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Cable's Role in the 5G Evolution

A Technical Paper prepared for SCTE•ISBE by

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Introduction

For years, mobile network operators (MNOs) have tried to deploy small cells to boost coverage and increase capacity. Deployments have been limited because of the costs involved in putting sub-5-watt radios everywhere, and they end up going back to the macro site and increasing capacity there. The cost issues involve power, backhaul, and real estate. However, with 5G there will be a need to move to a more densified network and MSOs have all the components available to them to assist the MNOs in deploying these networks. This paper will discuss the challenges and trends from the mobile networks and how MSOs can take advantage of their existing assets to enable the next wireless generation.

The Need for Wireless Densification

Mobile traffic continues to grow at an accelerated rate, and each generation of wireless technology has fueled this growth. Every 10 years there is a new generation in wireless networks. As we are entering the 5G era, it offers traditional MSOs an opportunity to participate in this next generation. Each "G" has offered new applications to consumers and businesses. 2G was focused on digital voice, 3G on mobile browsing, and 4G on mobile video. 5G is promising three main benefits: enhanced mobile broadband, Internet of Things (IOT), and ultra-low latency. The other promise each generation has had is an investment in the physical network. 4G drove fiber to the cell sites to support the mobile backhaul requirements, and while MSOs were able to participate in providing this backhaul, the 5G network offers even more opportunities in supporting the wireless rollout.

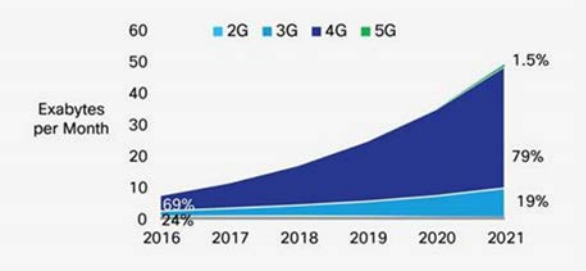


Figure 1 - Cisco Visual Networking - Mobile Data (Cisco, 2018)

Just like every generation of wireless technology 5G will place new requirements on the network. The macro cell network does not look sufficient to supply capacity, latency or connections for the 5G network. The only method of solving this is to densify the cell sites. Architecturally this means more cells at the building and street level throughout cities and residential neighborhoods.

Much of the new wireless spectrum used for 5G will be at a higher frequency to allow for greater capacity, however it will also neccesitate smaller cells due to the shorter distance the wavelengths will travel effectively. There will also be change at the macro sites. Centralized and cloud RAN (radio access network) will drive more equipment at some sites and more fibers between sites. Regardless, the next generation of wireless network will run on fiber and will present an opportunity for those that have fiber and the ability to use it.

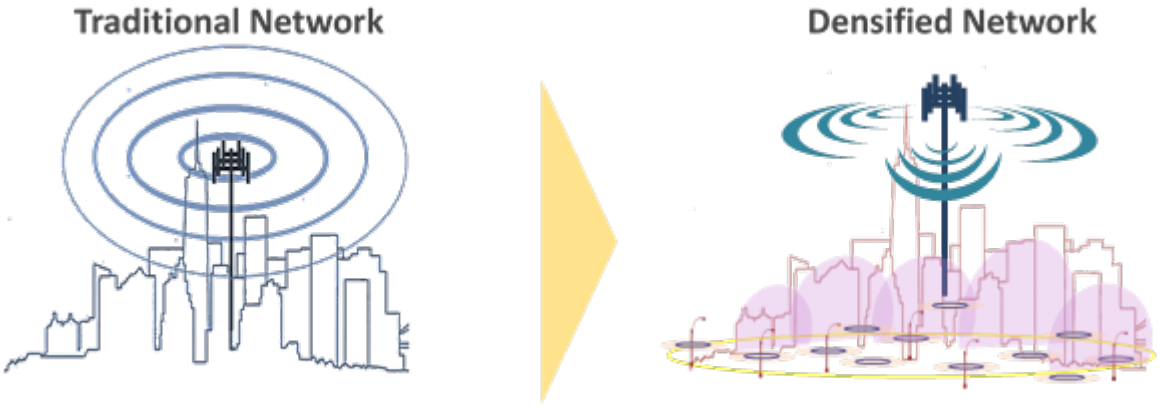


Figure 2 - Wireless Network Migration

The Need for a More Efficient Solution

Wireless network operators are facing a key problem as it relates to operating the wireless network. The amount of data provided has continued to grow at an exponential rate while the average amount paid for wireless access has only increased slightly.

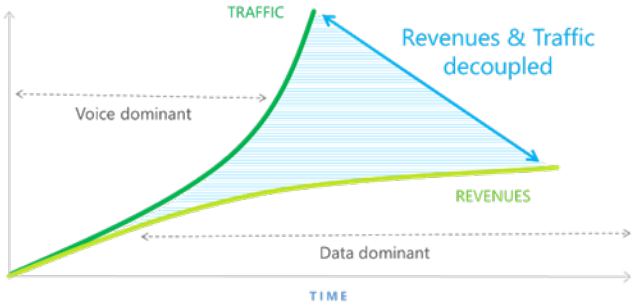


Figure 3 - Revenue vs Traffic in Wireless Network

This drives a need to increase efficacy in deploying wireless services. There are three main challenges in deploying a cell site:

- Power,
- Backhaul, and
- Site Acquisition

Each of these have prevented the widespread use of small cells in the past and must be more economically solved for 5G to succeed in the future. This paper will take a closer look at each of these areas and how MSO networks can solve these challenges.

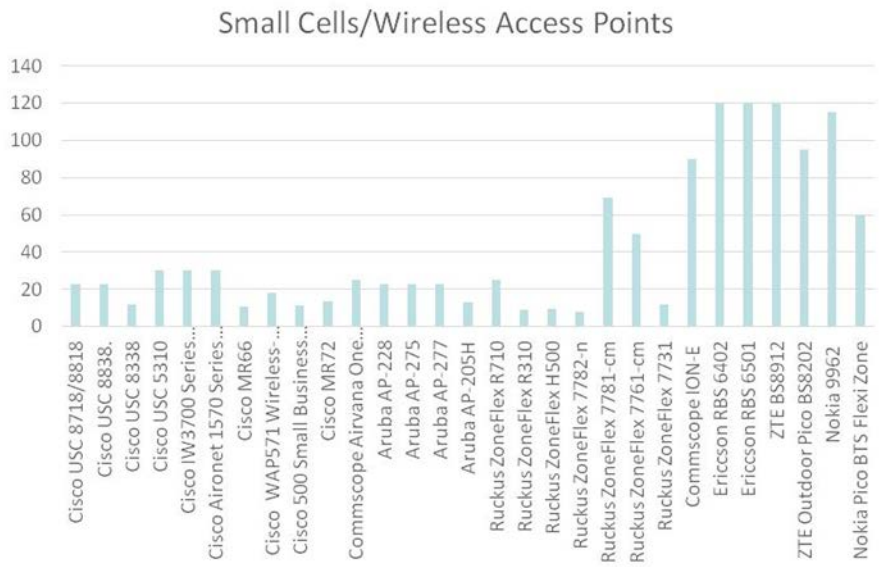
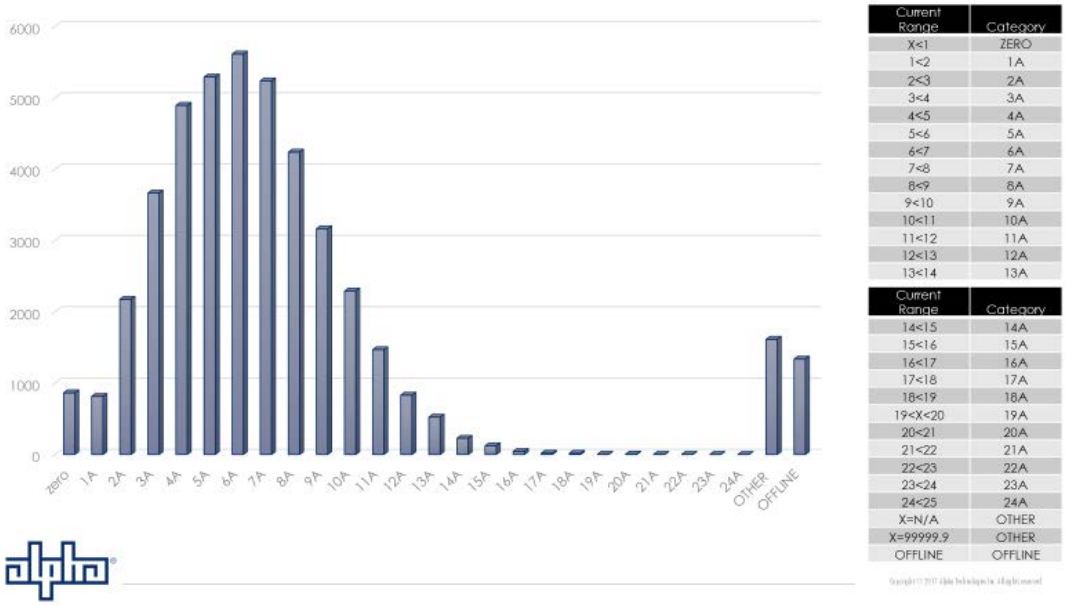


Figure 4 - Low Power Small Cells

Power

The powering needs for small cell solutions vary based on the size and desired performance of the cell. Larger "Small Cells" will require full metered drops from the power grid at the cost of thousands of dollars. These sites will support multiple bands of wireless spectrum and sectors. However, there is another set of small cells that will require less than 120 watts.

MSOs with their HFC network are well positioned to provide power to these types of small cells. Typically, 15-amp service at 90 VAC is available, and industry Pareto analysis shows and average usage of only 7-8 amps. On average that leaves 600 watts of unused power, more than enough for wireless APs whether Wi-Fi or LTE/5G small cells distributed along the plant, which may operate at lower than 50 watts each. This alone would significantly help in the economics of deploying small cells. For the larger "small cells" the MSO community has more experience obtaining and managing power in the OSP than any other type of network operator.



Current Range	Category
X<1	ZERO
1<2	1A
2<3	2A
3<4	3A
4<5	4A
5<6	5A
6<7	6A
7<8	7A
8<9	8A
9<10	9A
10<11	10A
11<12	11A
12<13	12A
13<14	13A

Current Range	Category
14<15	14A
15<16	15A
16<17	16A
17<18	17A
18<19	18A
19<X<20	19A
20<21	20A
21<22	21A
22<23	22A
23<24	23A
24<25	24A
X=N/A	OTHER
X=99999.9	OTHER
OFFLINE	OFFLINE

Figure 5 - Power Consumption in HFC

Backhaul

The new CRAN deployments bring different requirements on the backhaul network as the base band unit is being moved from the site to centralized locations. This centralized RAN, creates three types of backhaul with different demands: front, mid and backhaul.

Figure 6 - RAN Backhaul Diagram

The RU/AAU is the radio unit, the DU is the distributed unit of the baseband controller, and the CU is the centralized unit of the base band controller. 5G allows for splitting the stack of the baseband into two units like remote PHY. Generally, there are four methods of deploying cell sites, each with different advantages and disadvantages.

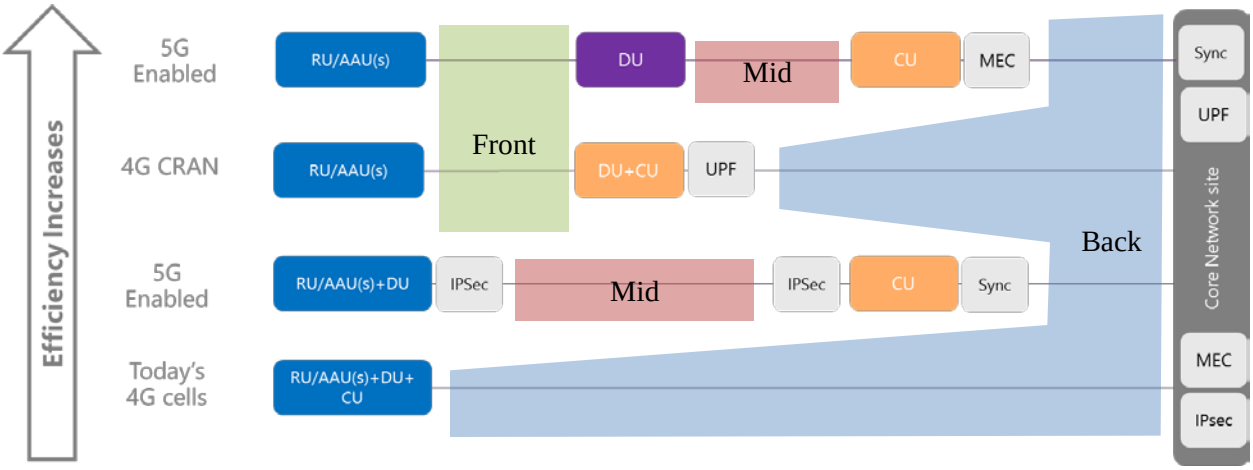


Figure 7 - RAN Front, Mid, Backhaul Methods

While dark fiber can be used in each area and is often the preferred method for MNO's, other technologies can be leveraged with the HFC network to provide front, mid and backhaul to small cells. WDM technology can be used to optimize the fiber used in front, mid and backhaul. The MSOs are more familiar with WDMs and able to track the wavelengths better throughout their network. In some midhaul applications PON or DOCSIS™ can be leveraged. Even more applications for backhaul can use PON or DOCSIS™. The MSO community has fiber and coax in appropriate places to be able to provide the connectivity to cell sites.

Site Acquisition

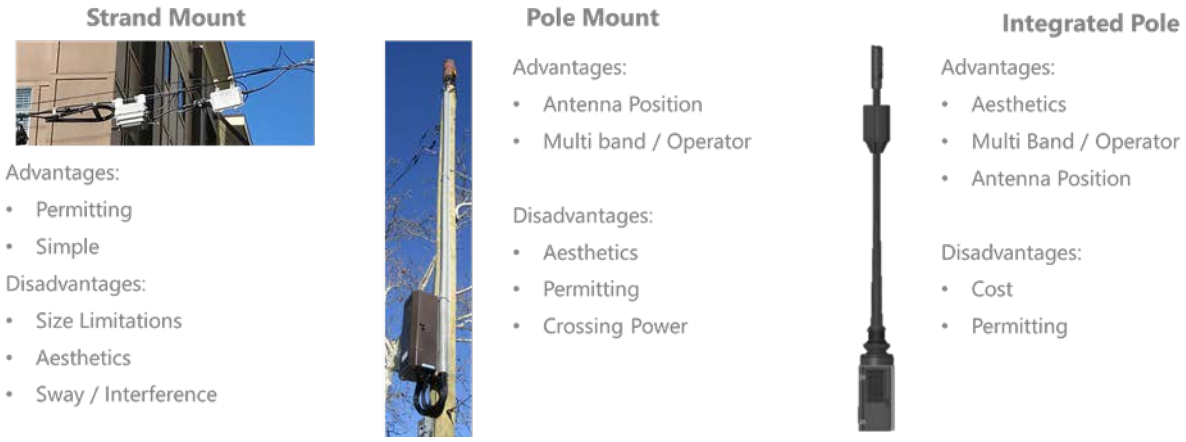


Figure 8 - Small Cell Siting Methods

The last challenge in deploying small cells is placing the radio and antenna. MSOs have access to many of the poles and other sites. There are solutions that place radios and antennas on the top of poles. There are also smaller radios that are capable of being placed on strands simplifying the deployment process further. In locations where the plant is underground, other solutions can be leveraged to provide the vertical height for mounting antennas. Considerations include integrated light poles and active equipment cabinets. Either way, the MSO community has vast experience in working with municipalities in siting equipment in the OSP.

Conclusion

The drive to 5G is underway, but the MNO's will need help solving the economic problems presented by the densification of the wireless network. The networks operated by the MSO community contain many advantages in deploying small cells for the 5G and 4G densification. The three main challenges in deploying small cells are power, backhaul, and site acquisition. Each of these can be provided using existing plant or provided by the MSO community.

Abbreviations

AP	access point
HFC	hybrid fiber-coax
SCTE	Society of Cable Telecommunications Engineers
RAN	Radio Access Network
MSO	Multiple System Operator
PON	Passive Optical Network
RU/AAU	radio unit in wireless network
DU	distributed unit of the baseband controller in a wireless network
CU	centralized unit of the baseband controller in a wireless network

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