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SDN, NFV, and Future Mobile Backhaul

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SDNs Define Future Network Thinking

SDNs (software-defined networks) will play an important role in mobile backhaul networks, especially for administration of large backhaul networks. Most operators are going after other SDN projects before mobile backhaul. In our September 2015 *Macrocell Backhaul Strategies: Global Service Provider Survey*, a study of 23 operators controlling 42% of global telecom capex, 45% of respondents plan to implement SDNs for mobile backhaul by 2017, and a further 27% are still evaluating whether they will do so at some point.

SDN is designed to take complexity out of a network and deliver automation, flexibility, efficiency, and resilience. Using traffic analytics tools, an SDN controller at a master node can understand all the traffic flows across a backhaul network and can make traffic offload decisions to other nodes. Backhaul traffic is characteristically very bursty, with high peaks but a much lower average, so SDN intelligence could be used to reach a more efficient usage of available capacity in the network.

The challenge for any operator is to manage backhaul networks connecting the 100s to 1,000s to 10,000s of cell sites, with many pieces of equipment and different types of backhaul paths and technologies that must maintain timing, latency, and traffic loads. Provisioning, management, and monitoring are complex and error prone. China Telecom and Huawei are working on a massive SDN project on their backhaul network of some 400,000 pieces of equipment. We expect to hear progress reports during the year, and although we will not see significant conversions to SDNs in backhaul networks in 2015, many MNOs are moving toward some sort of SDN-readiness.

Outdoor Small Cells Deployment Accelerates

Over the past few years there has been much discussion about small cells—what they are, how and when they will fit into existing networks, and what benefits operators can realize. There is plenty of investigative activity by MNOs trialing small cells, so deployments will come, but technical, operational, and financial challenges remain. These challenges extend to backhaul, where the range of solutions must be more cost effective and more easily deployable before large-scale small cell deployment can be viable.

Though small cell deployments likely will first leverage fiber where it's available, technological advancements in wireless backhaul make it a very viable solution that can also be tapped as needed. We see continued development and advancement of small cell wireless backhaul technologies that will evolve significantly beyond 2015.

Operators will not go far down the outdoor small cell deployment path by year-end in terms of scale of rollout, but they will go a long way toward understanding the small cell ecosystem, which may need to accommodate carrier WiFi as well as micro/picocells; in the coming year, small cells will evolve from current indoor deployments to growing outdoor deployments. This year also marks the beginnings of dynamic small cell networks, and auto-alignment, reconfigurability, auto-restore, path-searching, and dynamic capacity features will become necessary integrated components for deploying robust small cell networks quickly and efficiently.

Operators will deploy a wide range of small cell backhaul solutions and architectures. Clearly there is no single solution, so operators need to assess spectrum availability and the operational, site, and zoning aspects of individual deployments. What an operator deploys in one area (say, a metro area) may be different from what it deploys in another area. As a consequence, the small cell backhaul market is growing in 2015, but it remains somewhat fragmented.

Pursuit of Higher Backhaul Capacity Solutions

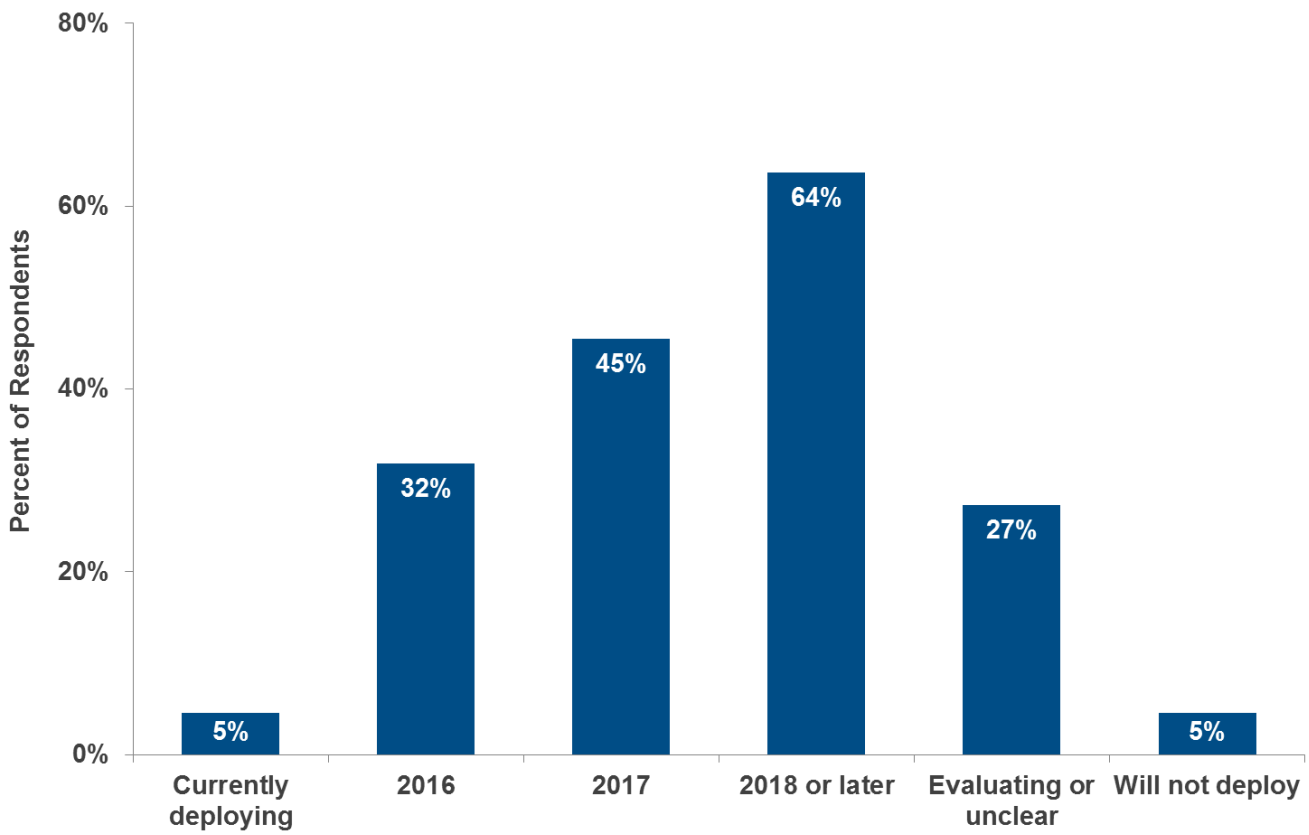
One of the characteristics of next-gen RAN is much higher capacity being delivered on the radio access side, as LTE and LTE-A are more widely deployed; more access capacity drives the need for more backhaul capacity. Thus, the market continues its transition from hybrid TDM/Ethernet microwave, which has been the mainstay of 3G network backhaul, to pure packet microwave backhaul solutions.

Despite the lingering caution in the macroeconomic climate, mobile operators have to accommodate rapidly rising mobile broadband traffic, and Ethernet-based microwave is one of the most cost-effective solutions for accommodating the demands of higher network capacities. Developments driven by the increased need for high-capacity LTE macro backhaul will drive microwave equipment capable of delivering new modulations, multichannel support, bulk-compression technologies, and wider frequency bands. E-band millimeter wave (based on 71-76GHz and 81-86GHz spectrum) will also continue to be of interest as a solution.

SDN and NFV in Backhaul Networks

For our October 2015 *Macrocell Backhaul Strategies and Vendor Leadership Global Service Provider Survey*, we interviewed 22 service providers that operate a mobile backhaul transport network. Respondents have detailed knowledge of their companies' backhaul strategies for macrocell networks and have influence in the planning and purchase decisions for these networks. Respondents indicated if/when they will introduce SDN (software-defined networking) into the backhaul network. The chart below shows *cumulative* responses.

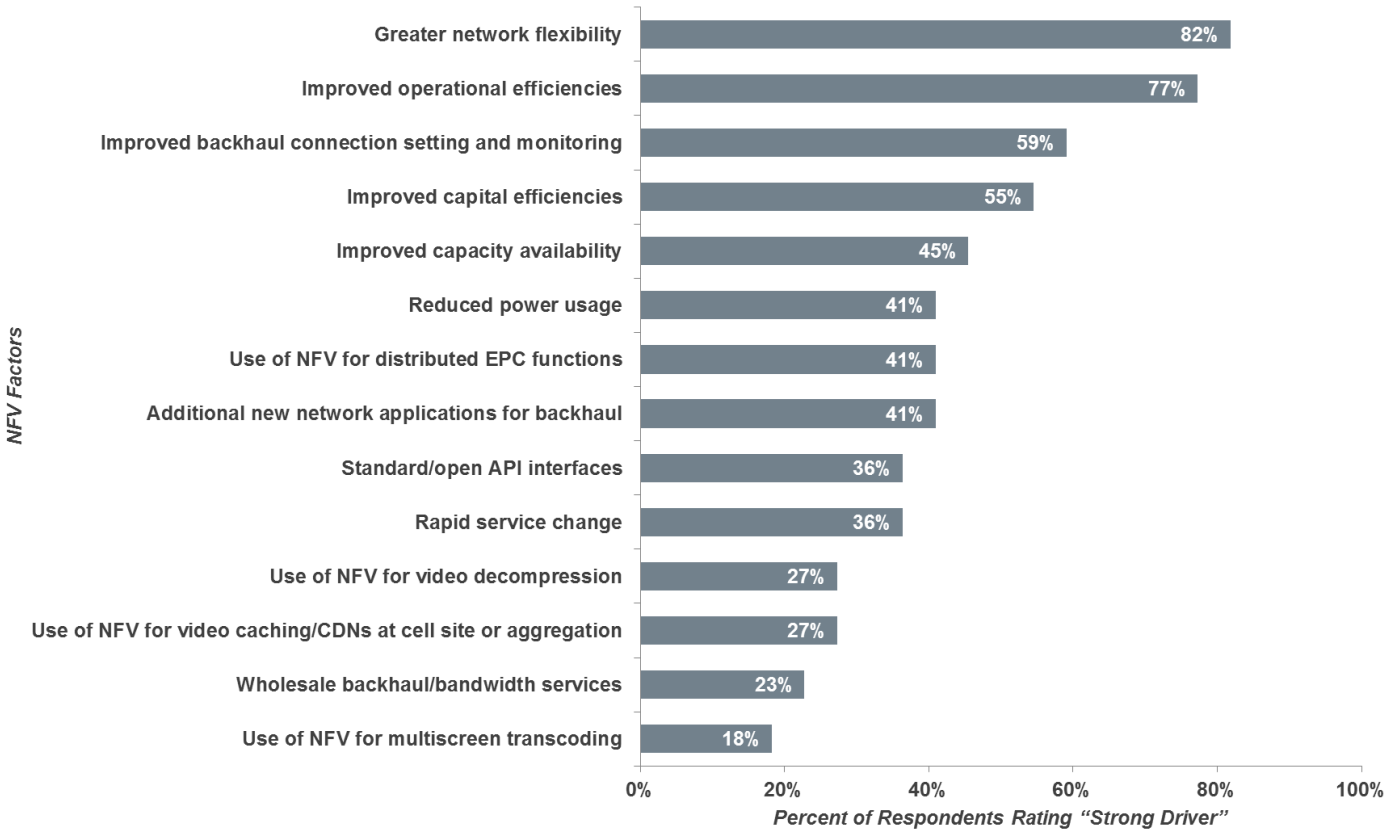
Exhibit 1: Operators Evaluating and Deploying SDN in Mobile Backhaul



64% are planning to deploy by 2018 or later with only 1 respondent saying they will not deploy. Overall, this growth in deployment of SDN in the backhaul network will grow quite quickly: from 1 respondent saying they are currently doing so to nearly a third of respondents saying they expect to do so by 2016. Some of the market is in watch-and-wait mode: 27% of respondents are evaluating this as a possibility but as yet are unclear when they might deploy SDN.

We asked respondents to rate factors in deploying NFV (network function virtualization) in their backhaul networks on a scale of 1 to 7, where 1 is *not a driver*, 4 is *somewhat of a driver*, and 7 is a *strong driver*. The next chart shows the percentage of respondents rating each factor 6 or 7, or a *driver*.

Exhibit 2: Drivers for Deploying NFV in Backhaul Networks



The top 2 drivers are really the same strong drivers we would expect to see for any sort of NFV deployment: flexibility and operational efficiency. Of course, implicit in the latter is opex savings, and all mobile operators are looking to lower their backhaul costs. Another typical NFV driver is improved capital efficiencies, rated by over half of respondents.

The leading backhaul-specific driver for NFV is improved backhaul connection setting and monitoring. This also relates to flexibility as operators are seeking the ability to turn-up/turn-down bandwidth on backhaul connections according to changing demand; though they will continue to overprovision capacity for backhaul links, they want a closer relationship between amount of bandwidth provided and amount required—this requires more intelligence in the network and more flexibility in terms of how capacity is delivered.

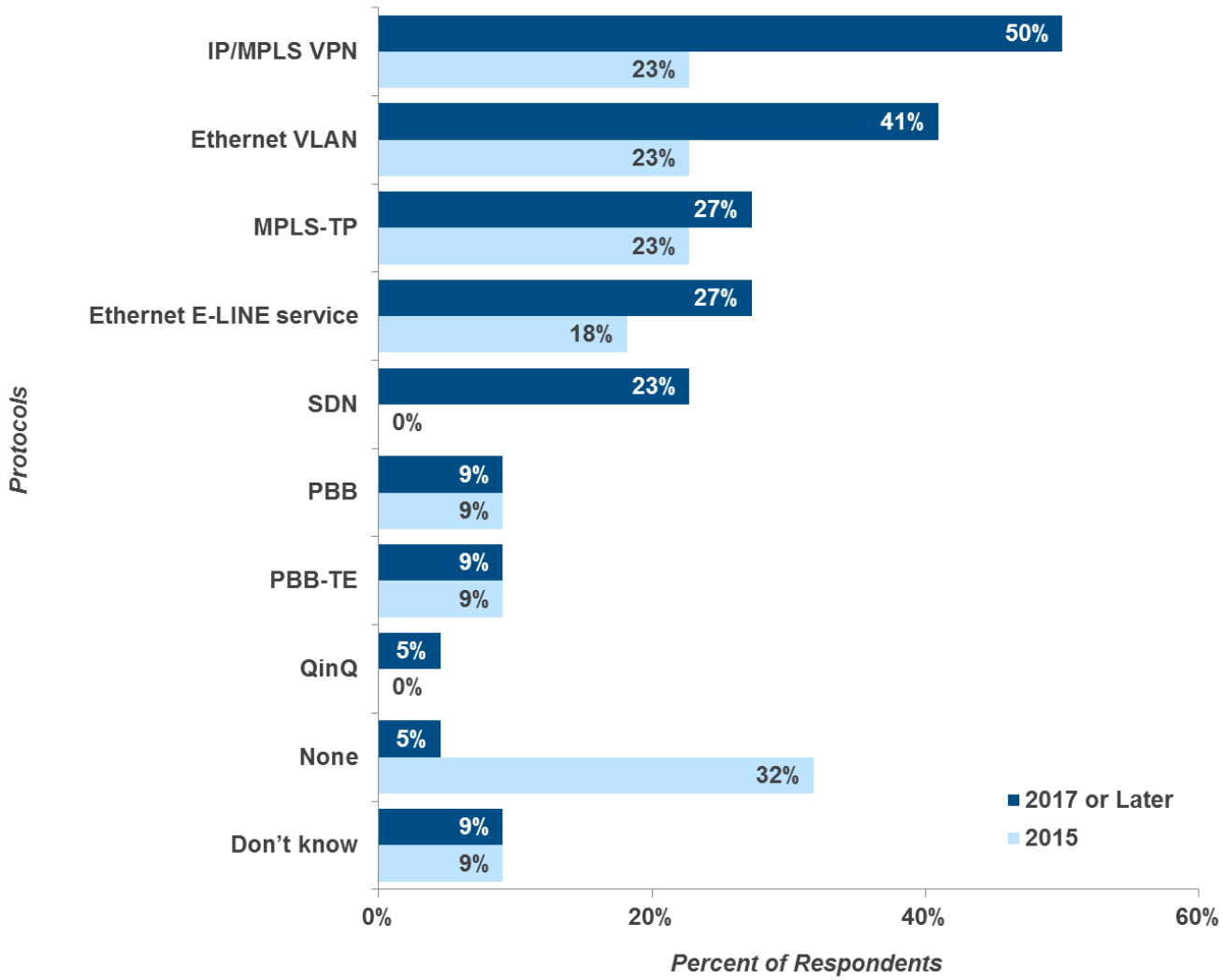
Outdoor Small Cell Backhaul

Nearly all operators plan to use Ethernet for outdoor small cell backhaul, but with which protocols? In our September 2015 *Small Cell Backhaul Strategies Global Service Provider Survey*, we interviewed 22 service providers that currently operate a mobile backhaul transport network. We asked respondents which transport protocols they will deploy for small cell backhaul in 2015 and by 2017. Since many operators continue to test and field trial, these answers may change.

IP/MPLS is most widely used for this purpose by the end of 2017 (by half of respondents), ahead of Ethernet V-LAN (41%), Ethernet E-line service (27%), and MPLS-TP (27%); each of these protocols sees adoption growth for small cell backhaul by 2017.

No respondents plan to deploy SDN for small cell backhaul this year, but by 2017, 23% expect to have done so (up from 16% in our survey last year). Solutions in this area are still maturing, but this is a strong indication of interest in SDN-based solutions for small cell backhaul.

Exhibit 3: Outdoor Small Cell Backhaul Transport Protocols



Bottom Line

The irresistible growth of mobile devices will continue to strain the capacity of backhaul networks. In addition to how people are using their smart devices (e.g., video), the Internet of Things (IoT) and machine-to-machine (M2M) are set to become additional strong capacity drivers. We are embarking on a very long journey of network densification that goes far beyond the sole concept of small cells. Make no mistake, this is reality: the blending of small cells, WiFi, and C-RAN is happening, and at the same time, mobile networks are changing; this will create new demands on the transport networks that backhaul traffic from the RAN to the core.

The over-arching trend in microwave is unchanged: the inexorable transition to all-Ethernet, which is accelerating. The emphasis on small cell backhaul solutions will continue, and it will be vital for all microwave equipment providers to establish very clear roadmaps for each of these opportunities. In addition, millimeter wave fronthaul will generate discussion and be the focus of positioning activity by several vendors, although it is not generating much actual revenue this year.

These days, operators are not only striving to upgrade backhaul capacity; they are evaluating ways in which evolution of the access network will drive transformation of the backhaul network.

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