Automating Small Cell Turn-up & SLA Management

A Technical Paper prepared for SCTE/ISBE by

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Introduction: The Exponential Growth of Small Cell Backhaul & Ethernet Services

The telecommunications marketplace is experiencing a significant growth in small cell backhaul and Ethernet backhaul service deployment. This year alone, revenues for mobile data and mobile networks have increased by 16% while total units are up by 35%. And these numbers are only predicted to grow. By 2021, the small cell market will skyrocket to $2.2B with a CAGR of 8.4% and more than 2 million units deployed in the network to support the surge in mobile traffic (source: IHS). The number of small cells being deployed is going to vastly outnumber those of macro cells.

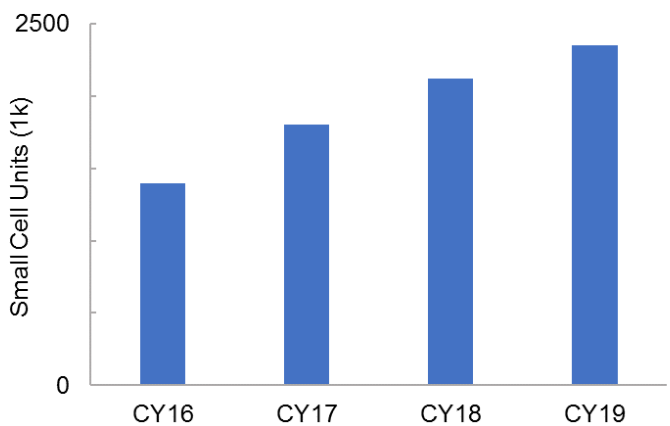

Figure 1 – Worldwide Service Provider Small Cell Units CY 2016-2019 (Source: IHS)

With the increased deployment and growth of small cells comes an increased demand for small cell mobile services. However, to truly realize the benefits of a small cell deployment, the cell must first be connected into the mobile network infrastructure. This connectivity drives the demand for backhaul services. The industry tends to refer to these backhaul services as Ethernet services, implying a single technology; however, small cells use a variety of technologies for backhaul connectivity such as microwave, hybrid fiber and coax, A/C cable networks, dedicated fiber, and more.

Small cell backhaul equipment revenue is predicted to grow to $1.2B in 2021 at a 5-year CAGR of 51%. No matter the backhaul technology in place, the bottom line is that reliable, low latency connectivity is imperative for these small cells so they can deliver the high quality mobile services that customers expect. To meet these high customer expectations, services need to be guaranteed with service level agreements (SLAs). SLAs govern acceptable levels of packet delay, jitter, loss, availability, and other key metrics for small cell connectivity to the core mobile network. The only way to effectively monitor backhaul SLAs is through continuous active testing of the links.

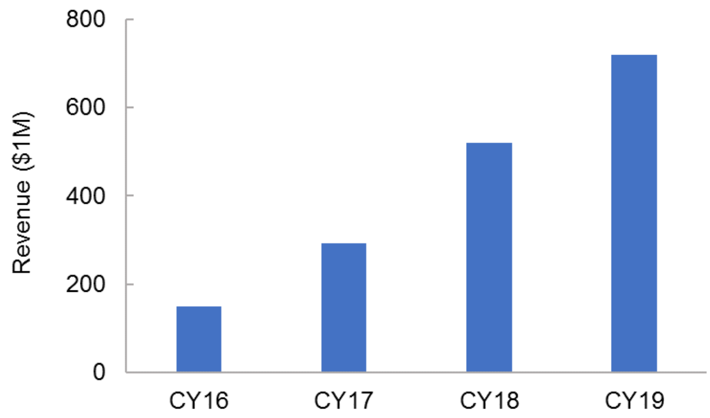

Figure 2 – Outdoor Small Cell Backhaul Equipment Revenue CY 2016-19 (Source: IHS)

While it is possible to turn-up and validate that backhaul services are working and small cells are functioning as designed, service providers need to be able to monitor these connections in real-time and in an ongoing fashion to ensure that SLAs are being met. Adding to the already complex nature of these deployments is the fact that many providers operate heterogeneous backhaul solutions using a plethora of technologies and equipment vendors. Services are needed in specific locations and the backhaul technology available to provide connectivity varies based on these locations. For example, some providers have invested heavily in fiber backhaul networks, while other providers use a mix of microwave, legacy TDM, cable modem, and hybrid fiber/COAX connections.

This paper explores key challenges service providers face as they deploy large volumes of small cells with heterogeneous backhaul connectivity. The paper explains how automation of small cell acceptance workflows can address these challenges and deliver significant benefits in terms of speed of deployment, cost savings and customer satisfaction.

Small Cell Deployment Challenges

The challenges for service providers deploying small cells are threefold:

1) Service delivery
2) Trouble/fault management
3) SLA management

The critical issue from a service delivery perspective is the installation and turn-up of the small cell, including service provisioning and validation. With thousands upon thousands of deployments, traditional turn-up methods are not scalable. Additionally, there is a certain percentage of sites which will be non-functional at turn-up and providers need a way to quickly identify these defective units. Service validation is another concern because failure to deliver the service that was ordered leads to increased customer dissatisfaction and churn.

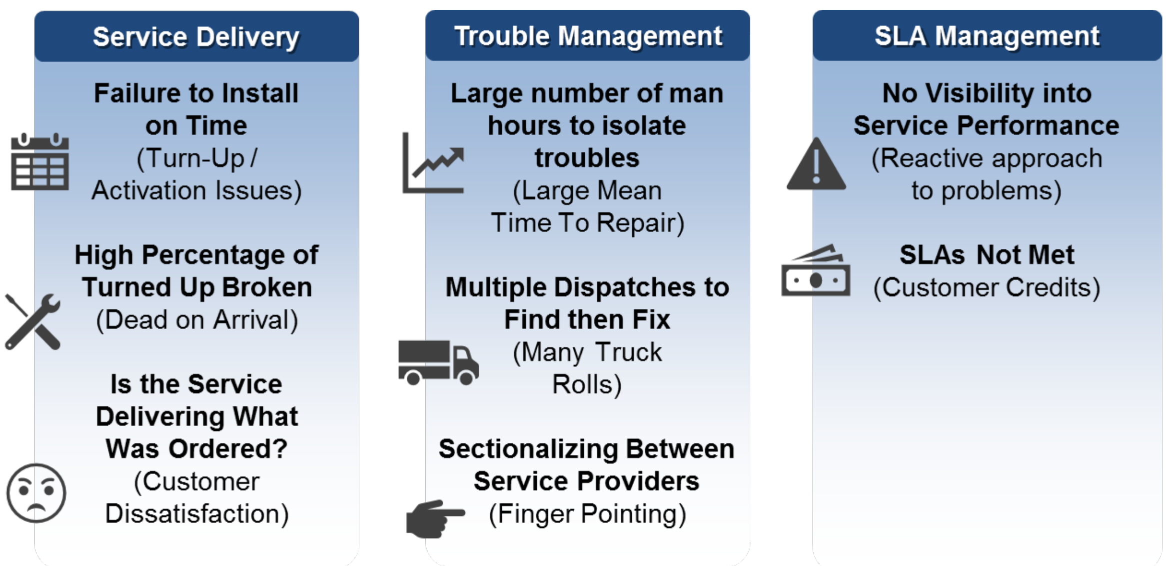

Figure 3 – Small Cell Deployment Challenges

Once the backhaul service is up and active, providers transition into SLA and trouble management mode. SLA management challenges include limited visibility into the service performance and the inability to proactively manage SLAs, both of which can result in significant issues. These challenges often lead to a reactive approach to fault resolution, which can have serious monetary consequences for the provider.

When dealing with fault resolution, an adhoc approach to troubleshooting results wasted time spent isolating the root cause of issues, leading to an increased time to fix the issue and remedy associated SLA violations. Additionally, multiple dispatches are often required to find and fix the issue which can be very costly. When the backhaul is provided by an off-net service provider, too much time is often spent trying to isolate issues between service providers. As most of these services are being delivered through a third-party vendor, alternate access vendor (AAV), or type II service provider, there tends to be a lot of finger pointing back and forth between providers to determine whose network is at fault. If providers are unable to rapidly determine who owns the problem, it further delays resolution, which exacerbates SLA violations, costly fees, and customer dissatisfaction.

Current Test & Assurance Approaches

Many service providers are deploying small cells and see the need for major network expansions consisting of thousands or tens of thousands of small/mini-macro cells. Providers must provision IP backhaul for each site and typically must support multiple network equipment vendors. Additionally, they have multiple access vendors or off-net providers with various topologies such as microwave, fiber, DOCSIS, and a public Internet with asymmetrical bandwidth. This creates significant challenges for standardizing turn-up, provisioning, and monitoring processes.

Furthermore, many service providers take a manual approach to the testing and assurance requirements of these processes. The acceptance workflow usually involves manual testing of backhaul connectivity and performance for every small cell immediately after turn-up, with no good way to ensure that all topologies and vendors use exactly the same process. If the KPIs are not acceptable and the validation process is incomplete or inconsistent, diagnosing the root cause and fixing the fault can be extremely difficult and time consuming.

A key challenge to this manual approach is that providers need to manage these deployments using their current resources. They want to avoid the cost of hiring additional staff or contractors, yet they need to significantly increase the scale of deployment. With traditional processes, providers can activate approximately 10 cells per day, but to deploy large numbers of sites, they need to be activating at least 100 cells per day with a process that is consistent and reliable. The reality is that a manual test approach can’t be scaled fast enough to meet these objectives and it certainly can’t be done with existing resources.

Automation of Turn-Up & SLA Monitoring

To meet the demands of rapid, high-volume small cell deployments, the acceptance testing and SLA monitoring workflows must be automated. Based on our history and experience with small cell backhaul deployments, about 80% of initial turn-ups will be successful while approximately 20% will have a material performance issue that requires troubleshooting. Service providers can implement "zero-touch" fully automated approaches for the 80% of initial turn-ups with no issues. The automation consists of the following elements: detection of new links, performance testing, creation and storage of turn-up records, and setup/initiation of SLA monitoring.

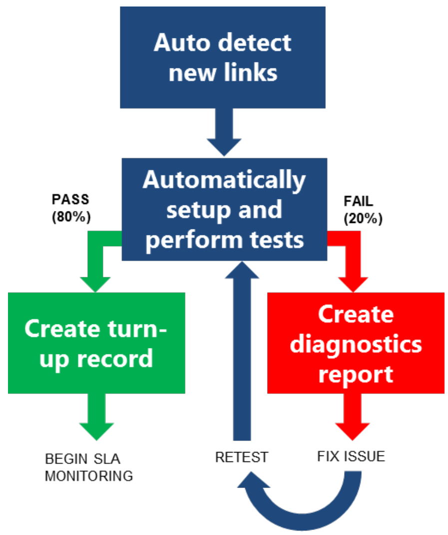

Figure 4 – Small Cell Deployment Automation Workflow

For the 20% of activations that require troubleshooting, automation can accelerate the troubleshooting process by providing detailed diagnostic reports that help isolate root causes. Diagnostic data associated with the turn-up failure, including isolation to a specific network segment or element, can also be pushed to the appropriate organization to drive faster fault resolution.

1. Automation Solution Components

There are several key components required to automate the process of small cell turn-up and SLA management:

- Centralized active test probes and/or Virtual Test Agents (VTAs)
- Service Assurance Test Controller
- Small cell network elements with support for industry test standards
- Inventory Interface
- Trouble Ticket Interface

The service assurance test controller is needed to configure and manage the active test probes/VTAs and communicate with network elements and small cells. Fortunately, most small cell network elements support Ethernet or IP service assurance industry standards (e.g., TWAMP, Ethernet OAM, MEF 48, MEF 46 standards) which allow standardized service assurance tests to be performed across backhaul connections between probes or agents and the small cell.

The Inventory Interface/Gateway detects newly activated small cells and configures and executes backhaul validation tests. An accurate inventory database is a must: automation is not possible without an accurate network inventory which provides a clear understanding of how the service is built, the service attributes, what network elements are included and how they are configured.

A Trouble Ticket Interface/Gateway is needed for the 20% of small cell backhaul deployments that typically fail on initial turn-up. This allows the test controller to communicate with back office systems, open a ticket, and send it to the correct organization.

2. Putting it All Together

Once the key components of the automation process have been assembled, they must be integrated to perform the following automated steps:

1) The Inventory Gateway detects a new live backhaul link and loads the network configuration to the Service Assurance Test Controller.

2) The Inventory Gateway builds service records to enable testing and sends test requests to various test heads, whether physical or virtual.

3) The test agents then send tests to the small cell and perform SAT tests, which can be a combination of MEF 48, RFC 5164, or RFC 2554, depending on the desired level of activation testing. Some providers have the need to test up to Layer 4 TCP throughput in order to validate the service from the core to the macro/small cell. If desired, such tests can be performed as well.

4) If the test is successful, a turn-up record is created and 27x7 active service monitoring begins.

5) If the test is unsuccessful, the Test Controller creates a diagnostic report and trouble ticket, both of which are routed to the appropriate organization. Based on the accuracy of the inventory data, the Test Controller can even perform a sequence of automated fault isolation tests to determine exactly where the fault is located and include this location in the trouble ticket for faster fault resolution.

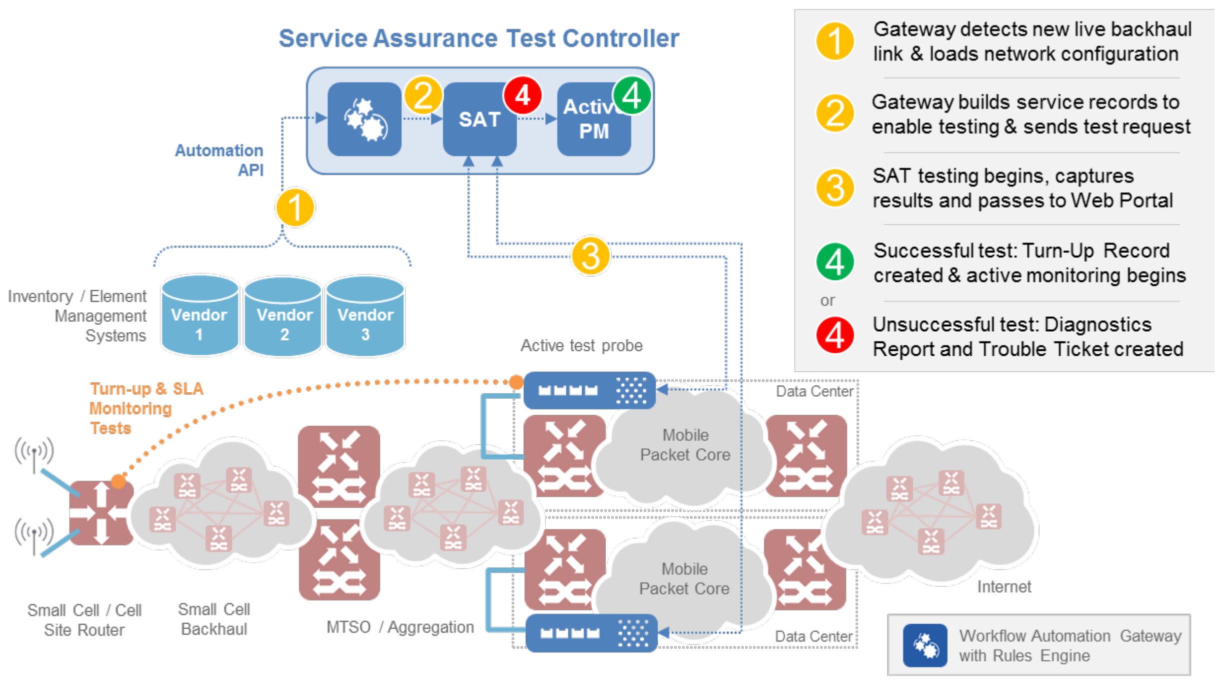

Figure 5 – Turn-up & SLA Monitoring Automation System Architecture

Conclusion: Automation Leads to ROI and Cost Savings

Service providers that have adopted the automation approach and other best practices outlined in this paper have achieved significant benefits including reduced deployment costs, faster deployments and improved service experience.

Figure 6 – Key Benefits of Automating Small Cell Acceptance

Automation of the small cell acceptance process, by leveraging a service assurance controller with tight integration to back office systems, enables providers to avoid hiring any additional staff or contractors, even as they turn-up an order of magnitude more small cell backhaul links. Costs are also reduced because this process is vendor agnostic, allowing for a more heterogeneous network of vendors and ultimately improving efficiency. Integration to back office systems reduces manual testing by 95% which also provides significant cost savings.

Leveraging automation, providers can accelerate time to revenue by activating more than 1,000 small cells per week. This process provides more than a 10x faster time to revenue when compared to traditional, manual processes. Manual processes that require 2 hours per small cell, now only take minutes, allowing new small cells to start carrying revenue-generating services faster.

Small cells provide coverage in critical, under-served areas. They also provide service to areas where congestion on a single tower or a single macro cell has reached a point where the service quality is unacceptable. Enabled by automation, rapid small cell deployments lead to a significantly improved service experience for customers in uncovered or congested areas. The faster a small cell can be turned-up, the higher quality of service the end user will experience. This higher quality of service ultimately leads to increased levels of customer satisfaction and provider loyalty.

Abbreviations

AAV	Alternate Access Vendor
DOCSIS	Data Over Cable Service Interface Specification
MTSO	Mobile Telephony Switching Office
PM	Performance Management
SAT	Service Activation Test
SLA	Service Level Agreement
TWAMP	Two-Way Active Monitoring Protocol
VTA	Virtual Test Agent

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