Cisco Universal Small Cell RAN Management System

Product Overview

Today's large number of small cell devices, the wide array of small cell deployment scenarios, and advanced interference management requirements are some of the challenges that small cell management systems must address. What's the best approach for managing small cell deployments? Automate all key activation and management tasks. Aside from enhancing efficiency, this lowers your operational costs. That's what the Cisco® Universal Small Cell RAN Management System (USC RMS) delivers. A key component of the Cisco Licensed Small Cell solution, it is a standards-based provisioning and management system for Home Node B (HNB) for 3G and Home evolved Node B (HeNB) for 4G LTE small cell access points.

The Cisco USC RMS provides the following small cell management functions:

- Activation
- Configuration
- Firmware management
- Fault management
- Performance management
- Care and troubleshooting
- Status monitoring

Reduce Costs, Improve Coverage and Capacity

The Cisco Licensed Small Cell Solution (Figure 1) is designed to address the challenge of mobile service coverage and to expand network capacity. Small cells extend voice and data services to mobile subscribers while offloading traffic from the macro network. Additionally, Cisco small cell capabilities are uniquely used to deploy consumer services that are based on indoor location and presence and new enterprise services such as integration with enterprise voice systems and access to local enterprise networks.

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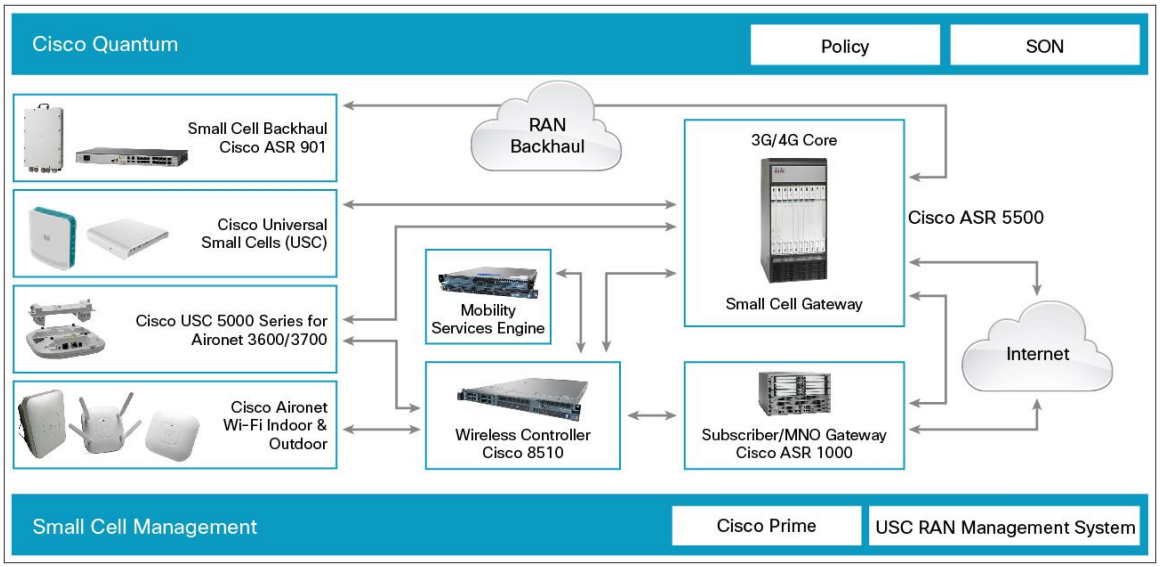
Figure 1. Cisco Small Cell Solution



The Cisco Licensed Small Cell Solution represents what we've learned from our extensive experience deploying residential femtocells, implementing scalable carrier backhaul and rolling out Cisco Service Provider Wi-Fi to a rapidly growing base of customers. This experience has allowed Cisco to deliver a comprehensive solution that addresses the real-world challenges of small cell deployments. Among the challenges we've addressed are interference management, network security, broadband backhaul requirements, access control, zero-touch provisioning, and mobility. The Cisco Licensed Small Cell Solution is fully deployable today and complies with the small cell architecture and interfaces as defined in the 3GPP standards, delivering unprecedented Quality of Experience (QoE).

Cisco Licensed Small Cell Architecture

The Cisco Licensed Small Cell Solution is an end-to-end architecture. The primary elements depicted in Figure 2 are:

- Enterprise and home small cells
- Small cell gateway
- Management and provisioning
- Small cell backhaul

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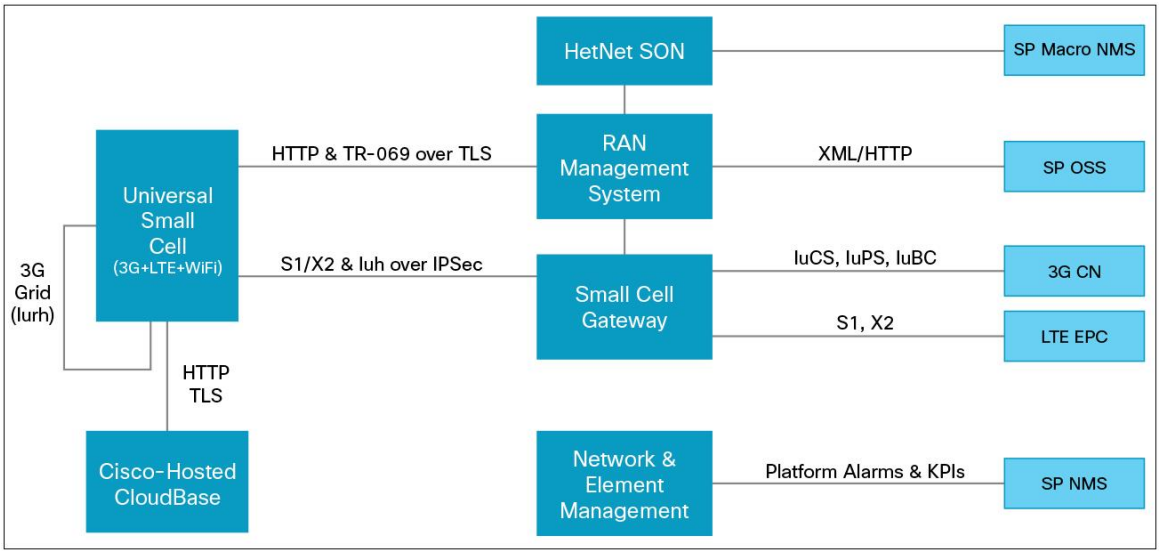
Figure 2. Cisco Small Cell Architecture



Small Cell Network Management Challenge

The requirements for provisioning and configuration management in small cell network differ in many ways from traditional RAN management systems. They include:

- Large number of small cell devices
  - Small cell management should be a scalable solution
  - Should support automation of functions
  - Automation of parameter selection/assignment is critical
- Direct impact on the end user QoE connected closely to these devices
  - High availability of the provisioning and management platform
  - Flexible and comprehensive monitoring functionality
  - Need for continuous optimization and support for SON solutions
  - Advanced customer care support
- Difficulty in physically accessing the small cell devices by SP technicians
  - Advanced remote management capabilities
  - Zero touch provisioning and management
- Different use cases: residential, enterprise, public, multiple technologies
  - Management platform for all deployment scenarios
  - Multi technology support
  - Support for standalone and multimode devices
- The need for confirmation before service enablement (e.g. based on location or tampering)

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Features and Benefits

The Cisco USC RMS addresses these needs, by providing the following operator benefits:

Reduced costs through:

- Automation of key activation and management tasks
- Field proven zero-touch provisioning
- Advanced group management capabilities
- Geo based auto-configuration
- Comprehensive CLI tools for reporting and to assist in bulk operations
- Award-winning heartbeat status monitoring
- Complete and proven support for Self-Optimizing/Organizing Network (SON)

Faster time to deployment due to:

- Pre-tested elements of the Cisco Small Cell Solution, so no interoperability testing is needed for new release introduction
- Unified architecture that simultaneously covers multiple deployment scenarios, from residential to enterprise to public implementations
- High capacity, high availability solution that scales to manage millions of devices with proven high availability - greater than 99.999 percent uptime - on the largest worldwide small cell network
- A distributed architecture that allows horizontal scalability to extend the RMS depending on network growth

Flexible integration with operation support systems and business support systems (OSS/BSS):

- Advanced APIs and interfaces allow for an easy and flexible integration with the operator provisioning chain and Certificate Signing Request (CSR) tools
- Advanced features such as group management and auto-configuration capabilities reduce the complexity of integration in the operator network and the amount of parameters to be managed in the customer network

Built on standards:

- Cisco small cell management is a standards-based (3GPP, TR-069, TR-196) field proven solution managing some of the world’s largest small cell networks

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The Cisco USC RMS includes these functional components (Figure 3 and Table 1):

Figure 3. Cisco USC RMS Functional Components

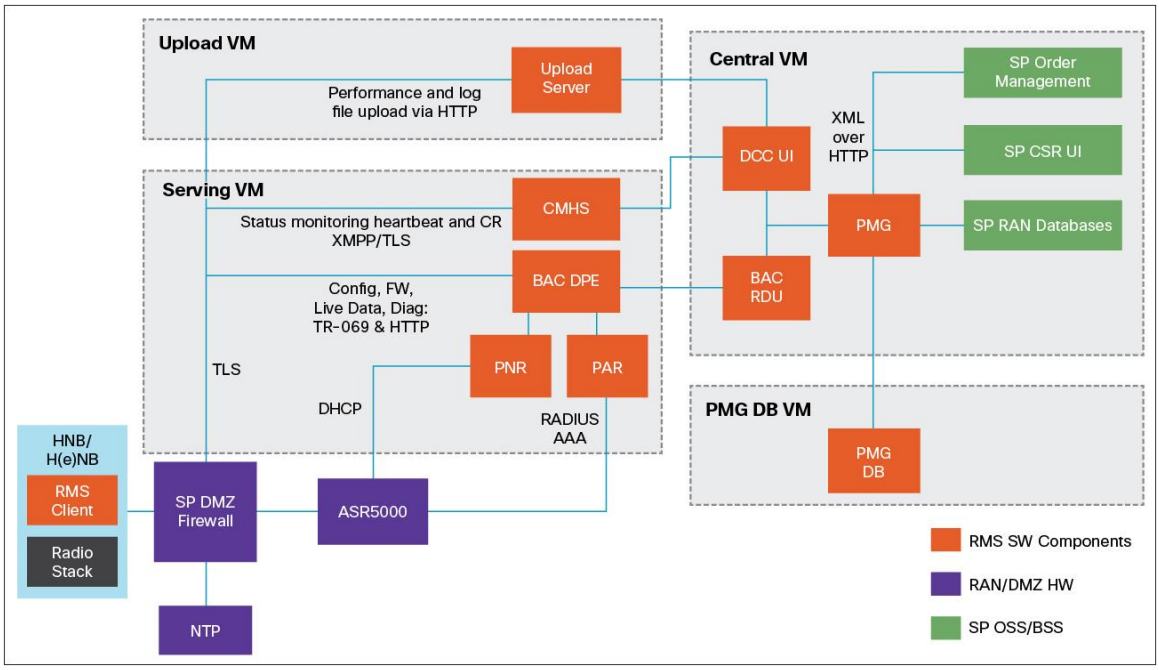

Table 1. Cisco USC RMS Components

Full Name	Description
Broadband Access Center (BAC)	A versatile TR-069 management system that provides all essential small cell management functions including configuration, firmware, data retrieval, troubleshooting. Consists of the Device Provisioning Engine (DPE), which provides service broker (SB) services and regional device unit (RDU) central functions.
Provisioning and Management Gateway (PMG)	Provides northbound (NB) API to OSS/BSS/IT. XML/HTTP requests and notifications. Small cell activation workflow with PMG and BAC. Allows automatic assignment of gateways, SAI, Cell ID, location-specific parameters and whitelist management.
Device Command and Control (DCC)	UI and CLI tools for small cell-specific provisioning functions. Provides GUI, CSR interfaces and administration tools for operations personnel.
Cisco Management Heartbeat Server (CMHS)	A highly scalable XMPP-based service, which is designed for active status monitoring of small cells. This service provides real-time monitoring and management functions not covered by TR-069 protocols.
Upload Server (US)	A high-scale service for receiving uploads from the small cells, including periodic performance data, logs and traces.
Cisco Prime™ Access Registrar (PAR)	Cisco AAA product. Provides AP authentication on HNB-GW and delivers AP whitelists to HNB-GW via RADIUS.
Cisco Prime Network Registrar (PNR)	Cisco DHCP product. Used to allocate IPSec addresses for SeGW via DHCP. The lease database can then be queried to discover the current AP IP address.
Provisioning and Management Gateway Database (PMG DB)	Provides translation service from LAT/LONG into area for advanced Geo based provisioning mechanism.

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The Cisco USC RMS provides the following features:

Zero-Touch Activation

A key challenge in managing small cells is to provide a full plug and play solution allowing zero touch provisioning of the small cell access points. After plugging the devices into the home or enterprise network, provisioning, auto-configuration and self-optimization are launched automatically. The devices are up and running without any end user or operator intervention. For a full plug and play solution, USC RMS provides advanced capabilities to automate small cell configuration and optimization. The auto-configuration is provided at the small cell access point level or at a group level. These capabilities are key to zero touch provisioning and provide for specific operator requirements and configuration scenarios.

Backend Integration for Zero-Touch Activation

To enable the zero-touch flow, it is often necessary to integrate with the service provider's existing OSS/BSS systems such as billing systems, subscriber management systems, e911 systems, spectrum data, registration portal, etc. The integration flows can go in both directions with some data supplied by the service provider OSS to the Cisco USC RMS, and with other flows going from the USC RMS to the SP service provider OSS. Several Cisco USC RMS components work in unison with the service provider OSS/BSS to accomplish the zero-touch tasks.

Location Verification

Location verification is essential to the small cell activation process for two reasons:

- It may be necessary to know location of the small cell for emergency calling and
- It is important to prevent the small cell from radiating on the wrong frequency, thus violating regulatory requirements.

The Cisco USC RMS provides a number of methods of small cell location verification and detection of location change in general alignment with 3GPP standards. These methods include GPS, Macro check/Radio Neighbor check, and IP address check

Configuration

The configuration of the small cell is accomplished using the TR-069 protocol and the TR-196 data model. Small cell settings for configuration and operational parameters can be managed at a group level or individual device level. Having device grouping at the RMS level reduces the effort of managing parameters in a customer's IT system. These groups can be customized depending on customer specific use cases and customers can create their own group types and select a parameters list for each created group.

Firmware and Software

The firmware and software on the small cell is managed using an automated process. Multiple use-cases for firmware upgrades are supported, including:

- Automatic upgrade on initial activation
- On-demand upgrade of individual small cell
- Bulk upgrade during maintenance window
- Automatic on-connect upgrade
- Rollback of firmware if required

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Fault Management

The TR-196 data model allows small cells to expose extensive fault information. For Enterprise environments, the small cell can be configured to send TR-069 notifications to the DPE that can in turn transform them into SNMP alarms and send to the SP OSS. In large-scale deployments, the key status indicators of the small cells can be monitored via CMHS and periodic bulk reports.

Performance Management

The small cells can be configured to automatically upload performance data to the upload server at user-defined intervals. The upload server can package and transform this data for consumption by the service provider performance management systems.

Registration and Care Functions

Mobile operators typically have existing customer registration and support care portals for their support personnel. The Cisco USC RMS provides simple integration interfaces to add small cell care functions into existing service provider systems.

The PMG API provides a XML/HTTP interface which supports a number of troubleshooting functions including:

- Register and update device information
- View registration data
- View small cell status
- View small cell alarms
- Reboot small cell
- Change subscription
- Block/unblock service
- De-activate service

These functions are also available in the Cisco USC RMS UIs for administrators and Tier 3 support personnel. The USC RMS UI provides additional low-level support functionality for deep troubleshooting with audit data and log uploads.

Status Monitoring

The small cell Status Monitoring functions allow service provider operations personnel to quickly assess the operational state of the small cell deployment. For example, the operator can get a quick view of the number of small cells that have a radio up or down in the entire deployment. The status data maintained at the CMHS servers can be queried by reporting tools and combined with provisioning data into reports. This data can also be exported in bulk in CSV formats. When troubleshooting a specific small cell, the status monitoring data provides a history of small cell connectivity and may help isolate connectivity issues from service issue.

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Reporting

The Cisco USC RMS provides detailed reports about small cell provisioning, activation and operational status. These reports can be provided in the CSV file formats suitable for import into Excel or other tools. This opens up infinite opportunities for manipulating report data. The reporting tools are able to gather multiple types of data from multiple sources, including:

- Registration data in RDU
- Discovered data in RDU
- Provisioning status data in RDU
- Status data from CMHS
- Live data from small cells

The data from multiple sources can be combined into a single CSV report. The reports can be scheduled or can be executed on-demand with custom parameters.

Self-Optimizing Network Support

The Cisco USC RMS provides the necessary northbound APIs, notifications and reports to support with multivendor self-optimizing network (SON) and network intelligence into the RAN. The Cisco USC RMS facilitates automatic configuration changes of small cell access points to facilitate real time optimization.

Redundancy and Failover

The Cisco USC RMS can be deployed with no single point of failure. Every component supports local and geographic redundancy. The servers that interact directly with the small cells support Active-Active redundancy and full automatic switchover. They can also perform ongoing functions when connectivity to the central servers is lost.

The central servers (RDU, PMG) support redundancy via Active-Hot standby and automatic switchover process. This also handles the cases of disaster recovery. In addition, the Cisco USC RMS supports full backup and restore of important data.

Security

All protocols for interactions with the small cells support highly secure connections. For TR-069, HTTP downloads and HTTP uploads, the Cisco USC RMS supports TLS. The CMHS uses TLS for XMPP. The TLS option provides for an end-to-end mutual authentication of small cell and USC RMS servers. Mutual authentication with TLS can take advantage of client-side certificates on the small cell. The Cisco USC RMS can provide hosting of the certificate revocation lists (CRLs) issuing by the certificate authority.

Hardware Platform

All components of the Cisco USC RMS are deployed as software applications on general-purpose Cisco Unified Computing System™ rack or blade servers. USC RMS supports various deployment architectures to provide service provider full flexibility based on network size.

- Cost optimized single server configuration for small network deployments
- Distributed server architecture for medium to large network deployments

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Product Specifications

Table 2 lists the product specifications for the Cisco USC RMS.

Table 2. Product Specifications

Item	Specification
Protocols	TR-069, TR-196v2
Components	BAC-TW, RDU, PMG, CMHS, Upload Server, DCC UI, PNR, PAR
Connectivity	Small cell to USC RMS connectivity via highly secure TLS
Reliability and availability	99.999%
Management and security	SNMPv2 TLS 1.2

System Requirements

Table 3 lists the of system requirements that must be in place in order to install the Cisco USC RMS.

Table 3. System Requirements

Item	Requirement
Disk space	5 TB
Hardware	UCS C240 server
Memory	128 GB
Software	RHEL, VMware vSphere 5.5, vCenter 5.5 (RMS5.1MR) RHEL, VMware vSphere 6.0, vCenter 6.0 (RMS5.2)

Warranty Information

Find warranty information on Cisco.com at the Product Warranties page.

Ordering Information

To place an order, visit the Cisco Ordering Home Page. To download software, visit the Cisco Software Center. Table 4 lists the ordering information.

Table 4. Ordering Information

Description	Part Number
Cisco Universal Small Cell RAN Management System - USC RAN Mgmt SW, Base SW - RMS 5.1MR	SC-RMS-BASE-5.1MR
Cisco Universal Small Cell RAN Management System - USC RAN Mgmt SW, Base SW - RMS 5.2	SC-RMS-BASE-5.2

Cisco Small Cell Services

The Cisco Small Cell Solution is delivered by Cisco Services, an organization with exceptional experience and expertise in implementing large commercial small cell deployments and providing world-class systems service integration. With specialized tools, knowledge, methodologies, best practices, and a collaborative delivery model that combines Cisco expertise with our partners' and customers' capabilities, Cisco Services achieves superior results.

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For More Information

For more information about the Cisco USC RMS, visit http://www.cisco.com/go/smallcell, or contact your local account representative.

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