

Cisco SON for Small Cells: Reduce OpEx and Improve Quality of Experience

What You Will Learn

As wireless operators deploy more small cells to offload the macro network, automated provisioning and optimization become indispensable. This white paper explains the value of the Cisco SON for Small Cells:

- Significantly lower today's capital expenditures (CapEx) and operating expenses (OpEx)
- Increase savings as you add more small cells
- Improve the quality of experience to reduce churn
- Extend the life of existing equipment, because the solution works with all radio access network (RAN) layers and multiple vendors' equipment

Managing More Small Cells: A Growing Challenge

Globally, IP traffic will grow three-fold from 2012 to 2017, a compound annual growth rate of 23 percent.¹ To serve more users in the same area, operators are deploying small cells to offload the macro network. Small cells help improve the user experience indoors, where more than 70 percent of data traffic is consumed.

You are probably deploying different types of small cells from multiple vendors, including residential small cells, indoor small cells for buildings, and public small cells in indoor hotspots. Most 3G small cells today are **passive** in operation - they do some auto-configuration on start-up but can't react to changes in traffic or in their radio environment. Others, such as Cisco Universal Small Cells and some other 4G small cells, are **auto-adaptive** - they employ algorithms to adapt constantly to their micro-environment, but they cannot see what is happening in the wider radio network.

But manually configuring and optimizing a large number of small cells, often with a mix of passive and auto-adaptive capabilities, is not practical. For example, suppose a customer with an office small cell complains that the connection is dropped near the window - a frequent occurrence. Today, you need to dispatch two technicians. One performs a site survey to find outdoor macro base stations with the strongest signal, then manually configures the small cell's neighbor list. Another technician needs to manually enter small-cell neighbors in the macro cell base station. This work might take a full day. And the next time the network changes - which might be the next day - the user experience suffers until technicians can manually make another set of changes.

The time it takes to manually configure and optimize passive small cells also degrades the quality of experience for customers who are connected to your macro cells. One reason is that the signal from a small cell placed near a window can leak outside and cause interference. Placing the small cell far away from the window doesn't solve the interference problem. Instead, a smartphone used near a window needs to emit a strong signal, which can also cause interference at the macro cell.

The more small cells you deploy, the more challenging it is to manage interference. To provide a consistent quality of experience, you need a solution that automatically optimizes performance at all layers of the RAN.

¹ Source: [Cisco Visual Networking Index](#).

Lower the Costs of Optimizing HetNets

To minimize OpEx, choose a solution that:

- Works with macro as well as small cells
- Works with any vendor's equipment in all layers
- Lets you deploy new cells in minutes
- Works with passive and auto-adaptive small cells
- Does not require advance planning for deployment - the main reason deployment currently takes weeks or months
- Automates handover between small cells and macro cells
- Continually monitors the RF scenario, automates changes, and automates rollback if the change does not improve performance

Three Requirements for Managing Multilayer RANs

Optimizing performance in a multilayer RAN requires three new kinds of capabilities. The first kind is recognizing and optimizing all cells at all layers, including LTE/4G, 3G, small cells, and Wi-Fi. The self-optimization software built into your base stations is not enough, because it cannot see changes in the small-cell environment that affect macro-cell performance.

Second, the management solution needs to work with equipment from multiple vendors. Although base stations from different vendors can share neighbor relations and interference information, they typically do not know what to do with the information. To optimize performance, you need centralized management software that can orchestrate the operations in a heterogeneous network (HetNet).

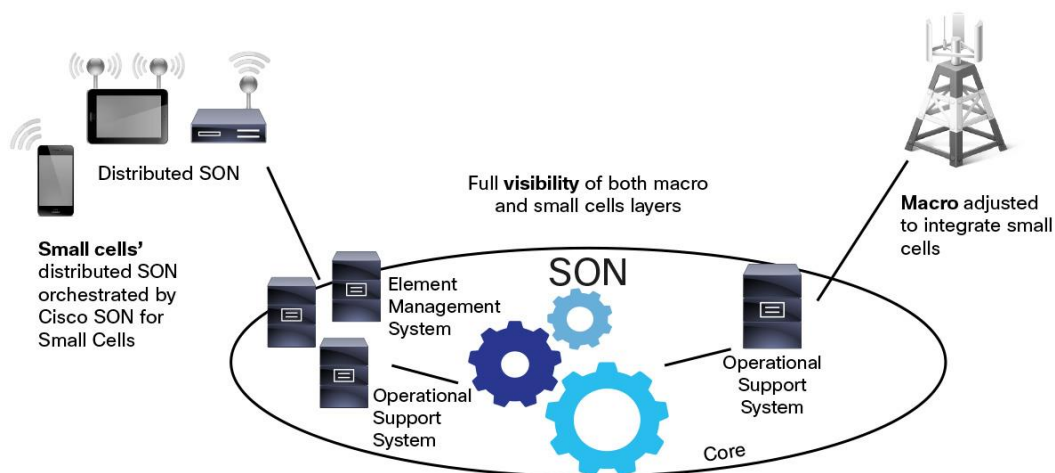
Third, the solution needs to continually optimize small-cell configuration. Some management solutions collect key performance indicators (KPIs) and push out hundreds of thousands of configuration changes every three to six months. But in between

updates, performance declines. And if an error occurs, pinpointing the responsible change among thousands is difficult.

Cisco SON for Small Cell Solution

The Cisco SON for Small Cell solution works with any type of cell, anywhere in the network. The cells can be passive or auto-adaptive. As shown in Figure 1, the software is deployed centrally to provide zero-touch integration of small cells into the macro cell. It automatically detects the location of small cells and identifies macro stations that are handover targets.

Figure 1. Connect Small Cells with the Macro Network to Create a Heterogeneous RAN



To continually optimize performance, the Cisco SON for Small Cells solution uses algorithms to identify a change that might improve the quality of experience. It makes the change automatically and then monitors the results for a few seconds or a few minutes. If the change improves performance, even just a little, the software looks for another optimization. If the configuration change does not improve performance, the software reverts to the original configuration (Figure 2).

Figure 2. Dynamic Self-Optimizing Network (SON): A Closed Loop

**Real-Time Diagnosis
"Snapshot"**

Faulty and underperforming cells and clusters identified

**Automatic Adjustment
"Action"**

Algorithmic applications tweak the network without engineer involvement



Instant Feedback

Results captured, analyzed - and lead to new adjustments

The following features of the Cisco SON for Small Cells solution optimize the user experience and reduce management time.

Effective Macro Offload and Load Balancing

Challenge: The power disparity between macro and small cells is very large. If you use normal cell selection procedures, most smartphones and tablets connect to the macro cell. This is true even if the small-cells layer provide more total capacity, which limits the value of small cells.

Cisco solution: The solution increases utilization of small cells by dynamically steering users in between layers (macro cells and small cells). It makes decisions based on real-time network load and the user experience. When the macro is fully loaded, the solution steers more users to the small cell. If the small cell becomes loaded, the solution steers more users to the macro cell.

Hand-In from the Macro Network

Challenge: For hand-in from the macro network to small cells, each small cell must have a unique primary scrambling code (PSC) and a neighbor relation with the macro cell. This is not possible in large deployments because of the limited number of PSCs.

Cisco solution: The solution allocates unique PSCs and creates a neighbor relation with the small cells that are targets for hand-in, such as the entry cells near the building entrance. It also supports mobility within the grid of small cells.

Neighbor Management

Challenge: Macro cells need a way to recognize neighboring small cells for hand-off. Many small cells can create a neighbor list by sniffing their environment. But indoor small cells cannot create neighbor relations with indoor or outdoor cells that they cannot detect. They can't hand over calls to hidden neighbors, resulting in dropped calls.

Cisco solution: The solution automatically creates neighbor relations between macro cells and small cells. This approach minimizes the dropped call rate (DCR) by only creating neighbor relations where small cells are actually installed. The solution also automatically adds missing neighbors that the small cell could not detect.

Scrambling Code Optimization

Challenge: PSCs are used for macro cells as well as small cells. So generally, there are not enough for every small cell. Too few PSCs in the small cell network leads to collisions, which degrade wireless performance.

Cisco solution: The solution dynamically detects available PSCs in each small cell's location, allocating them to the small cells that need them at the moment. This technique effectively increases the number of available PSCs because small cells in different areas can use the same codes. The solution also monitors PSC collisions and uses this information to optimize PSC allocation.

Why Cisco?

Cisco provides a SON solution that works across multiple network layers and with multiple vendors' equipment. We are also a market leader for small cells. When you work with us, you benefit from our experience working with operators around the world.

Conclusion

Deploy Cisco SON for Small Cells solution to:

- Optimize the performance of your existing base stations and small cells from any vendor, postponing new equipment purchases
- Decrease OpEx by not having to plan ahead for deployment, dispatch technicians to perform site surveys and manually change configurations, and allocate staff time to ongoing optimization
- Increase profitability by improving quality of experience, helping to retain and attract customers

For More Information

To learn more about Cisco SON for Small Cells, visit the [Cisco SON Page](#).

To learn more about Cisco's Universal Small Cell solution, visit the [Small Cell Solutions Page](#).



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