CABLE BROADBAND WHITE PAPER

Leveraging HFC Infrastructure to Deploy 5G

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INTRODUCTION

5G has molded its way to the top of popular consciousness, with promises of lightning-fast, low-latency connectivity and ubiquitous coverage. While improving user experiences in gaming, streaming and online reliability, 5G will open doors to new worlds of connectivity such as autonomous transportation, augmented and virtual reality, and smart city automation.

Initial 5G coverage has been accomplished mostly through radio equipment upgrades at cell tower sites, and by leveraging new radio spectrum availability and processing techniques. However, to meet the speed and latency goals of 5G, operators will need to deploy small cell radios by the thousands throughout cities, neighborhoods, metropolitan districts, and venues, presenting new installation and management challenges. Each radio must have a physical high-speed connection for backhaul, a permit and location for the radio, and reliable power to keep the radio running. Providing any one of these basic elements to a new radio site will require construction, leading to spiraling costs and time delays.

Successful 5G small cell deployments require reliable, widely accessible, cost-effective infrastructure. Fortunately, the cable broadband operators have built the perfect network for small cells, providing a well-maintained infrastructure that delivers battery-backed power and high-bandwidth backhaul. The cable operators' Hybrid Fiber Coax (HFC) networks are deployed through almost every city and neighborhood across the United States and much of the world. This white paper will identify the infrastructure pain points for small cell deployments and will highlight the features of the cable broadband network as an optimal solution for enabling mass small cell deployment.

TO MEET THE SPEED AND LATENCY GOALS OF 5G, OPERATORS WILL NEED TO DEPLOY SMALL CELL RADIOS BY THE THOUSANDS THROUGHOUT CITIES, NEIGHBORHOODS, METROPOLITAN DISTRICTS AND VENUES

SMALL CELL INFRASTRUCTURE CHALLENGES

Small cells function very much like macro cells but are a fraction of the size and cost. Most small cells only transmit a few hundred feet, similar to a Wi-Fi hotspot. The small cell uses the same radio frequency spectrum as the macro cell. However, there are fewer users sharing the available bandwidth of the small cell, resulting in more bandwidth per user. In addition to lower density, the close proximity of the radio to the end device enables higher modulation formats, resulting in higher bandwidth connections. Due to the smaller coverage area and desire for low user density, the number of small cells in each area can be very high, potentially 125 - 200 small cells, to make up the coverage of a single macro cell[1].

Cost-Effective Infrastructure Availability

Operators know that there is more to deploying small cells than finding the RF sweet spot. Once they identify the right physical location (pole, wall, strand, etc.), they must ensure that there is a source of power and backhaul available. Conventional methods are to run fiber to the site for backhaul and obtain a drop from the electrical grid for power.

The expense of bringing infrastructure to the radio can be overwhelming. Running aerial fiber for example can cost as much as $15 per foot, while trenching for underground fiber costs can run much higher[2]. Delivering power to a small cell

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1 J Chapman, 2021, HFC and 5G Backhaul — Two New Friends, Broadband Library, viewed 3/1/2021 https://broadbandlibrary.com/hfc-and-5g-backhaul-two-new-friends/
2 Hovis, Afflerbach, 2014, GIGABIT COMMUNITIES Technical Strategies for Facilitating Public or Private Broadband Construction in Your Community, CTC Technology and energy, viewed 4/14/2021 https://www.ctcnet.us/wp-content/uploads/2014/01/GigabitCommunities.pdf

may require a utility meter, costing $5k to $10k, as well as trenching costs of $20 to $40/ft [3].

With 4G small cells, acquisition of power and backhaul were often as big a problem as obtaining the permit to place the equipment. In fact, Neville Ray, T-Mobile's President of Technology, explained that adding network capacity through the installation of additional small cells is time consuming and expensive, due to the need to obtain construction permits and equipment for the devices. "The small cell progress has been meaningful but it's still a battleground with the various jurisdictions. So, if you're staring down the barrel of, 'I gotta build a couple hundred thousand of these things,' that's a nightmarish scenario"[4].

Utility Power Disturbances

More than ever, keeping the mobile network running at full capacity without interruption is essential. This requires protection from harmful elements that could shorten the life of sensitive processors and electronics. While protection from natural elements of temperature and environmental conditions must be considered, so must the quality of the power driving the equipment.

Most problems relating to electricity and electronic devices can be traced to power quality disturbances, generally defined as any change in power (voltage, current, or frequency) that interferes with the normal operation of electrical equipment.[5]

Power disturbances can be categorized by the wave shape of the alternating voltage and current:

- Transients
- Interruptions
- Sag/Undervoltage
- Swell/Overvoltage
- Waveform distortion
- Voltage fluctuations
- Frequency variations

Spikes and surges are over-voltage conditions, where the voltage is higher than what it normally is. Spikes, or more formally called transients, are very short in duration, while surges last longer and typically are what cause most problems to electronics.

The small cell radios have internal AC to DC converting power supplies that can operate within slight over-voltage conditions and occasional spikes but may be limited in their ability to handle surges. Nearby lightning strikes and line cross conditions will send high voltage surges through

3 In-house estimates
4 M Dano, 2020, T-Mobile network chief on building lots of small cells: It's 'nightmarish', LightReading, viewed 3/1/2021 https://www.lightreading.com/5g/t-mobile-network-chief-on-building-lots-of-small-cells-its-nightmarish/d/d-id/761818
5 IEEE Standard 1159-1995, "IEEE Recommended Practice for Monitoring Electrical Power Quality"

the utility power line. Without adequate suppression, this surge of energy will pass through to the radio equipment, damaging or destroying sensitive electronic components requiring costly repairs or replacement.[6]

Under-voltage utility events can wreak havoc on a small cell deployment. While most small cells are designed to withstand a slight variance in voltage, even a blip of lost power will likely cause the radio to reboot, creating service disruption to the wireless user.

OVER-VOLTAGE Any voltage greater than what should normally be present on any given power line
Event: Transient (Spike) **Impact:** Most electronic equipment designed to withstand **Duration:** Billionths to millionths of a second **Event: Surge** **Impact:** Can be quite harmful to electronic devices due to duration **Duration:** Thousandths of a second
UNDER-VOLTAGE Any voltage lower than what should normally be present on any given power line
Event: Sag (Momentary) **Impact:** Rarely affects electronic devices. Relays and contactors in motor starters can be sensitive to voltage sags, resulting in shut down of a process when they drop out. **Duration:** Magnitude of the voltage is reduced below 90% for 0.5-60 cycles **Event: Brownout (Interruptive)** **Impact:** Equipment reboots **Duration:** Up to several seconds **Event: Blackout (Interruptive)** **Impact:** Outage **Duration:** Minutes to hours

Table 1: Utility Impairments[7]

6 Knowledge Base, 2018, What are blackouts, brownouts, spikes, surges and sags?, Indiana University, viewed 3/1/2021 https://kb.iu.edu/d/aeop

7 https://www.pge.com/includes/docs/pdfs/mybusiness/customerservice/energystatus/powerquality/voltagesags.pdf

CABLE'S DISTRIBUTED BROADBAND UTILITY GRID

Distributed Infrastructure

Multiple Systems Operators (MSOs) over time have designed and built extremely robust, well-maintained and widespread infrastructures to support their DOCSIS and Fiber networks. The Cable Broadband Access Network, also referred to as the HFC network, represents the cable operators' outdoor physical fiber optic and coaxial cable network infrastructures used to deliver Cable Television, Internet and other services to nearly every street of every town, city and most populated areas (Figure 1 below). In most cases, fiber is run deep into the network (represented by yellow lines), with coax providing the distributed connections to homes and businesses (blue lines).

In the coaxial portion of the HFC network, power is needed to run "active" equipment such as nodes, amplifiers and Wi-Fi access points. This power is provided by cable uninterruptible power supplies (UPSs) that convert utility power and energize the coax. This series of network-enabled

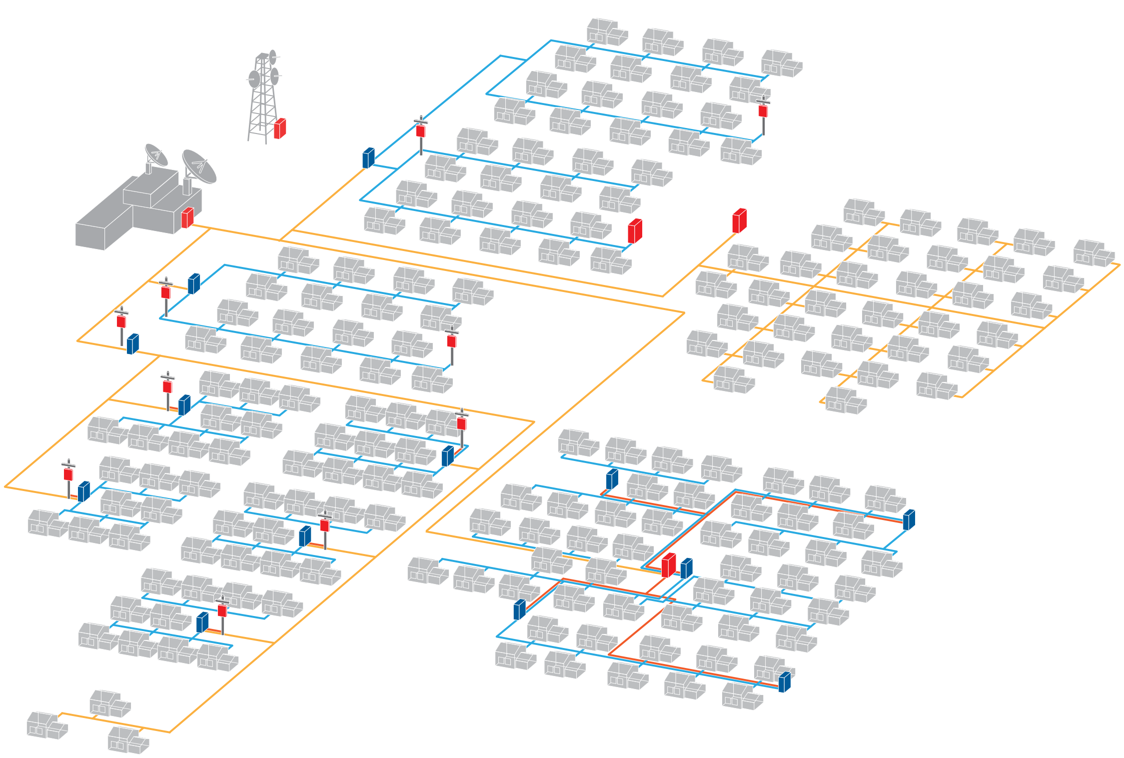


Figure 1: HFC Network

power cables throughout a city or region effectively becomes a "Broadband Power Grid." High-speed Internet and reliable power, often backed up by batteries, enable transport through the same physical cable, as shown in Figure 2.

Most cable UPS's supply 15 Amps or 18 Amps of power for HFC, providing a budget of 1600Watts for the devices on the coax spans. Operators tend to only use 50-60% of their power capacity for nodes and amplifiers, so this extra capacity can be used to power small cells with little or no extra investment to the network. This is a key advantage that will enable mass deployment of small cells on the HFC network.

Most new residential and commercial developments require power and communications cables to be buried underground. Established neighborhoods tend to use poles to run the cables above ground, in what is termed 'aerial plant'. According to the NCTA, 1.7 million miles of fiber-optic and coaxial cable have been deployed in the United States.[8] Roughly half of those deployments are above ground.[9]

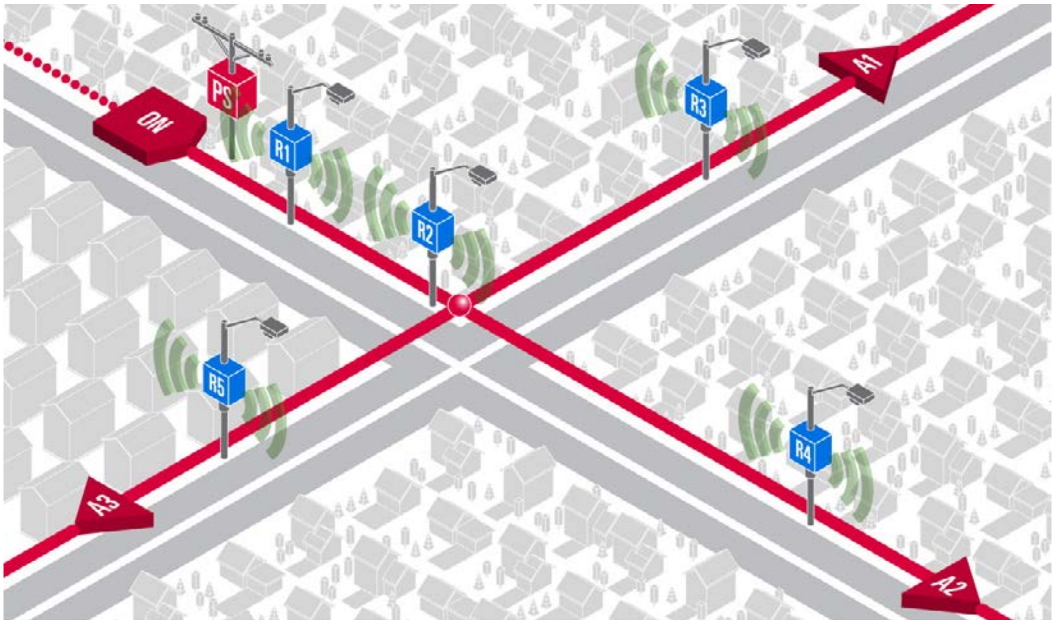


Figure 2: HFC Network Elements

8 iGR, 2020, A Strand of Hope: How strand-mounted small cells can address the demand for 4G and 5G mobile data, iGR Media Center, viewed 3/15/2021, https://igr-inc.com/media-center/white-papers/strand-mounted-small-cells/strand-mounted-small-cells.asp

9 In-house calculations based on aerial vs ground cabinet sales and customer insight.

Power Governance

The National Electric Safety Code® (NESC®) sets the guidelines for aerial cables spanning between poles in the United States. Like their counterpart CSA in Canada, NESC dictates that cable broadband coax cables belong in the "Communications Space" along with fiber optic cables and telephone wires. NESC also specifies that if a cable in the Communications Space is carrying power with alternating current (AC Power), that the voltage level measured across that cable must be below 90 volts (VAC), as opposed to the 120V or higher in the power company cables in the Supply Space. (See Figure 3). Most HFC networks outside of Europe run at 89VAC to maximize the distance that the voltage can travel while staying within the NESC limits. European operators are limited to 63VAC for their cable networks. .

One benefit to this guideline is that it allows cable technicians to work on powered equipment without requiring a licensed electrician. At the same time, this voltage requirement limits the equipment that can be deployed in this space, creating a challenge for small cells. Fortunately, gaining interest in using HFC for small cell deployments is driving small cell manufacturers to widen the voltage range of the radio down to levels as low as 40VAC. This is not a trivial change as there are other factors unique to HFC that must be considered in the design of the radio power conversion system. Some of these unique power elements are described in the next section, but design-specific considerations are outside the scope of this paper.

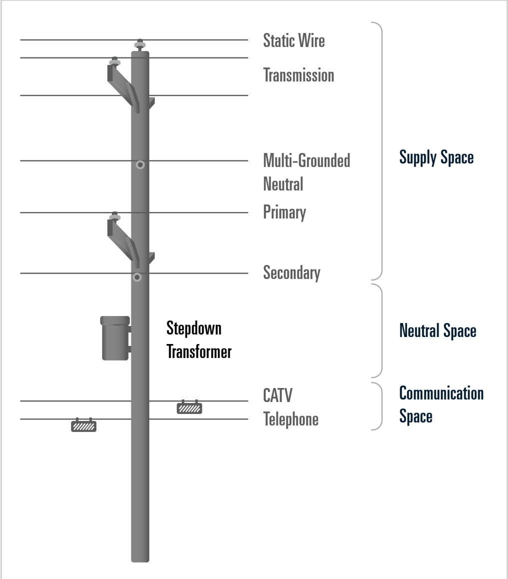


Figure 3: Aerial Communications Space[10]

10 W Miller, 2018, Utility FTTx Networks for the Future, ISE, viewed 3/1/2021, https://www.isemag.com/2018/12/fttx-networks-rural-aerial-cable-solutions/

DELIVERING QUALITY RELIABLE POWER

The illustration below shows the different stages of HFC power transformation and distribution from left to right.

Power Conversion and Line Conditioning

The local power company delivers standard 120/240VAC sinusoidal voltage *utility power* to an *HFC uninterruptible power supply (UPS)* located in a cabinet mounted on a utility pole or in a ground-mounted pedestal. The job of the UPS is to convert the utility voltage to the appropriate HFC voltage level and condition the power to prevent any utility power disturbances from reaching the network. In many cases, the batteries will be located in the UPS cabinet to provide extended runtime during utility power disturbances.

At the core of the HFC UPS is a *ferroresonant transformer*. The ferroresonant transformer has been in use for almost 100 years in wired communications networks and has proven to be a reliable and effective

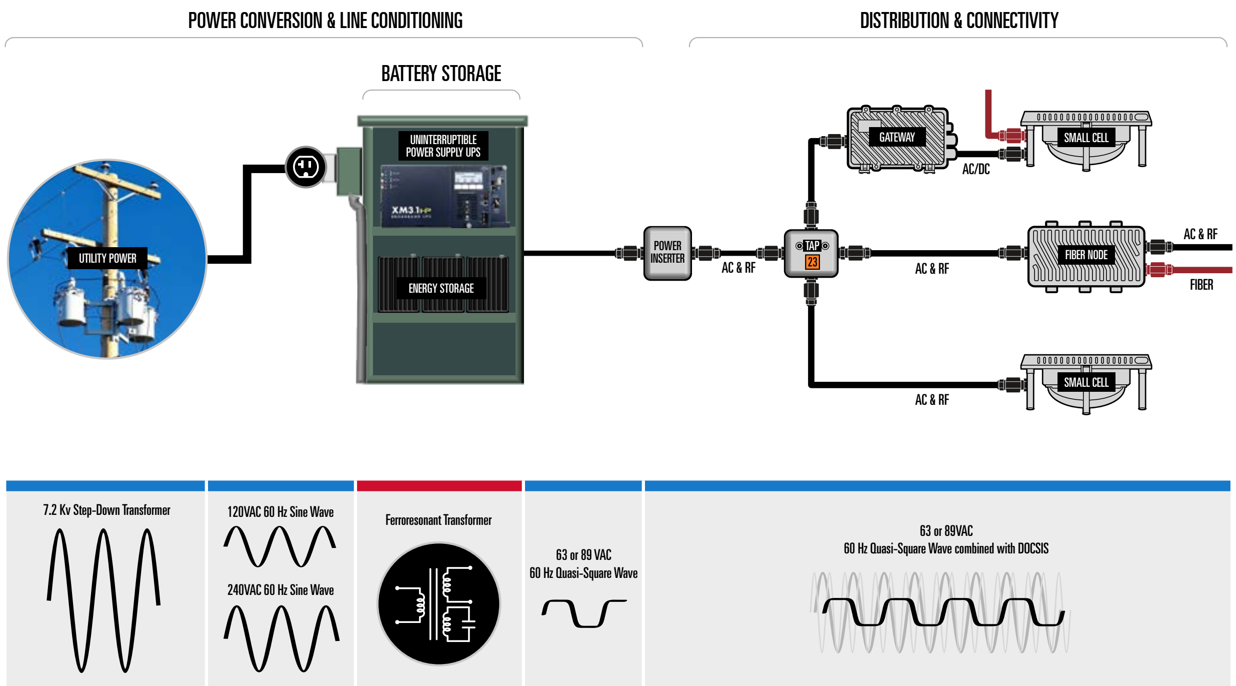


Figure 4: HFC Powering Elements

means of providing surge and voltage variation protection. The design of the ferro transformer uses a capacitor and resonant winding to produce a constant output waveform even when input (utility) voltage and plant load conditions change.

For example, a nearby lightning strike can send voltage surges through the utility line even if the utility line is not directly hit. The surge of voltage travels through utility wires and reaches the HFC UPS and the ferroresonant transformer. The energy from the surge saturates the ferroresonant primary windings (I.e., reaches the limit of energy it can hold). The figure below illustrates the ferroresonant transformer conversion.

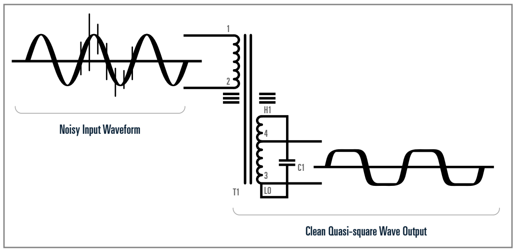


Figure 5: Ferroresonant Effect on Input voltage disturbances

The transformer itself has no moving parts or electronics, lending to long life and very few problems. The inherent nature of the ferro transformer also provides excellent output protection. If there is a short circuit event on the HFC plant, the secondary winding of the ferro will saturate and drop the output current. Once the short circuit is removed, the transformer will no longer be saturated and current flow to the network will resume.

Figure 6 below shows the relationship between the input voltage (Utility) and the output voltage (HFC). You can see in red when the Input voltage exceeds the saturation point, there is very little change in output voltage.

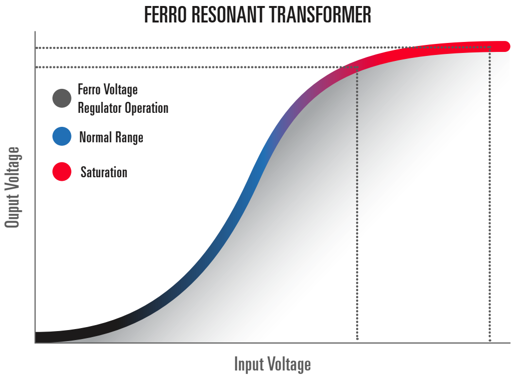


Figure 6: Ferro Resonant Transformer

Energy Storage

The addition of *batteries* to the HFC power supply system increases the power reliability by allowing the network to continue running when utility power is lost or impaired. Most cable operators have enough reserve energy to keep the network running for several hours in a utility outage situation.

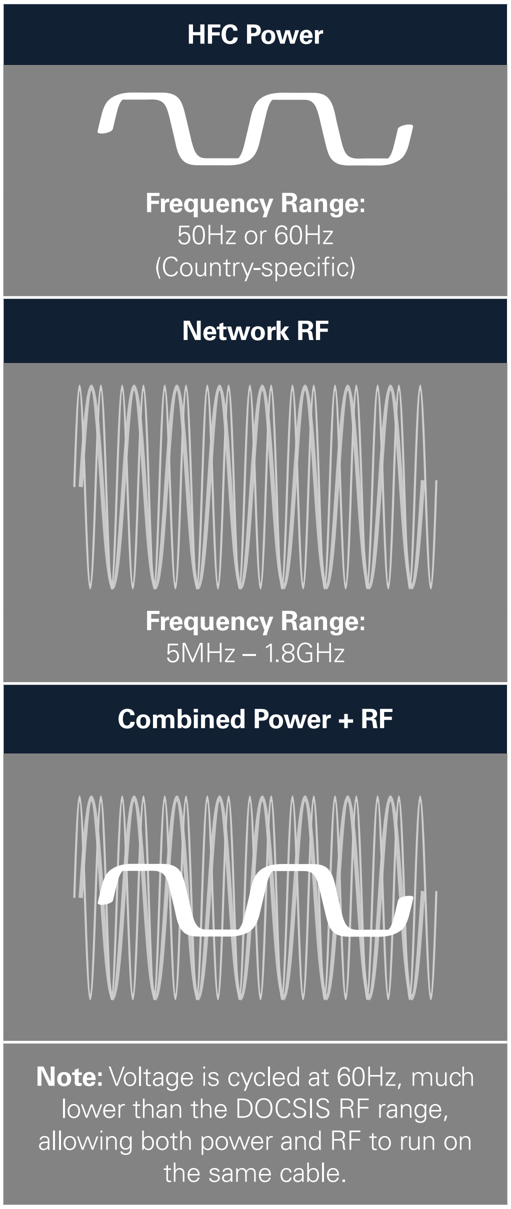
THE ADDITION OF BATTERIES TO THE HFC POWER SUPPLY SYSTEM INCREASES THE POWER RELIABILITY BY ALLOWING THE NETWORK TO CONTINUE RUNNING WHEN UTILITY POWER IS LOST OR IMPAIRED

Today's HFC power supplies can switch to battery mode before the equipment in the network realizes that there is a problem. This prevents nodes, amplifiers and radios from dropping power and resetting during this power transfer. Because a small cell radio can take several minutes to recover from a power loss event, this undetectable switch to battery mode is an essential element of ensuring network reliability.

Power Distribution

Digital television programming and Internet traffic travel through fiber and coaxial cables as modulated Radio Frequency (RF) waves. The job of the power inserter is to combine the power from the HFC power supply with the RF data coming from the headend while at the same time energizing the aerial or underground distribution coax cables.

The HFC network coax cables carrying power and data are much thicker than the "drop" coax cables going into or through a building. These larger diameter *hardline coax* cables have thick center conductors and heavy shielding to optimize power and data transport.



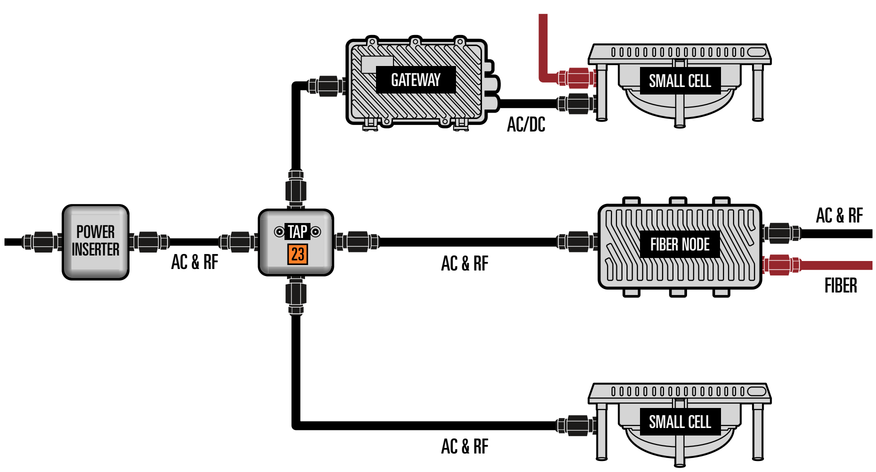
Tapping into the Grid

The HFC network can be divided, split and "branched" by using power passing devices like splitters, taps and power inserters. These elements are all designed to be cut into the coax, meaning that coax is the input as well as the output. Alternatively, an element that does not pass coax is called an *end point*. Wi-fi and small cell radios fall into this category.

Extracting power and DOCSIS from the coax is accomplished through the reverse process as the power insertion. The radio or network device takes HFC coax as an input, then uses spectrum filtering to separate the power and DOCSIS RF signal. At this point, the device can convert the voltage from AC to DC, to power the device. If desired, RF can be used for DOCSIS backhaul with the integration of a cable modem.

The AC voltage level on the coax cable drops the further away from the HFC power source. Because of this phenomenon the voltage at the input of the small cell will be lower than at the output of the cable power supply. This requires devices powered by HFC to operate at voltage levels from 90VAC down in the 35-45VAC range. Traditional AC-powered electronics are designed for utility voltages with much higher voltage ranges around 90-110VAC, while other small cells are designed to run on DC power. Either way, the small cell radio will need to adapt to the HFC voltage range.

An operator may choose to use a *gateway* device to perform the power and DOCSIS conversion for the small cell radio. This eliminates the need to design small cell radios specifically for the HFC network and can significantly improve the time it takes to test and approve the radio for HFC deployment.



Side note: Adding inline devices and splitting the coax affect the signal strength of the DOCSIS RF channels and other signals in the HFC network, so careful planning is required when adding to or reducing elements in the network.

Figure 7: Small Cells are endpoints, whereas Nodes will continue to send power along the network

DOCSIS FOR BACKHAUL

Mobile operators for years have insisted on fiber for radio backhaul due to the superior bandwidth, low latency and synchronization characteristics. These are essential factors for real-time use cases like gaming, video streaming and remote healthcare, where the experience requires seamless communications. While fiber may be preferred, it is not always cost-effective when construction is needed to bring the fiber to the location where the small cell is installed.

MSOs are pushing fiber optics deeper into neighborhoods and moving much of their core network processing from regional headends out to the edge of their network. This "edge computing" greatly improves processing time, enabling higher capacity with lower latency.

In a cable network, Internet & TV programming are modulated into DOCSIS Radio Frequency communication at the headend using a CMTS (Cable Modem Termination System). From there, the RF is distributed through the network via fiber optic and coax cables. The DOCSIS cable modem or gateway demodulates the RF and is required to provide Internet connectivity to a small cell or other network device. In a home network the gateway sits inside and plugs into the wall for power. In the outside network, gateways are specifically designed to use the power from the coaxial cables and are built to operate in extreme temperatures and weather conditions. These outdoor gateways also perform the function of converting the HFC power to a voltage that is within the small cell operating range.

Cable broadband technologies also continue to evolve, closing the gap on fiber's superiority for small cell backhaul and fronthaul. Cable broadband delivers

CABLE BROADBAND DELIVERS HIGH-SPEED NETWORK CONNECTIVITY USING DOCSIS, A SET OF SPECIFICATIONS THAT ALLOWS TRAFFIC TO EFFICIENTLY TRAVEL OVER COAX CABLES

TODAY'S DOCSIS CAN DELIVER SPEEDS OVER 1GBPS WITH A ROADMAP TO SYMMETRICAL 10GBPS AND HIGHER WITHIN THE NEXT FEW YEARS.

high-speed network connectivity using DOCSIS, a set of specifications that allows traffic to efficiently travel over coax cables.

Today's DOCSIS can deliver speeds over 1Gbps with a roadmap to symmetrical 10Gbps and higher within the next few years. With the added advantage of accessibility and reliable power of broadband coax, DOCSIS is well positioned for small cell connectivity. A recent CableLabs® analysis showed >50% reduction in TCO for an outdoor use case of backhauling small cells when served by DOCSIS networks compared to a more traditional deployment served by fiber.[11]

DOCSIS 3.1

DOCSIS 3.1 is currently deployed globally in millions of homes and businesses. Today's DOCSIS 3.1 modems are delivering 1Gbps – 2.5Gbps, enough to simultaneously serve multiple small cell radios.[12] DOCSIS 3.1 introduces support for full duplex communication, and also provides an option to increase upstream spectrum from the traditional 5-45MHz range to a 5-205MHz range. This adds significant upstream capacity improvements and sets the groundwork for future improvements coming with DOCSIS 4.0.

5G virtual radio access network (vRAN) architecture centralizes Layer 3 RAN functions to the cloud with latency targets around 5 milliseconds.[13] Prior versions of DOCSIS could not reach these targets, but that is changing. Through DOCSIS enhancements known as Low Latency X-Haul over DOCSIS, 5G backhaul latency over DOCSIS can be reduced to approximately 1ms.[14] With Low Latency X-Haul, a communication is setup between the 5G scheduler and the DOCSIS scheduler. This communication, called a bandwidth report (BWR), allows the 5G schedule to reserve communication slots within the DOCSIS upstream,

11 DOCSIS® Network vs. Fiber Backhaul for Outdoor Small Cells: How Larger Footprint of DOCSIS Networks Lowers TCO in the Outdoor Use Case, https://www.cablelabs.com/docsis-vs-fiber-backhaul-outdoor-small-cells
12 5G Small Cells and Cable; Realizing the Opportunity, https://www.nctatechnicalpapers.com/Paper/2018/2018-5g-small-cells-and-cable-realizing-the-opportunity/download
13 5G Low Latency Requirements, McLaughlin, 2019, https://broadbandlibrary.com/5g-low-latency-requirements/
14 CableLabs Low Latency DOCSIS® Technology Launches 10G Broadband into a New Era of Rapid Communication; https://www.cablelabs.com/cablelabs-low-latency-docsis-technology-launches-10g-broadband-into-a-new-era-of-rapid-communication

minimizing DOCSIS RTT latency for backhaul applications. LDD was introduced after the initial DOCSIS 3.1 launch, but fortunately, existing DOCSIS 3.1 modems can be automatically upgraded by the cable operator to install LDD.

10G Initiative and DOCSIS 4

The next major milestone for the broadband community is their 10G Initiative, targeting synchronous 10Gbps throughput. This is not to be confused with 5G, which is the 5th generation of mobile network technology. 10G will utilize a combination of HFC plant upgrades as well as DOCSIS 4 specifications, with early trials expected in late 2022 to 2023.

DOCSIS 4 is being developed with two architectural models designed to allow deployments in future1.2GHz and 1.8GHz expansions. The two models are Extended Frequency Division Duplex (FDD) and Full Duplex DOCSIS (FDX). FDD requires significant upgrades to the physical network, whereas FDX will work in the existing 1.2GHz range.

THE NEXT MAJOR MILESTONE FOR THE BROADBAND COMMUNITY IS THEIR 10G INITIATIVE, TARGETING SYNCHRONOUS 10GBPS THROUGHPUT

DOCSIS 4.0 introduces full duplex for both FDX and FDD, meaning that modems can transmit and receive data on the same frequency at the same time. Extended Frequency Division Duplex Spectrum DOCSIS 4.0 will take advantage of the extended 1.8GHz of spectrum as well as full duplex to maximize throughput. DOCSIS technology leaders expect throughput target speeds of 10Gbps downlink and 5Gbps uplink.

AERIAL STRAND FOR SITING

HFC is prevalent in older established neighborhoods with cables typically above ground spanning between poles. iGR estimates that over 150 million users in the United States alone can be covered by small cells that utilize the cable broadband aerial strand.[15] The fiber and coax cables running between poles are lashed to a galvanized steel messenger cable referred to as the "Strand" which provides a mounting platform for network equipment. This messenger cable also provides the network's grounding.

Research by wireless consulting firm iGR across the country has found that most outdoor small cell deployments are being delayed up to 12 months due to unsettled jurisdiction issues.[16]

New Street Research analyst Spencer Kurn agrees that one of the biggest problems with densifying a network with small cells is going through the process of zoning, securing, siting, permitting and regulation. However, as Kurn explains, "Cable companies already have the public right of way with poles and strands of aerial cables. Altice is unique in that they did this for Sprint in return for a really attractive wireless MVNO."[17]

Local broadband cable operators enter into franchise license agreements with local cities and municipalities they serve, allowing them to hang equipment to the messenger cable without having to apply for permits for each piece of equipment. The MSO will pay attachment fees to the pole owners, (where the strand attaches), but not for the equipment mounted to the strand.

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15 iGR, 2020, A Strand of Hope: How strand-mounted small cells can address the demand for 4G and 5G mobile data, iGR Media Center, Viewed 3/15/2021 https://igr-inc.com/media-center/white-papers/strand-mounted-small-cells/strand-mounted-small-cells.asp

16 iGR, 2020, A Strand of Hope: How strand-mounted small cells can address the demand for 4G and 5G mobile data, iGR Media Center, Viewed 3/15/2021 https://igr-inc.com/media-center/white-papers/strand-mounted-small-cells/strand-mounted-small-cells.asp

17 L Hardesty, 2019, Altice's 19,000 small cells in Long Island don't help Sprint's network much, say analysts, Fierce Wireless, viewed 3/1/2021, https://www.fiercewireless.com/wireless/altice-s-19-000-small-cells-long-island-don-t-help-sprint-s-network-much-say-analysts

INFRASTRUCTURE OWNERSHIP & MANAGEMENT

Another very important but often overlooked area of consideration for small cell deployment is the maintenance and ownership of the infrastructure. For cable broadband operators, the HFC network is the backbone of their business and so they spend a tremendous amount of time, effort and money to expand this network and keep it operational.

Recent government incentive programs in the United States for rural connectivity are funding further investments in the broadband infrastructure. In Q4 2020 the Rural Digital Opportunity Fund (RDOF) awarded over $1.3 billion to Cable operators.[18]

Additional broadband infrastructure funding of up to $3.2 Billion will come from the December 2020 COVID-19 relief bill for an Emergency Broadband Connectivity Fund (EBB).[19]

In addition to Government programs, MSOs are spending over $1 billion annually on cable infrastructure and customer premise equipment.[20] According to Charter CEO Tom Rutledge, "We think it's good for us financially to extend our broadband network ... to as many people as possible".[21]

18 J Baumgartner, 2020, Charter tops US cable's RDOF take, LightReading, Viewed 3/1/2021, https://www.lightreading.com/opticalip/fttx/charter-tops-us-cables-rdof-take/d/d-id/765946
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21 J Baumgartner, 2020, Charter tops US cable's RDOF take, LightReading, Viewed 3/1/2021, https://www.lightreading.com/opticalip/fttx/charter-tops-us-cables-rdof-take/d/d-id/765946

SMALL CELL DEPLOYMENT EXAMPLES

Example: Sprint/Altice[22]

Sprint deployed over 19,000 small cells in a year by using Altice's vast cable broadband infrastructure across much of Long Island and the greater New York area. The project, which started at the end of 2017, achieved 96% completion by Q3 2018. The deployment was a collaboration; Altice provided the infrastructure and performed the physical installations, while Sprint managed the backend provisioning. According to Mark Walker, Sprint's VP of network for the Northeast region, the joint deployment effort was a success, saying the project "was absolutely worth doing" and "of all the projects I've been a part of this was the most smooth running, highest volume we've had."

"THE PRODUCT DELIVERED DOWNLOAD SPEEDS UP TO **16 TIMES FASTER** THAN JUST RELYING ON OUR MACRO SITES"

In addition to providing power and strand space for mounting, the 2.5GHz strand-mount small cells came equipped with DOCSIS cable modems which leveraged the Altice DOCSIS network for backhaul to the Sprint core. This ultimately saved valuable cost and enhanced speed of deployment vs. running fiber to each radio.

Sprint reported Ookla independent performance results from before and after the small cell deployments, which found significant improvements in download speeds. 2017 test results showed 11.6 Mbps download speeds, whereas in 2019, (after the completion of the small cell deployments), the download speeds showed a 200% improvement to 35 Mbps. Additional testing by Sprint's internal drive tests showed even better results. According to a Sprint spokesperson, "During our own internal drive tests in the April 2018 timeframe where we'd deployed 2.5 GHz strand-mount small cells, the product delivered download speeds up to 16 times faster than just relying on our macro sites."

22 L Hardesty, 2019, Sprint counters that the Altice small cells in Long Island do improve speeds, FierceWireless, viewed 3/1/2021, https://www.fiercewireless.com/operators/sprint-counters-altice-small-cells-long-island-do-improve-speeds

CONCLUSION

Successfully scaled small cell deployments require access to available, cost effective, quality infrastructure, including siting, power and backhaul connectivity. From a total cost of ownership perspective, the cable broadband HFC infrastructure provides the best of all worlds. HFC cable is widely deployed and well maintained. It has the unique characteristic of carrying both reliable backed-up power and high-speed low latency communications for small cells, and solves the real estate problem for siting. Using the HFC infrastructure helps meet cost, time and scope requirements of your small cell deployment.

About the Author

Greg Laughlin is a Strategic Marketing Manager for Broadband markets at EnerSys® Energy Systems (formerly Alpha Technologies®). In his 15+ years at EnerSys®, he was the Senior Product Manager for the Gateway product line and DOCSIS products, with a US patent awarded around broadband communications products. He currently sits on several SCTE committees and is co-chair of the Smart Cities working group. Prior to Alpha®, he worked for MCI, WorldCom and Electronic Data Systems as a systems engineer, managing remote data center management systems.

About EnerSys® Energy Systems

EnerSys® Energy Systems powers the connected world. Communication networks depend on reliable, available power and bandwidth to deliver the advanced services and connectivity that today's business, industry and hybrid work from-home customers demand. By combining the resources and reach of EnerSys®, the world's largest supplier of industrial batteries, with Alpha Technologies® history of innovative power conversion technology, EnerSys® Energy Systems was formed to deliver unparalleled service, solutions, and value to our global customers in the communications industry.
From internet access, 5G and Wi-Fi to smart cities, IoT and Industry 4.0, EnerSys® Energy Systems helps you keep your customers online today, while defining what's possible tomorrow.

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