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The Wireless Data Revolution and its Impact—Boyle’s Law states that a gas will expand to fill the available space. The same can be said for a data network. The more throughput available, the more uses people will find to fill up that pipe. Every month, more than 20,000 apps are released in the Apple iOS store, with the vast majority requiring some sort of broadband connection to run. To date, there have been over 50 billion downloads from the Apple iOS store, with over half of those being downloaded in the last 12 months. The proliferation of smartphones and tablets with even higher resolution cameras and two-way video capabilities has only exacerbated the consumption of data. As such, the wireless networks of today simply cannot handle the onslaught of traffic that is being pushed through the virtual pipes.

The demand for wireless data services, driven by smartphone and tablet use, is in an explosive state of growth — growth that will continue for years to come. A Cisco Systems Inc., study from early 2013 reported global mobile data traffic grew by 70 percent in 2012; wireless data use was almost 12 times greater in 2012 than all Internet traffic — wired and wireless together — in 2000. Cisco predicts worldwide mobile data traffic will continue to expand, increasing 13-fold by 2017, a compounded annual growth rate of 66 percent. Strategy Analytics also predicts a tremendous escalation in wireless data usage, estimating a total rise in data traffic of 300 percent between 2012 and 2017, with wireless video streaming, Internet browsing and apps consuming the terabytes. And UK-based Juniper Research forecasts that mobile data traffic will grow 10-fold by 2017, reaching an “equivalent to almost 42 quadrillion tweets or approximately 7 billion Blu-ray movies.” While the predictions may vary slightly, all point to a data-heavy mobile future. Wireless traffic is now measured in zettabytes, or a billion terabytes.

As mobile network operators (MNOs) migrate to 4G/LTE, they are achieving more efficient use of radio channels, while improving uplink and downlink speeds for users, but this is limited by the amount of available spectrum. MNOs are looking to make use of Wi-Fi where possible to help offload the radio network. However, Wi-Fi has inherent limitations with respect to spectrum interference mitigation and mobility. A “managed” Wi-Fi hotspot has the same issues with regard to deployment and backhaul as a licensed small cell.

The MNOs are looking for solutions to accommodate this rapid influx of data. Cell splitting, by adding new macro towers, is time intensive, and the addition of new RF channels is challenging because the MNOs are using their spectrum to full capacity. Small cells, inevitably, are part of the solution. Small cells are just that — smaller versions of macro tower sites. The antennas are roughly two cubic feet, weigh less than 30 pounds, and are mounted 25 feet above ground level. These small cells are about 1/10 the overall size of a macrosite and are rapidly deployable, economical and provide targeted coverage for those high-density hotspots to offload the congestion from the macro network. In addition, where the investment for new macro infrastructure is cost prohibitive, small cells can be used in areas where coverage is thin or nonexistent today.

While small cells are viable in a number of situations, they are not a cure-all. Challenges remain to small cell engineering and deployment. These small cells need to

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be implemented efficiently and in a manner that does not disrupt the existing live network. Small cells can be placed in a wide variety of outdoor and indoor locations, but placement is still subject to rigorous regulatory oversight from state and local authorities. Since every site is different in terms of mounting, loading, and coverage, it is imperative that a simple set of installation and commissioning instructions be replicable across an entire carrier implementation. Backhaul, the movement of traffic from the network edge to the core and back, continues to be the lynchpin in the small cell network. Without a way to efficiently move the traffic from the mobile device quickly, all of the benefits of the small cell are lost. As the MNOs seek to establish these heterogeneous mobile networks (HetNets), they must consider the entire network ecosystem. Meeting these challenges requires a deep understanding of site location planning, broad experience in delivering backhaul solutions and reliable access to capital.

THE CASE FOR SMALL CELLS

In the next 24 months, Tier 1 MNOs are expected to deploy in excess of 100,000 new small cells. Worldwide, nearly 11 million small cells have already been deployed by 47 operators. AT&T Mobility has announced their Project VIP, which alone will deploy more than 40,000 small cells by 2015 in the U.S. Other industry experts predict at least 5 million small cells will ship annually by 2017, translating to an annual growth rate of at least 125 percent beginning in 2014.

The reasons for this industry-wide embrace of small cell technology are many, and begin with the two key fundamental drivers in today’s rapidly changing mobile network arena: time and cost. As MNOs race to meet customer demand and improve quality, small cells can provide that much needed relief. Roughly 10 small cells can be deployed in an area that would replace a macrocell in a fraction of the time that it would take to deploy a traditional macrocell. Additionally, the lack of viable real estate coupled with stringent local and state zoning regulations — not-in-my-backyard (NIMBY) — make the siting of a new macro cell challenging within customer demand-driven timeframes. Small cells are the logical option. The deployment cost is significantly reduced by the physical size of the small cell, both in terms of the hardware expense and the required real estate footprint. While small cells alter the scale of a network and add many new sites to monitor and manage, leading to increased operational costs, these expenditures are generally offset by the value inherent in a more efficient and higher capacity network, more subscriber traffic and an improved experience.

Small cells can be deployed on the sides of buildings, on utility poles, street furniture, along right-of-way corridors, in airports, schools and indoors. The coverage can be targeted for parks, stadiums, hospitals, office buildings, residences, or anywhere traffic offload is required. Small cells operate on licensed frequencies, and improve an MNO’s quality of service capabilities, while offering additional coverage flexibility. For example, a series of small cells can be deployed near stadiums to add additional capacity during big games or events. Those same cells can then be moved the following week to cover the championship parade route. Or, they may stay permanently fixed in those locations as a capacity “underlay” network complementary to the existing macro network.

The cost, deployment time and signal quality benefits that make small cells invaluable for increasing capacity in dense urban areas also make them vital in outlying rural regions. While the expense of constructing macrocell towers in unpopulated regions may not be justified, small cells are cost-effective, and are helping MNOs reach new subscribers and improve the data services across regions for existing users.

By offloading data from the macrocell, improving coverage at the cell edge and between cells, and by connecting difficult-to-reach rural areas, small cells are becoming an increasingly attractive solution for handling mobile network growth.
MAKING SMALL CELLS WORK

While small cells bring great promise, their deployment presents certain challenges, particularly in the areas of infrastructure demand and regulatory requirements. There are high-profile instances where cities are attempting to regulate against the proliferation of small cells in an area by imposing regulatory hurdles. Small cells still require zoning approvals and a mountable, co-locatable structure (such as a utility pole or low rooftop) for the antennas, with access to utilities and backhaul services.

Although the small cells themselves weigh approximately 30 pounds, there is ancillary equipment that is required to support this mini base station. For example, there may be a need to house the backhaul equipment, a router to properly control and direct the information, or even a battery backup system with generator access in the event of loss of power. This entire package can weigh upward of 400 pounds and can put a tremendous strain on utility poles that were installed dozens of years ago, and which were initially designed to support only transmission lines. Additionally, rooftop and building owners will have to weigh the prospects of incremental revenue with the need for consistent third-party access, potential leakage or damage to their property.

In the U.S., the utility grid for the most part is clean and reliable but these small cell systems are designed for low power consumption (100 – 200 watts @ 110VAC), which may not be economical for the utility company to provide this type of service along high-tension lines.

Small cells use a mix of backhaul solutions to connect with the core network; these solutions are often guided by the constraints of a small cell location. Just as often, the location choice itself is influenced by existing infrastructure and real estate considerations.

Available backhaul options today range from fiber to high-capacity, fixed broadband wireless. While fiber is the preferred backhaul option, connecting fiber to multiple small cell sites in dense urban areas, for instance, may not be cost effective. The conundrum is that it may not be cost effective to dig up and repave the streets of a city center or a suburban shopping area to connect hundreds of small cells with fiber, but those areas are where the capacity is needed. So, MNOs may look to high-capacity microwave solutions to provide this vital connectivity.

However, high-capacity microwave is traditionally limited to line-of-sight and licensed spectrum availability, which puts further limitations on the small cell placement.

CONCLUSION

MNOs today are pursuing a comprehensive strategy for small cell deployment that considers network capacity and coverage needs and backhaul requirements together, balancing issues of backhaul deployment costs, real estate opportunities, network capacity and coverage needs and service level requirements.

These heterogeneous networks are a multi-layered series of interlocking high-capacity networks tied together with network intelligence. Together, they are driving transformation within the carriers at a rate never experienced. These next-generation small cells will likely evolve using the same platform that drove the traditional macrosite builds: co-locatable structures, available power and efficient backhaul. The nature of small cells and their varied and multiple site potential require the pursuit of a new approach. Speed to market is more critical than ever before to be able to enhance and shape the overall customer experience. Companies can deliver these key attributes in a single, comprehensive platform. Combining backhaul and construction capability with access to thousands of miles of rights of way through urban, suburban and rural population areas, offers attractive opportunities for small cell deployments throughout the U.S.

Small cell technology is no longer a hypothetical future for mobile network environments. Nor is it a distant solution to coverage and capacity concerns: it has already arrived. Deploying the technology in a way that is cost-effective and cognizant of future network evolution requires an understanding of multiple backhaul solutions and emerging technology, and a commitment to incorporating new real estate into the equation of site considerations.

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