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Technical keys to successful network modernization: FTTA

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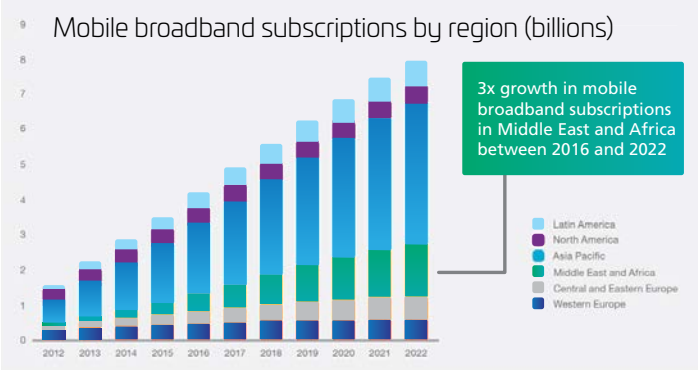
Introduction

In order to meet exploding data demands and increasingly challenging customer expectations, every network operator must continually work to update and modernize its network. There's no doubt that the long-term success of any network today hinges on the ability of operators to intelligently plan, maximize and manage networks. Not only do networks need to have the ability to meet current demands, they must also be able to ensure continuous high-level performance in a scalable environment so they can retain subscribers and keep up in a highly competitive industry.

In 2016, there were approximately eight billion mobile devices and connections globally. That number—which includes M2M modules—will grow to 11.6 billion by 2021.[1] Subscribers using multiple types of mobile devices are continuing to demand gobs of data, but not at the expense of reliability. Research consistently points to network performance as a significant driver of customer loyalty to mobile operators. This often ranks considerably higher than cost or even customer support concerns. The demand for reliable services concurrent with increased capacity will only continue to challenge network operators to modernize their networks with technologies that can evolve along with the industry.



Source: Ericsson Mobility Report, November 2016

There are many complex technical challenges when modernizing a network. To effectively address these challenges, network operators need to know the best strategy for optimizing their current infrastructure and adapting to these new technologies. For example, how do you make changes to existing tower components to meet new critical needs of remote radio unit (RRU) technology without overloading the tower? As importantly, how do you ensure adequate fiber capacity that will make your network future-ready while still reining in CapEx and OpEx costs?

Four technical keys

It's a lot to think about. But one practical way to approach network modernization is to take a holistic approach and try and look at the "big picture." Look at upgrading your network from the point of view of a puzzle with several key pieces. These are rather large pieces of the puzzle that are technical in nature, yet crucial to the overall success of the effort. These mission-critical technical keys include:

- Fiber technology in FTTA solutions
- Ultra-wideband antennas
- Weight and wind load tradeoffs
- Passive intermodulation (PIM)

Each of these topics is a complex discussion that warrants its own white paper. Therefore, CommScope has created a Technical keys to successful modernization series of white papers that explore each area. This document will explore fiber technology in FTTA solutions in greater detail.

Fiber technology in FTTA solutions

With the surge in data demands straining networks, it's up to mobile operators to upgrade their infrastructure and provide the bandwidth their customers need. Remote radio unit (RRU) technology will play a factor in the choices you make to modernize your network. Separating the RRU from the baseband unit (BBU) and relocating it to the top of the tower has created significant flexibility in deployment. Mounting the RRU close to the actual base station antenna reduces some losses in the system and can potentially improve signal strength.

To support RRUs at the top of the tower, wireless operators must migrate to fiber-optic technology. Moving away from traditional coaxial systems to fiber networks can help operators gain much more capacity out of their cell towers. That makes FTTA architectures the primary strategy for today's providers.

FTTA success begins with the basics: your fiber-optic cable system. It is the core component of your infrastructure. There are several technical questions you'll need to consider when making your fiber technology decisions.

- What fiber connectivity is right for my FTTA architecture?
- What type of configurations should be considered?
- How do I choose the right cable length?
- How do I efficiently utilize tower space?
- How do I protect my fiber connections?

There are a number of ways to approach the FTTA configuration. The optimal solution depends on the characteristics and needs of the individual site. Beyond material and installation costs, which are always considerations, key variables include current and projected tower loads, future plans to add RRUs to the tower, and the required deployment time. As with any decision related to the radio access network (RAN), selecting the best FTTA configuration involves trade-offs among these variables.

There are several FTTA configurations that incorporate hybrid cabling, in which one or more power conductors and multiple fiber cables are bundled within the same outer jacket. The hybrid cable enables delivery of power and fiber to the RRUs with a single run.

Hybrid pendant: Our newest FiberFeed® hybrid solution, pendant is equipped with integrated hybrid connector ports on its breakout terminal, delivering advanced plug-and-play connectivity to RRUs, minimizing installation errors and deployment times. And with its small profile and factory-attached hybrid trunk that is roughly 50 percent slimmer than other cable configurations, it saves space and minimizes visual concerns on site approvals.

Additionally, the Pendant's hybrid trunk is armored with a corrugated shield that protects the fiber and power cables housed within the trunk, as well as enables it to withstand weather extremes.

Hybrid direct: Similar to the pendant hybrid solution, FiberFeed direct also provides plug-and-play connectivity. The direct hybrid model incorporates a single hybrid cable that runs from the baseband unit (BBU) to a breakout assembly located just below the RRUs. Equipped with cable legs that easily connect directly to hybrid jumpers, the setup accommodates up to nine RRUs. It is highly scalable and future-ready, ideal for accelerated rollouts.

Hybrid standard: In this model, the hybrid cable terminates at a standard FTTA/PTTA junction box instead of a breakout assembly. While installation time is increased slightly compared to the direct hybrid model, this solution provides enhanced scalability. It also enables easy system upgrade, requiring only a replacement of the jumper cables.

Individual hybrid: The individual hybrid sector model uses a single run of hybrid cable from the baseband units to each sectorized RRU. It is an economical solution that enables installers to cut the installation time nearly in half and also reduces labor and accessory costs by half, compared to a separate power and fiber approach.[2]

Discrete: This economical model, most familiar to wireless operators and installers, involves two individual cables—power and fiber—running from the baseband units directly to the RRUs. The discrete approach provides good design flexibility. For example, separate fiber and power can be run either individually to each RRU or by fiber trunk and power trunk to connect multiple RRUs. Like the individual hybrid sector solution, the discrete model provides a low material cost.

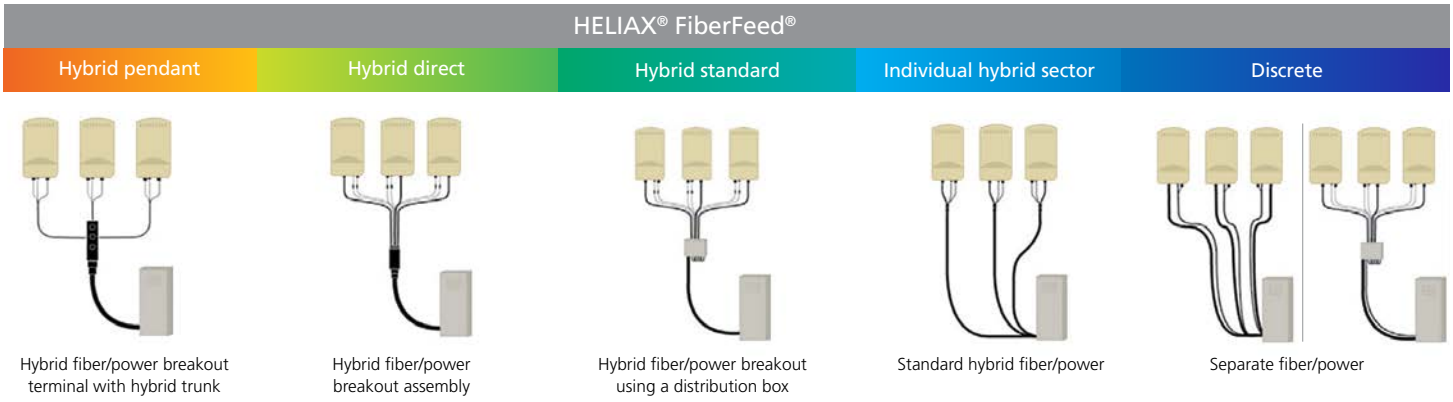


Figure 1 shows the basic configuration for each of the four FTTA solutions, using CommScope's HELIAX® FiberFeed® cabling.

Results of time-motion study

In December 2015, productivity researchers from Scott-Grant Ltd conducted a time study[2] comparing the time required to cable a typical three-sector cell site using two hybrid models, and a traditional discrete cabling model. The tower at the test site had three sectors and was 27 meters (88 feet) tall with one passive antenna and two RRUs per sector.

Table 1 reflects the aggregate time required to prep, install and connect the site using each of the three methods. Based on these results, the hybrid direct method is approximately 55 percent faster, from start to finish, than the traditional discrete model—and about 12 percent faster than the individual hybrid sector configuration.

Solution	Installation Time
Discrete	447.69 minutes
Individual hybrid sector	231.88 minutes
Hybrid direct	205.28 minutes

Table 1—Aggregate results

Cable fundamentals and installation best practices

Like any type of upgrade, success hinges on the quality of the installation. Testing, repair, and technicians skilled in fiber cable installation are essential. The correct fiber handling techniques should be followed to ensure reliable performance.

Choosing the correct cable length

Choosing the correct cable length is an important part of the equation. Cable lengths that are too short can delay installation, so it's better to err on the long side—excess cable can simply be stored on site or prepared for exact fit. Excess cable is commonly coiled and stored on the bottom of the tower or under radio cabinets. When an exact fit is desired, the hybrid cable has integrated ripcords that are used to separate fiber and power conductors at the bottom of the run, near the RRU. Power conductors can be cut to exact length for attachment to the power supply, and the excess length of fiber coiled up and stored by the BBU.

Factory-terminated cabling advantages

Network providers should strongly consider factory-terminated cabling for quality control reasons. Pretermination offers a stronger measure of connection quality, since testing and quality-driven processes are conducted in a tightly controlled environment.

Additional considerations for best performance

Quality-controlled environments for factory termination

When it comes to fiber connections, factory termination means a clean, dust-free and sterile environment under controlled conditions. That's important—even dust that is smaller than the eye can see will impact performance. A controlled environment also means there is less chance of damage to the fiber or connector during the termination process. Only precision factory polishing and 100 percent testing ensure you get exactly the performance you expect.

Bend radius considerations

Installers should also be aware of the bend radius specifications of the fiber-optic cabling. When installing, technicians should take note that standard fiber cabling can maintain a minimum bend radius of seven to 15 times the fiber cable diameter. Ignoring bend radius limitations puts undue stress on the cable fiber-optic core and could cause signal loss due to light being lost into the cladding. If there is any excess, it should be stored in a way that adheres to the minimum bend radius of the fiber cable.

Maximizing tower space

Space is a critical variable, too—and one of the advantages of hybrid fiber-optic cabling. For example, a single hybrid cable takes up a fraction of the physical space of a traditional FTTA deployment using separate fiber and copper lines. Today's evolving cell tower architecture means there's an increasing number of components at both ends. So this efficient design means being able to navigate tight spaces more easily, giving you more options when planning and routing—both in the shelter (or cabinet) and on the tower. The hybrid direct breakout system makes better use of every cubic inch of available space.

Protecting fiber connections from dust

Keeping dust off the fiber connectors is another important aspect of installation. Installers should keep protective dust caps on until the connection is made to the fiber-optic transceiver at the RRU. For a pristine contact area, installers should thoroughly clean and inspect the ferrule end face of the fiber-optic connector before inserting it into the RRU. It's a simple and quick precaution that can help ensure long-term performance.

Conclusion

The demand for reliable services concurrent with increased capacity will only continue to challenge network operators to modernize their networks with technologies that can evolve along with the industry.

The migration of fiber-optic technology to support RRUs at the top of the cell tower helps network operators gain much more simplicity, consistency and better performance out of existing and future networks. Top-of-the-tower considerations are necessary to meet growing demands for LTE 4G services. However, FTTA technology also presents many unique technical challenges, as outlined in this white paper.

CommScope can help you meet those challenges with a wealth of knowledge and global implementation experience, as well as industry-leading and proven solutions. We want to partner with you to make FTTA architectures part of your leading strategy.

Sources

[1] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016–2021 White Paper; February 9, 2017

[2] Scott-Grant Ltd. Time study, commissioned by CommScope; December 2015

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