White Paper

SON and the LTE Challenge: How to Get More for Less

What You Will Learn

LTE is touted as the solution to the rapidly growing data crunch in mobile networks. In this white paper, you will learn the following:

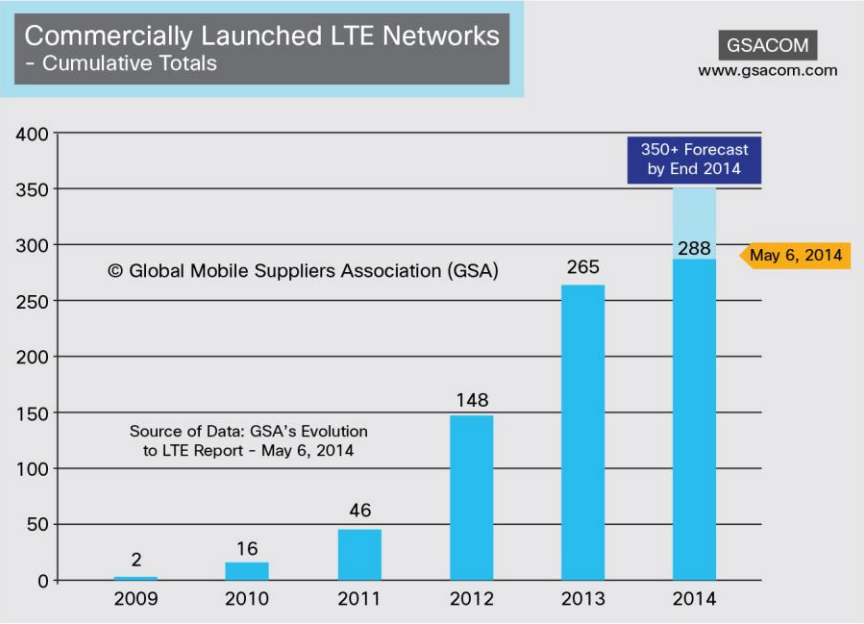
- Why LTE exacerbates the data crunch even though it improves throughput and performance
- Why small cells make it more difficult to optimize network performance even though they increase coverage and capacity
- How Cisco's hybrid SON solution gets the most out of distributed and centralized SON capabilities

Introduction

The joke used to be that LTE stood for "later than expected." Everyone was waiting for fourth-generation (4G) networks to arrive and save the industry from growing customer demand for data bandwidth and higher throughput. Smartphones and tablets arrived and the demand became even more acute and the waiting even more impatient.

Well, Long Term Evolution (LTE) technology is here and it's booming. According to the Global mobile Suppliers Association (GSA), it's the fastest growing wireless technology of all time and is projected to reach more than 350 commercially launched networks by the end of 2014 (Figure 1).

Figure 1. GSA Commercial LTE Launches, by Year

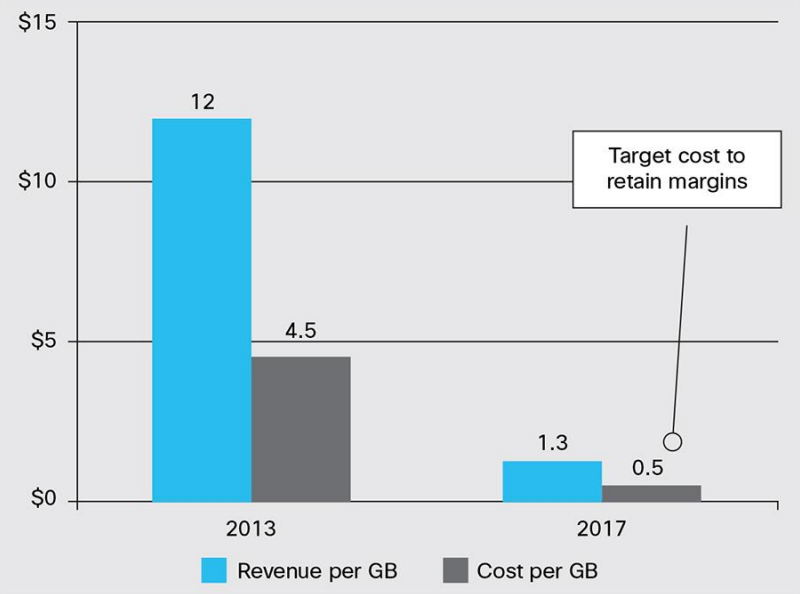


But rather than solving capacity problems, LTE is exacerbating them. It turns out that, around the world, the larger the supply, the larger the demand. Apparently, if you build the network, users will come.

- At the end of 2013, the GSMA reported in their "Global LTE network forecasts and assumptions: 2013-17" report that LTE users consume an average of 1.5 GB of data per month, almost twice the amount consumed by non-LTE users.
- In a November 2013 report on Verizon's traffic headaches, CNET reported that 4G Verizon's LTE users accounted for 64 percent of the carrier's traffic, even though they make up just a third of its customer base. And in many major cities, the traffic consumed by LTE devices is even higher.
- Last September, ABI Research projected that usage of LTE networks will grow so quickly that the data traffic on LTE will surpass that of 3G networks within three years.
- Cisco reports in the 2014 Cisco Visual Network Index™ (Cisco VNI™) that mobile data traffic will grow 11-fold from 2013 to 2018, a compound annual growth rate of 61 percent, reaching 15.9 Exabytes per month.

Demand continues to grow exponentially, but at the same time, data applications are driving down voice and small message service (SMS) revenues and average revenue per user (ARPU) is decreasing. Service providers are increasingly challenged to do more for less. So they urgently need to lower the cost per bit that travels across their LTE (le$$ than expected) networks (Figure 2).

Figure 2. Blended Traffic Revenue and Cost (Source: Analysys Mason/Cisco Research)



LTE Challenges

Although LTE does deliver simplified network architecture and higher rates of data throughput, it is not a panacea that solves all the operators' problems. Along with its demonstrated advantages, LTE introduces its own challenges.

Deployment Challenges

Deploying a new wireless technology is always expensive, and LTE deployment comes at a time when operators need to lower the “cost per bit” while maintaining the quality of user experience (QoE). In addition, operators are often required to deploy LTE rapidly and widely for two reasons. They need to meet market pressures with competitive differentiation, or they must satisfy regulatory requirements for making use of the allocated spectrum rapidly and providing mobile broadband to remote users. To lower deployment costs and provide adequate coverage, several strategies are being adopted, with individual service providers often deploying more than one:

- **Colocation:** Service providers are colocating their LTE hardware on existing third-generation (3G) sites to save the cost of site acquisition. They are also deploying multitechnology base stations and multiband antennas to maximize hardware ROI.
- **Small cells:** Small cells are increasingly seen as a low-cost solution to dense indoor coverage, and capacity boosters and are being deployed outdoors as well.
- **Network sharing:** Competing service providers are resorting to shared infrastructures to help lower costs, even at the expense of helping their competitors and reducing differentiation of coverage and capacity footprints.

These kinds of solutions can lower associated up-front costs, but they also create performance, operational, and Radio Access Network (RAN) orchestration challenges. Colocation may lead to serious problems of coverage, network performance, and inter-technology issues. It may also impose constraints on optimization. These problems, in turn, create end-user QoE issues, operational complexity, and associated higher management expenses. Money can be saved through reuse of real estate and equipment, but money must be spent to manage the problems. In addition to managing the technological and performance challenges, service providers need tools to automate the deployment process, so they can meet the conflicting demands of rapid deployment and lower operating expenses (OpEx).

Technological Challenges

LTE is frequently deployed on top of a preexisting 3G and second-generation (2G) networks. The presence of one or two additional mobile technologies complicates the RF engineering. In some cases these layers are provided by different vendors, further complicating smooth interactions. As part of LTE deployment, refarming of existing spectrum may be involved. Regardless of possible colocation or network-sharing strategies, interference, synchronization, and radio alignment must be managed.

In addition, neighbor relations and handover priorities become much more complicated, because different service providers will have different policies concerning handovers between technologies. The gradual introduction of voice over LTE (VoLTE) adds further complications, because voice has different requirements than data. Managing all these issues properly as new sites are deployed, old spectrum is reallocated, and VoLTE comes online can be daunting.

Performance Challenges

Small cells help improve coverage and capacity while reducing deployment costs. However, deploying large number of small cells presents new operational and technical challenges. Despite promises of fast, easy deployment, service providers face new issues, like grid configuration, alignment with the macro network to avoid interference on shared carriers, and establishing smooth hand-in and hand-out between the two network layers. These issues can require expensive engineering efforts to resolve.

Network sharing also reduces capital expenditures (CapEx) for shared infrastructure, and OpEx for ongoing shared management. However, it introduces its own set of RAN management problems at diverse border areas, which must be solved on an ongoing basis.

Keeping Up with Demand

The old adage that Mother's Day is the network's worst-case scenario has been replaced by "any time of any day can be Mother's Day."

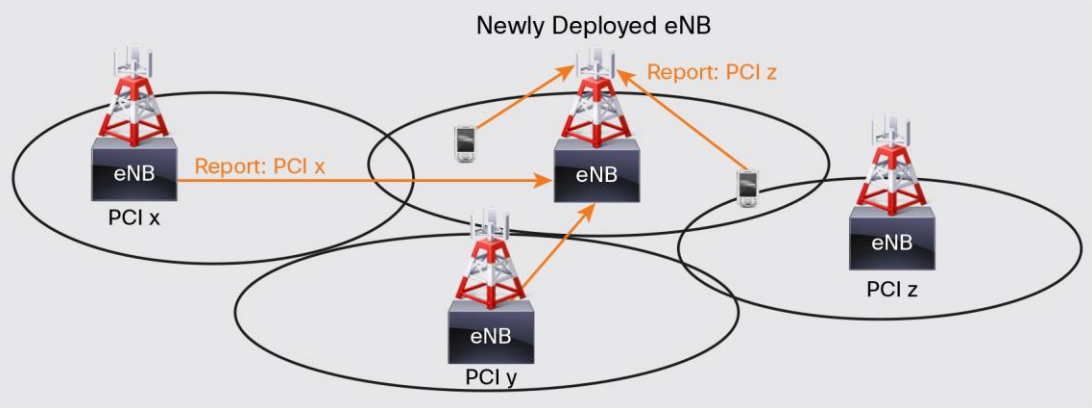
LTE deployment tends to drive up customer demand, because the opportunity to access more data at higher speeds seems to increase the appetite to do so. As more capacity becomes available, more gets used, and the usage is increasingly unpredictable. Older concepts of peak busy hour and recurring traffic patterns are no longer reliable. In this new reality, which includes a margin-strained environment, service providers must address the difficult challenge of meeting unpredictable peaks without extreme overprovisioning.

Standards to the Rescue?

The industry recognized that a common thread ran through the solutions being proposed to meet this challenge. The Next Generation Mobile Networks (NGMN) consortium determined that Self-Optimizing Networks (SON) had the potential to achieve and sustain peak network performance in a way that reduced both OpEx and CapEx. They realized that SON was essential for successful LTE rollout and management. The 3GPP translated this into standards in Release 8 and they have evolved through Releases, 9, 10, and 11 to cover topics such as self-configuration, self-optimization, and self-healing. According to 3GPP, the SON architecture can be a centralized, distributed, or hybrid solution.

At a high level, **self-configuration** (Figure 3) refers to the ability to deploy new sites in a quick and easy manner, such that the "eNB will by itself configure the Physical Cell Identity, transmission frequency, and power, leading to faster cell planning and rollout" (3GPP).

Figure 3. 3GPP PCI Reporting Self-Configuration Example



Self-optimization covers "optimization of coverage, capacity, handover, and interference" (3GPP), while **self-healing** scenarios cover automatic detection and corrective actions to handle failures. Typically the actions include adjusting the coverage and capacity of surrounding sites.

Centralized vs. Distributed SON

Major network vendors have responded to the 3GPP SON standards initiative by implementing distributed SON (dSON) functionality in their eNBs and small cells. For example, dSON solutions for LTE manage the immediate environment of the eNB or small cell, which means they cover rapid local activities, such as ANR and PCI, for LTE only. Deployment is quicker, with initial configuration handled automatically. Some operators feel that this is sufficient and do not understand the inherent limitations of such an approach. That is, dSON solutions for LTE and small cells typically only interact with other sites within their own technology and vendor. The 3GPP standard also proposed a centralized SON (cSON) that would operate at the network management layer.

Cisco believes that full optimization requires a hybrid of centralized and distributed optimization. The centralized function can optimize interactions, such as neighbor relations and interference, between technology layers and across multiple vendors, while steering the distributed functionality. This approach can achieve a superior result based on a wider view of the entire network.

Third-party vendors like Cisco created cSON to provide the necessary networkwide view and the Cisco SON solution can work as a hybrid solution to orchestrate, complement, and increase the value of built-in dSON functionality. RAN vendors, if they move beyond dSON, tend to focus initially on their own RAN equipment and are less effective in multivendor environments. Thus a third-party hybrid solution like Cisco SON helps deliver the best of both worlds.

Let the SON Shine

Cisco recognizes the need for SON in both mobile and fixed networks. With the Internet of Everything, the growth of data traffic will continue to skyrocket as sensors, meters, and connected devices from all aspects of our lives will generate ever-growing traffic. This increasingly mobile, connected world will make achieving and sustaining peak network optimization a necessity, not a luxury.

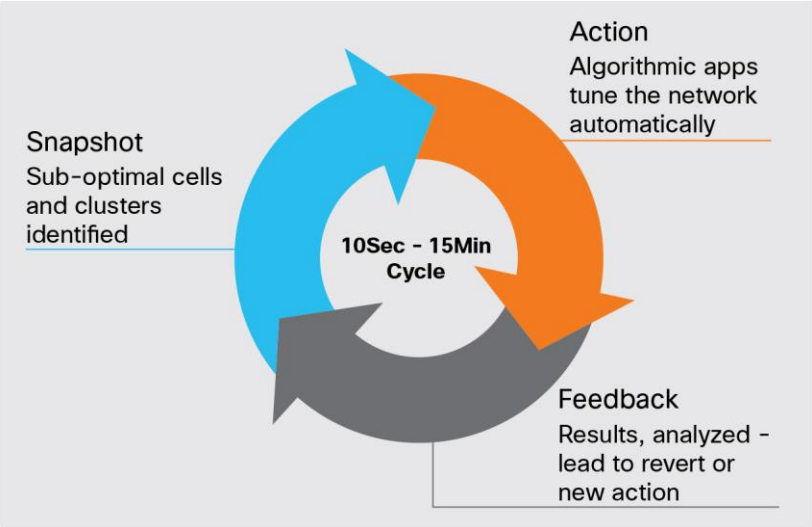
For example, connected-car data, according to various projections, is set to explode. Deutsche Telekom forecasts that, in the next few years, the volume of data transferred per vehicle per month will grow from around 4 MB to 5 GB. According to a 2012 study published by Oliver Wyman, a management consultancy company, by 2016 as many as 80 percent of all vehicles sold worldwide will be connected. In other words, around 210 million such vehicles will be on the roads. These findings suggest that a massive increase in the volumes of data to be transferred and processed is imminent.

This is one example from one industry. In the Internet of Everything world, multiple industries will generate ever more data, and much of it will be mobile. Clearly, the strain on wireless networks will only get worse.

The Cisco SON solution is designed to meet these challenges. Our multivendor, multitechnology solution addresses all the issues set forth by the 3GPP. Cisco SON is a cSON solution that was designed to work in a hybrid architecture, smoothly interoperating with multivendor, multitechnology equipment that incorporate dSON functionality.

As shown in Figure 4, Cisco SON includes a unique network visibility capability to check the current conditions of the network (**Snapshot**), fine-tune the configuration of network elements in near real-time (**Action**), and test the results (**Feedback**).

Figure 4. The Cisco SON Cycle



By operating around the clock, and constantly adjusting the network, Cisco SON helps ensure that the network dynamically keeps up with the traffic. If traffic surges or sites go down, Cisco SON is there to adjust the network, focus resources where they are most needed, and shift traffic away from overloaded areas. The feedback mechanism helps ensure that the adjustments improve the situation and unhelpful changes are immediately reverted.

For example, self-optimization features like Automatic Neighbor Relations and Dynamic Load Balancing continuously monitor traffic patterns and fine-tune the network to promote sustained optimal traffic across the network. When sites are added or go down, surrounding sites are automatically adjusted to take into account the added or decreased coverage resulting from the change. Improvements can be introduced in many ways, for example, by changing neighbor lists, altering power settings, and adjusting antenna tilts. Rather than relying only on the local optimization that dSON techniques provide through Intercell Intereference Coordination/Further Enhanced Intercell Intereference Coordination (ICIC/FEICIC), which acts as a scheduler coordinator between x2 connected eNBs, Cisco SON can take a wider view of the surrounding network and adjust power and tilt settings to solve the bigger problems.

Mass Event Optimization is another example of a Cisco SON module that greatly simplifies the challenge of managing one-time or recurring events where huge numbers of users are concentrated in a relatively small area. By regularly polling usage at short intervals and distributing the load across multiple carriers and between neighboring sites, Cisco SON can keep up with changing and surging traffic to promote optimal utilization of existing resources, in a way that is not possible manually.

Getting More for Less

So how does Cisco SON help service providers get more for less? There are three main aspects to consider: cost reduction, performance improvement, and management complexity.

Cost Reduction

Cisco SON has automated and autonomous optimization algorithms that can deliver significant OpEx reductions by freeing up engineers from tedious, repetitive (and error-prone) manual optimization tasks. New sites can be deployed more quickly and efficiently as their initial parameter configurations and optimizations are done automatically and continuously by Cisco SON. Many fewer drive tests are needed to measure and maintain network quality, because Cisco SON automatically measures network quality and autonomously adjusts the network to optimize coverage, capacity, and handovers.

CapEx is also reduced through two primary means. First, by creating and sustaining optimal load balancing, Cisco SON defers the need to deploy new sites, as network utilization is maximized. In addition, by supporting and optimizing multivendor, multitechnology interoperability, Cisco SON commoditizes the RAN and allows service providers to mix and match their RAN vendor infrastructure, which can drive down costs.

Performance Improvement

Cisco SON achieves and sustains peak capacity, coverage, and throughput by constantly monitoring and adjusting RAN parameters. Dropped calls are reduced; load is better distributed; interference is curbed; and throughput is increased. Special modules handle mass participation events by working at 15-second intervals to help ensure that load is balanced across all available carriers and sites. The net result is that more traffic can flow across a deployed infrastructure, and revenues can be correspondingly higher. Quality of experience and customer satisfaction are likely to be increased as well, helping to reduce churn.

Complexity Management

The challenges of managing a RAN are increasing dramatically. Service providers often deal with a combination of 2G, 3G, and 4G technologies, from a mix of different vendors. Add service provider Wi-Fi, along with the growing trend to densify networks with massive small cell deployments, and the mix of skills and expertise required to manage these heterogeneous networks is expanding all the time. Cisco SON also helps solve this problem. By transparently interfacing with different technologies and vendors and automatically optimizing their interactions, Cisco SON helps reduce the need for manual specialization to support all these interfaces.

Conclusion

Tomorrow’s industry directions require hybrid cSON solutions today. Cisco offers the widest industry deployment of cSON worldwide and looks forward to working with service providers to help ensure that they get the most out of their infrastructure investments.

For More Information

- http://www.cisco.com/c/en/us/products/wireless/son-suite/index.html.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

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