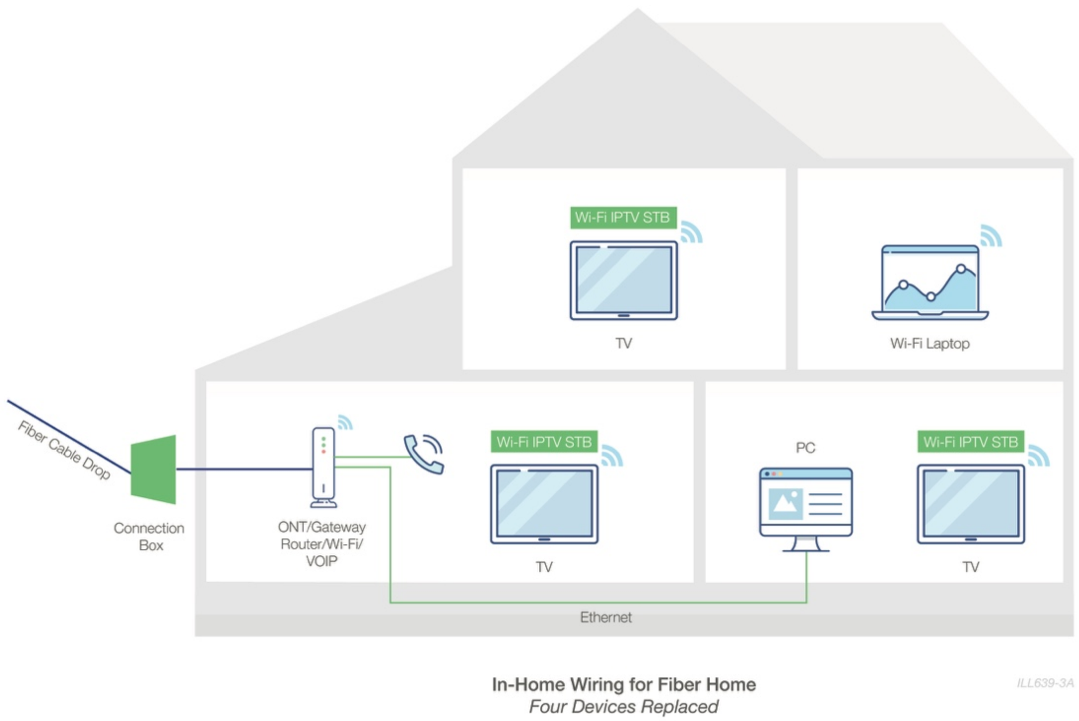


Figure 6

Referring to his deployment in Central Florida several years ago, the Tier 1 MSO VP of Network Architecture and Strategy put it this way, “Marketing teams had to have full feature parity which drove the RFOG overlay. This added about $160 per home cost. Today, things are different, and IPTV is possible. “

No Advantage. The myth is that NG HFC will be way ahead because of the ability to continue using legacy terminal equipment. In reality, we have a tie because it is likely that both FTTH and NG HFC will require terminal equipment replacement.

5. Apartments

Myth: *Replacing coaxial drops to each home in a Multi-Dwelling Unit (MDU) with a fiber drop is a daunting task to contemplate. The costs of drop replacement can run several hundred dollars per unit, and require a high level of disruption, despite the promise of fiber-optic service. 5G competitors stand ready to offer high bandwidth to each unit from the outside-in, without radically re-wiring the building. I must use my existing coax and compete somehow. These same concerns apply to multi-unit commercial buildings we also serve.*

Reality: Many apartment buildings have homerun coax available to each unit from a central lock box in each building, or on each floor. If fiber is run to this location, a centralized PON terminal could provide service to each unit over copper. Bandwidth may be limited, and specialized equipment will be required, but the cost of such a service should be much lower than ripping out the coax and replacing it with fiber. Standards such as MOCA, G.hn, or G.fast over Coax are available to facilitate these deployments. (Alternately, the operator could use the same techniques as its competitors to offer service via microwave from fiber-fed terminals located outside.) The Tier-2 MSO CTO reports, “We have successfully been using MOCA fed by our standard ONT to deliver service to apartments in a two-box solution”.

If running fiber to apartments is the decided course, newer techniques and equipment can make this less costly than would previously have been the norm. “We are experimenting with tiny fiber trays run in apartment hallways for real FTTH in each unit for new buildings,” the Tier 2 MSO CTO said. Tiny cables and “invisible” ultra-bendable fibers to eliminate “wall fishing” are now available.

No advantage. Coax infrastructure in apartments can continue to be used with NG HFC, however if bandwidth is greatly expanded or upstream/downstream splits are altered, the in-building network might need to be re-built for the new coax network. Radio access, on the other hand, requires no work inside the apartment building at all. FTTH systems can re-use home run cables with coax adapters, and new techniques make fiber wiring less expensive than ever before.

A 5G/mmWave network feeding apartments from the outside-in is one way to serve an MDU without rewiring the building, but the serving radios would likely be fed with fiber.

6. Training

Myth: *Any technician handling fiber will require special training because handling fiber is viewed as more complicated than handling coaxial cables. Technicians may also require specialized fiber tools such as fusion splicers and Optical Time Domain Reflectometers (OTDRs).*

Reality: Handling fiber drops themselves is really no more difficult or complicated than handling coaxial cable. “The training for FTTH is not any more difficult than for HFC, just different,” according to a Tier-2 MSO VP of Engineering. Putting on connectors does require special tools, but once a technician is trained the level of difficulty is similar. To avoid connectors, fusion splicing is now available for the street-side plant, in the drop connection, and in the home. Low-cost automated portable equipment makes fusion splicing for all connections (at least other than to the optical equipment) not only possible, but practical. Because fusion-spliced connections are permanent, one need not worry about re-mating connections letting dirt get in or connectors get damaged – an ever-present problem with fiber connectors.

An optical power meter is much easier to use than an RF signal level meter (as tuning is not involved, and an OTDR operates in the same manner as a copper TDR. Yes, training is required, but it is required for its copper counterparts as well.

It is also becoming increasingly difficult to find the talent for coaxial construction. The Tier-2 MSO CTO said, "It's hard finding people to splice coax! All of our field techs are trained in fusion splicing, including installers."

Advantage NG HFC. Since there is some new training required for FTTH, NG HFC where HFC is already in place would be easier. In greenfield situations, this is a tie.

7. Provisioning and Back-office Infrastructure

Myth: *Bringing an ONT online via established "telco" methods often involves procedures that are foreign to most cable operators. Older PON systems generally require that a specific ONT be brought online ONLY when that home is tied to an account and given some level of service. By contrast, many MSOs allow any DOCSIS modem to be connected and automatically be brought online in a "walled-garden" state. That modem can then be attached to an account and provided with Internet service by direct interaction with the walled-garden servers, often by the customer. Telco systems involve back office communication via Netconf or XML rather than DOCSIS. (These methods may be preferred by some cable operators) Lastly, I won't be able to use my PacketCable voice infrastructure to deliver voice on an FTTH network.*

DOCSIS infrastructure allows all of the housekeeping necessary for a cable modem service, including lawful Intercept of data and voice, encryption and privacy of data, Domain Name Service (DNS), Time of Day (TOD), etc. PON systems generally cannot use these DOCSIS tools. These items would need to be handled externally.

Reality: Yes, traditional PON is not DOCSIS. The vendors have noticed this, as have standards bodies such as CableLabs. Several years ago, the idea of DOCSIS provisioning of EPON gained some traction. Operators could use the same commands they send to their CMTS to provision an EPON OLT and the ONTs behind it. Today, the largest PON vendors have tools available to allow PON OLTs to act like DOCSIS modems in terms of how they operate with the cable operator's back office systems, and these systems work with both EPON- and GPON-based networks.

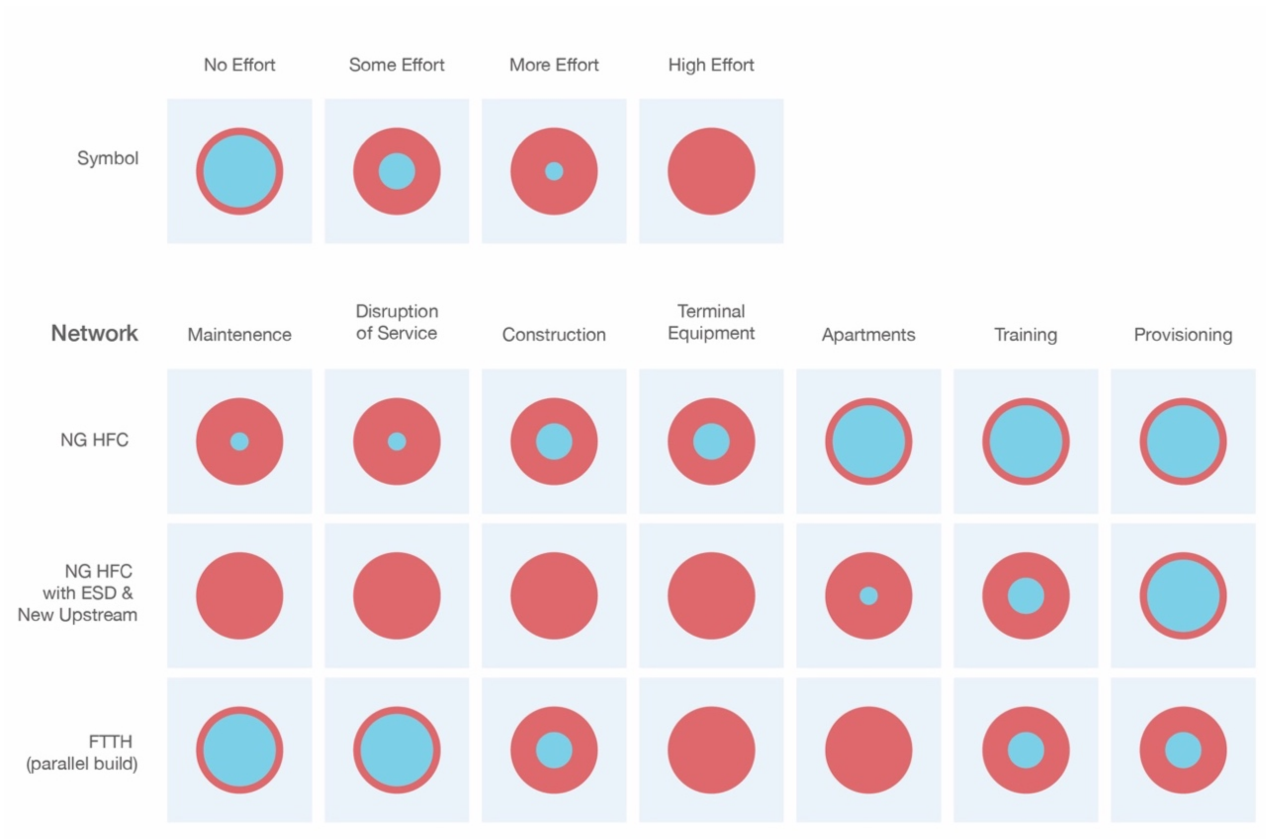
For voice services, voice adapters using SIP can be fed from the same soft switches used for cable telephony now. Some of these adapters are available built-in to PON ONTs.

When an operator is considering virtualizing its CMTS control networks, it is already talking about the same type of computing infrastructure required to provision PON networks with DOCSIS-like capabilities. The Tier-2 MSO CTO reports that they were able to create their own provisioning system in conjunction with their PON and OSS vendors and are very pleased with the results.

Advantage NG HFC. NG HFC networks using DOCSIS are already equipped and therefore come out ahead, however FTTH is not far behind due to recent advancements that enable it to mimic DOCSIS.

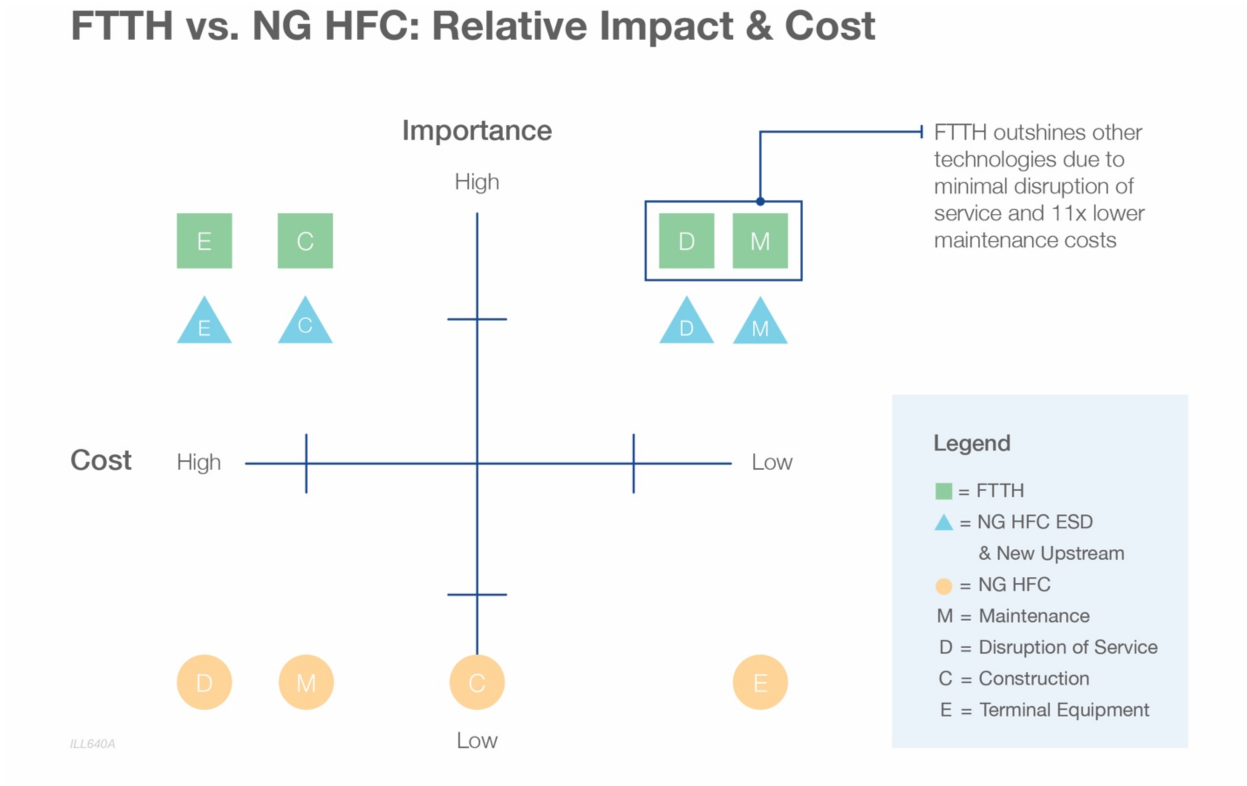
Degree of Difficulty

Based on this seven-factor assessment of the degree of difficulty for FTTH versus NG HFC, with maintenance, disruption and construction as the three most important factors, FTTH is the clear winner. This is particularly true when contrasting FTTH to NG HFC networks with extended bandwidth and/or higher upstream. Here's a graphical representation of these differences based on the degree of difficulty:



Conclusion

When you consider the degree of difficulty assessment together with the fact that the advantage goes to FTTH in four of the seven decision factors (including the three most important factors), FTTH wins. To further illustrate this point, let's look at the relative cost of the four most important factors and the business impact/value of FTTH and the two types of NG HFC.



Here again, FTTH wins. Just look at the top of the upper right quadrant.

The operating cost advantage for FTTH is strong. Once installed, a fiber network requires no power, no routine maintenance, no signal leakage measurement or remediation, and has no metallic connectors to fail or corrode. In any comparative study the ongoing cost of maintenance should be considered over the anticipated life of the plant.

"We felt we would never be done pushing fiber deeper and deeper, until everyone had a fiber drop. Why put in [coax] hardware that we know, someday, we will have to take out?"

CTO, Tier 2 MSO

No doubt upgrading HFC adds value to the business, however that impact is constrained by the limits of the technology. Unless bandwidth is expanded along with the upgrade, the opportunity to generate incremental revenue from new and existing customers is sub-optimized. Even with higher bandwidth, the network may need additional upgrades to accommodate ever-increasing customer demand along with all the disruption that this entails. FTTH, on the other hand, is only limited by equipment choices – the network itself need never be upgraded again.

The CTO put it best, "We felt we would never be done pushing fiber deeper and deeper, until everyone had a fiber drop. Why put in [coax] hardware that we know, someday, we will have to take out?"