SCT-220
SpiderCloud E-RAN System Description

CLARO AR (AMX)
Cordoba, Argentina
April, 2017

SpiderCloud Wireless

Deployment Process

Site Survey,

RF Survey,
System Dimensioning and RF Planning,

Integration & Optimization

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Site Survey

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Site Survey

- Site survey is essential so the E-RAN can be planned and deployed with all the necessary equipment and functions as intended.
- Site survey should be done with as much information as possible recorded.
- Site survey should cover:
  - Customer Information
  - Building Details
  - SpiderCloud Wireless Equipment Installation
  - RF Walk
  - Evaluation Summary

Sample Site Survey: Customer Information

Item	Description
Company name	Fenway West Investments
Type of business	Financial services
Number of users	800
Contact name	Rich Garces, IT Head
Contact phone number	310-555-1212
Contact email address	rich.garces@fenwaywest.net
Notes	Rich is the IT Head and in charge of all technology and infrastructure projects at Fenway West. Any high-level questions should be routed through him, though he will designate someone to work with us on the physical installation and internal network infrastructure.

Sample Site Survey: Building Details

Item	Description
Building name and number(s)	Plumeria Gardens, # 1
Address	512 East Plumeria Drive San Jose, CA 9534 USA
Available parking?	Surface lot
Hours of access	08:00 through 18:00, and by appointment
Security required	Employees have photo IDs displayed at all times. Guests register for temporary badges, which also must be on display at all times. There are undercover security personnel on premises at all times.
Security restrictions	Metal detectors at all entrances
Current macro coverage	Poor
Specific coverage requirements	They are looking to greatly expand their data throughput and cellular reliability. Auditorium holds meetings with up to 400 attendees.

Sample Site Survey: Building Details (cont.)

Item	Description
Building type and wall fabrication: (open plan office, office with individual rooms, warehouse or factory)	Mostly open with cubicles. 9 conference rooms, one break room/cafeteria, on each floor. One large IT room and one loading dock, auditorium, and storage area on ground floor.
Ceiling heights and construction	14 feet with asbestos tile
Number of floors	4
Dimensions of each floor	200’ by 440’
Location of building ingress and egress points	1 front, 1 side, 2 rear including loading dock
Other businesses in building	No
Number of common/meeting rooms	37
Health and safety issues	None

Sample Site Survey: Building Details (cont. 2)

Item	Description
Current systems in use (desk phones/Wi-Fi/DAS)	Landline desk phones, Wi-Fi
Patch panel locations	In dedicated closet
Building maintenance company	Tiante Maintenance Pros
Directions to site	From the San Jose Airport
Head northwest on Airport Blvd toward Airport Pkwy 0.2 mi Slight right onto Airport Pkwy 0.5 mi Continue onto E Brokaw Rd 0.5 mi Turn left onto Zanker Rd 1.4 mi Turn right onto E Plumeria Dr Destination will be on the right 0.3 mi	

Sample Site Survey: Building Details (cont. 3)

Sample Site Survey: SpiderCloud Equipment

Item	Description
Is the cable running above the ceiling with trays, or beneath the floor?	Above the ceiling
The total Cat 5e cable length between the enterprise switch and each radio node should be shorter than 100 meters (328 feet). Plan RN locations accordingly or add take into account extra PoE+ switches.	Yes, Cat6
Type and location of enterprise switch	(1) 5500-24G-SFP main switch (3) HP 1910-8G-PoE+ (180W) closet switches
Is fiber available for inter-story connectivity?	Yes
Potential coverage issues (elevator shafts, atriums, basements, underground parking lots)	Elevator and three stairwells.
Potential installation issues (fire systems, CCTV, other equipment)	None

Sample Site Survey: SpiderCloud Equipment (2)

Item	Description
Special installation equipment (ladders, drills, radio node padlocks)	Radio node padlocks
Number of Rack Units (RUs) allocated for the services node. Trial sites could require 4RU. Pilot sites require 2RU.	1 services nodes
Enter the rack space dimensions. The services node requires at least: Height: 4.37 centimeters (1.72 inches) Width: 44.83 centimeters (17.65 inches) Depth: 60.33 centimeters (23.75 inches) Ensure sufficient depth to account for proper cable bend radius if the rack contains a front door.	19” x 23”
Services node rack: free-standing or wall-mounted?	Free-standing cabinet
Is the rack seismically reinforced?	Yes
Is there maintenance access to front and rear of rack?	Yes

Sample Site Survey: SpiderCloud Equipment (3)

Item	Description
If the rack or cabinet has doors, will there be room for SFPs, antennas, and cables with the doors closed?	Yes, see attached photograph
Is the rack power provisioned?	Yes
Enter the power socket type (such as IEC or Euro, male to female kettle lead, or kettle lead to 3-prong)	Redundant hot plug - 48-60V 20A DC power supplies
Are there standby power arrangements?	Yes, UPS and generator
Have the services node power requirements been verified? Input voltage: AC 100V to 120V, or 200V to 240V Frequency: 50 to 60 Hz Input current:4.5 Amps (maximum) Input power: 150W	Yes

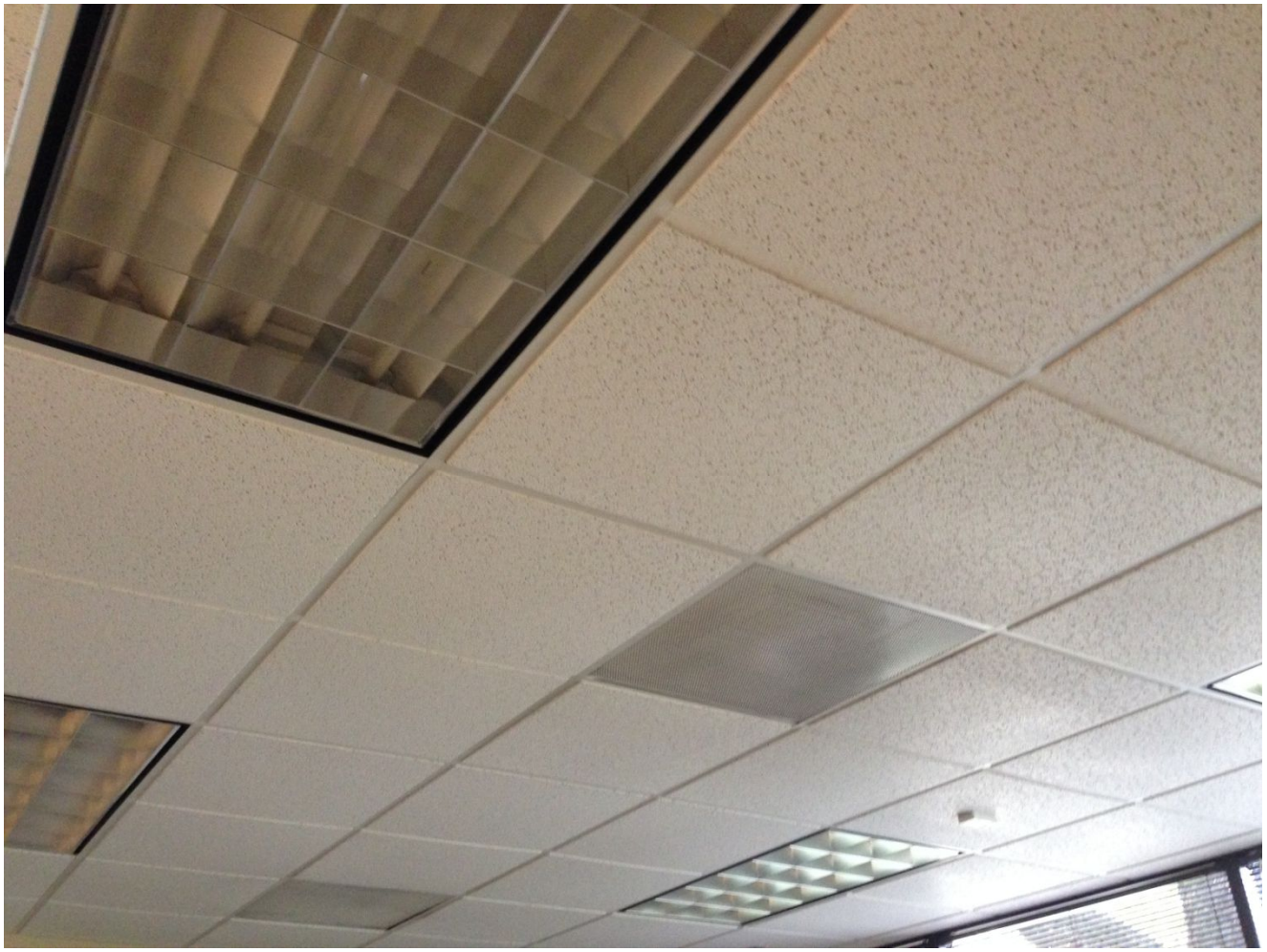
Sample Site Survey: SpiderCloud Equipment (4)

Item	Description
Have PoE+ radio node power requirements been provided?	Yes, PoE+ injectors
Describe the operating environment (temperature, humidity, ventilation)	Normal office environment

Sample Site Survey: Front Entrance

Sample Site Survey: Reception Area

Sample Site Survey: Typical Ceiling



Sample Site Survey: Airport Directions

Quiz

Q: What is the maximum distance for power and data when using PoE?

A: 100m (333ft) is the maximum distance between the Ethernet source and the Ethernet client.

Q: How many rack units are required are at the site?

A: SN needs 1 RU space. If a aggregator switch is used then you need 2.

Q: What are the 5 things covered in site survey?

A: Customer Information, Building Details, SpiderCloud Wireless Equipment Installation, RF Walk, Evaluation Summary

Q: How is the RN powered?

A: SCRN 310 requires PoE+

Q: What is the main purpose of RF Site Walk?

A: To understand the macro co-channel interference.

RF Survey

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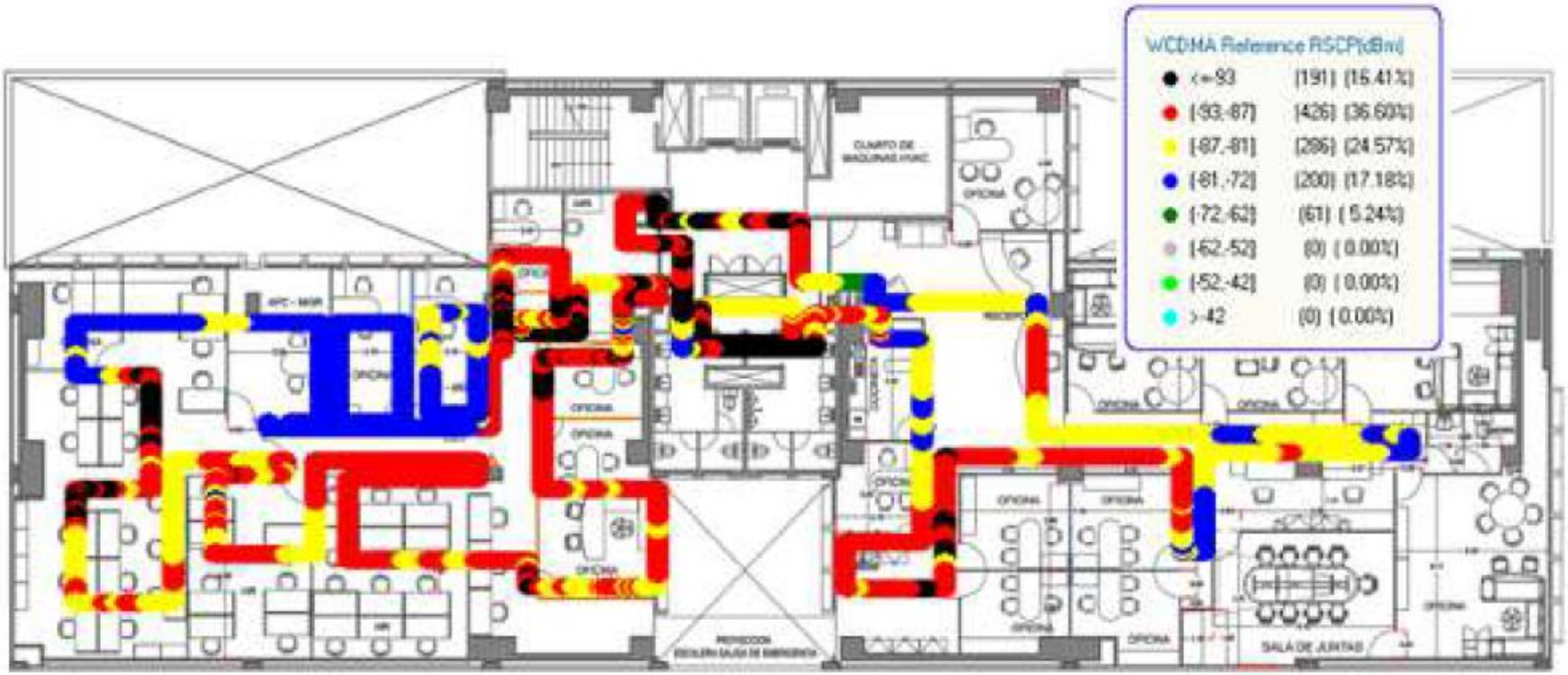
RF Survey

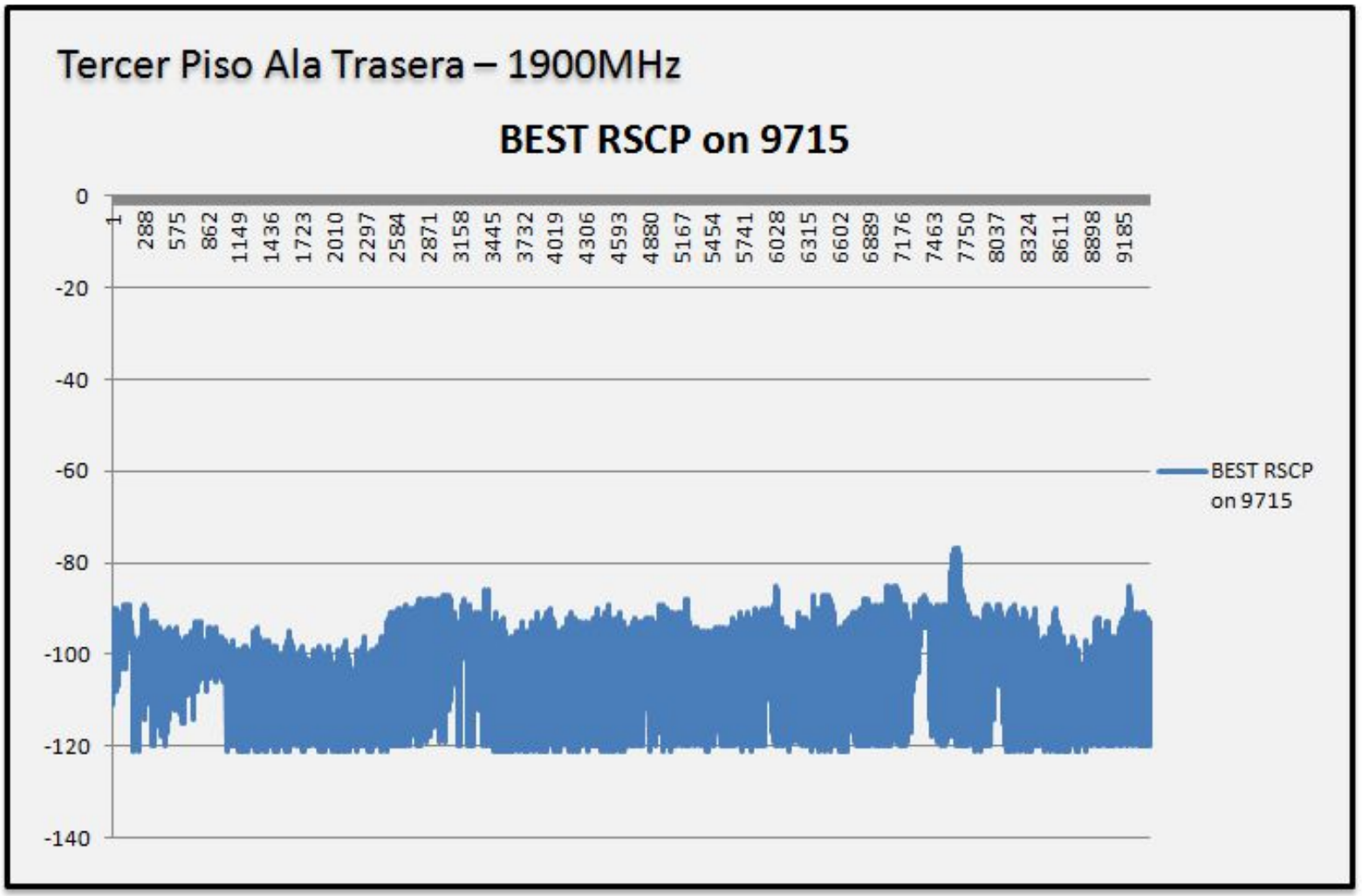
- RF walk test should be done using TEMS so we can record the current RF environment.
- For the test the device should be connected to co-channel LTE EARFCN.
- The test needs to be carried out on all floors where the E-RAN is to be installed.
- Whilst walking the floors, ensure you test all areas including any small rooms (toilets, canteens etc.), stairways and other areas that could potentially effect the E-RAN performance as well as the complete internal perimeter to see what the current Macro environment is showing.
- This information is vital in the planning and optimization of the E-RAN. The goal of this walk is to understand how strong is the co-channel macro in the building. This information will help determine the number of RN's required and if certain area's need additional RN's.

RF Survey – Walk-Test



RSCP (3G 1900 MHz) Piso 4

RF Site Survey Walk



Evaluation Summary

- This part of the site survey should cover the following information:
  - Number of people in building.
  - If desk phones are provided to the employees.
  - Staircase, elevators, atriums etc. should be noted.
  - Special coverage areas like conference rooms and cafeteria.
  - Determine ingress locations for each floor.
- All this information will determine how many radio nodes are required as well as help predict the call volume.

System Dimensioning and RF Planning

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System Dimensioning Tool

- System dimensioning tool is available on the SpiderCloud customer support portal.
- System dimensioning tool is also available on Spidercloud E-RAN Estimator app.
- This app works on both iOS and Android software and can be downloaded via App Strore(iOS) or Google Play(Android).
- Search for E-RAN Estimator in the app store.

System Dimensioning Tool (cont.)

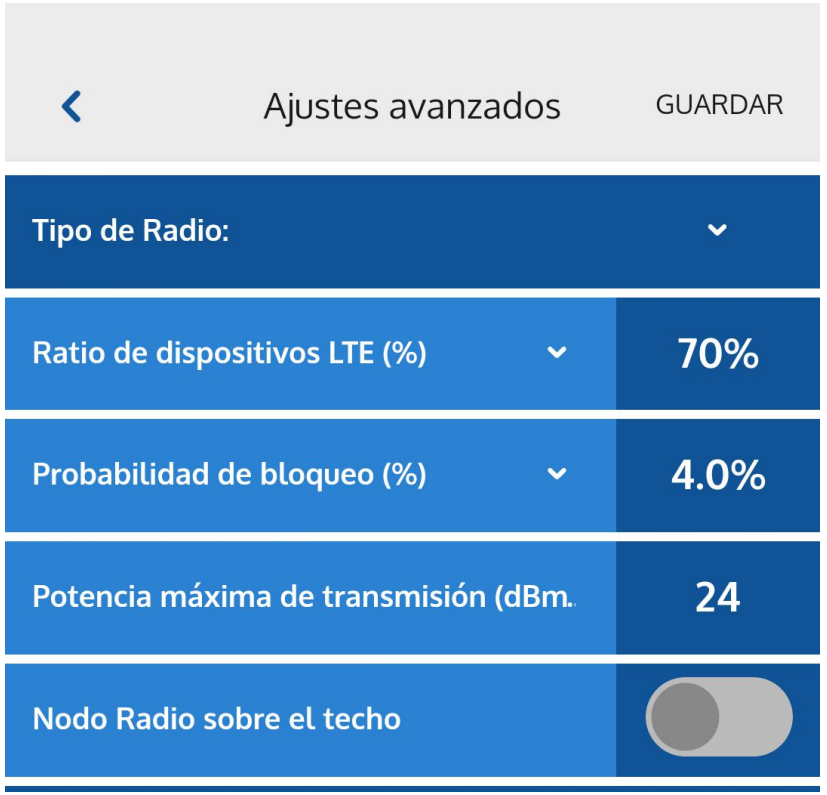
- Dimensioning tool helps in determining backhaul requirements, number of radio nodes and approximated separation between radio nodes.
- Based on the data collected during site survey input the number of floors, coverage area per floor, approximate number of subscribers and macro interference.
- Determine if the radio nodes are going to be placed above or below the ceiling. The tool assumes the ceiling tile loss of 3dB.

System Dimensioning Tool (cont.)

- Coverage Area class – Determined by type of building based on site survey

Class	Type of Facility
A	Shopping centers, conference halls, warehouses, factories with low shelving
B	Warehouses and factories with high shelving or large machinery
C	Open plan offices (with or without cubicles)
D	Offices with small rooms and sheet-rocked walls
E	Offices with small rooms and walls of brick, stone or concrete

System Dimensioning Tool (cont.)



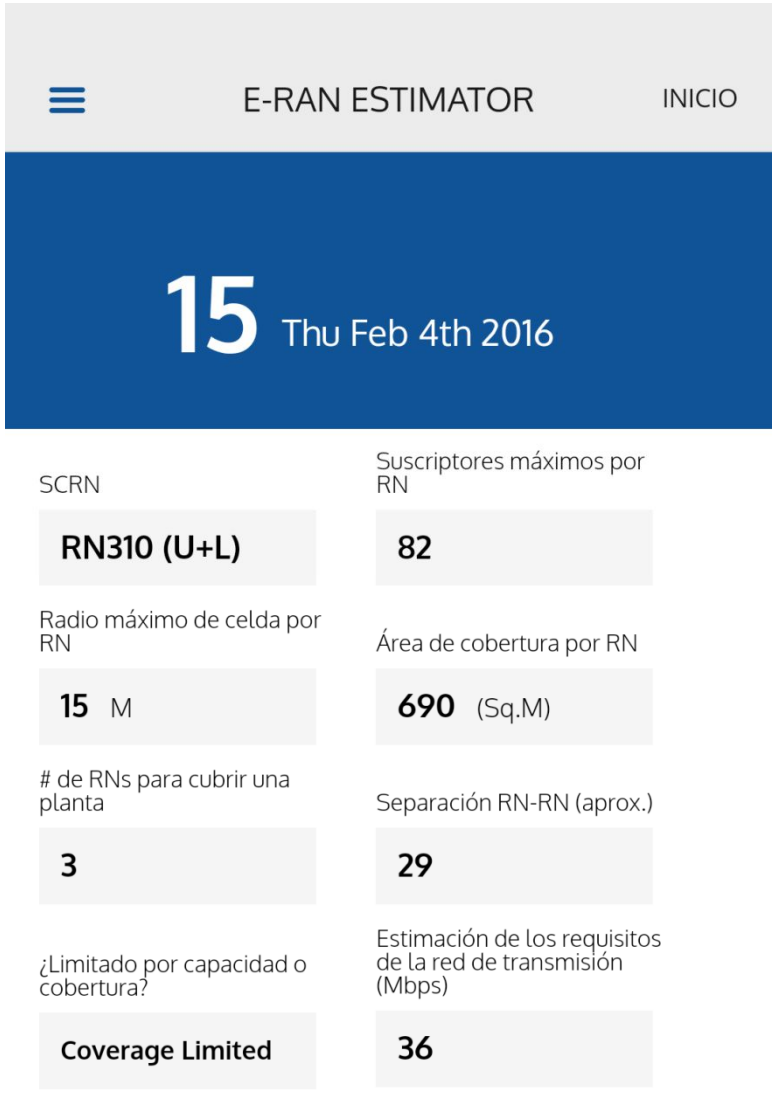
System Dimensioning Tool (cont.)

Canales	1: UMTS	2: LTE
Canal Radio 1:	UMTS	
Ancho de Banda:	5 Mhz	
Clase de Banda		2
Interferencia de la Macro (dBm)		-77
Voz por Usuario (mErlang)		200
Data por Usuario (mErlang)		25

Canales	1: UMTS	2: LTE
Canal Radio 2:		LTE
Ancho de Banda:		10 Mhz
Clase de Banda		4
Interferencia de la Macro (dBm)		-90
Data por Usuario (mErlang)		25

System Dimensioning Tool (cont.)

- System dimensioning tool gives an estimate on the number of radio nodes required per floor and the recommended backhaul for the site.



RF Planning

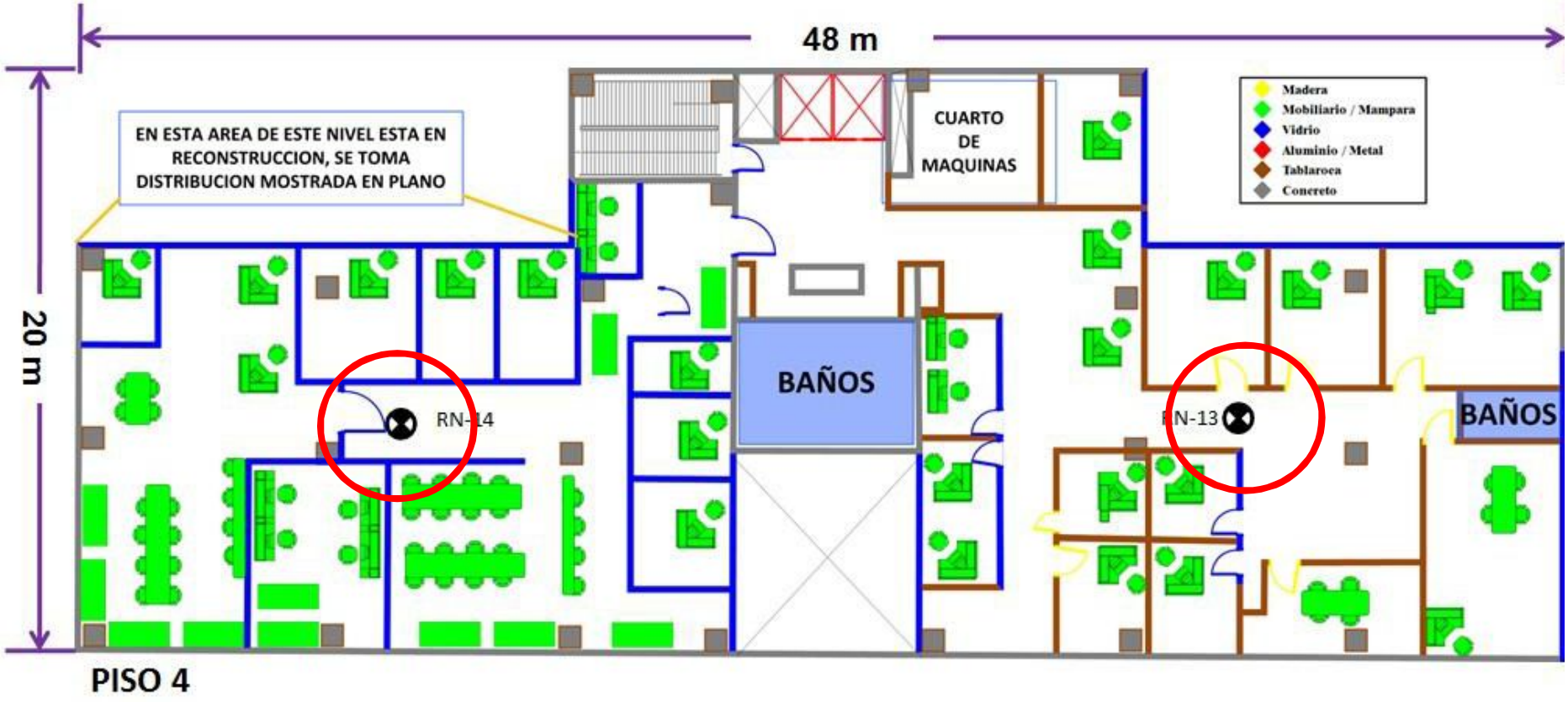
- The goal of the RF planning stage is to:
  - Determining radio node locations.
  - Determine approximate radio node-radio node separation.

- Some operator may require the use of indoor RF propagation tools to generate a heat map. Such tools are useful but not necessary for E-RAN deployment.

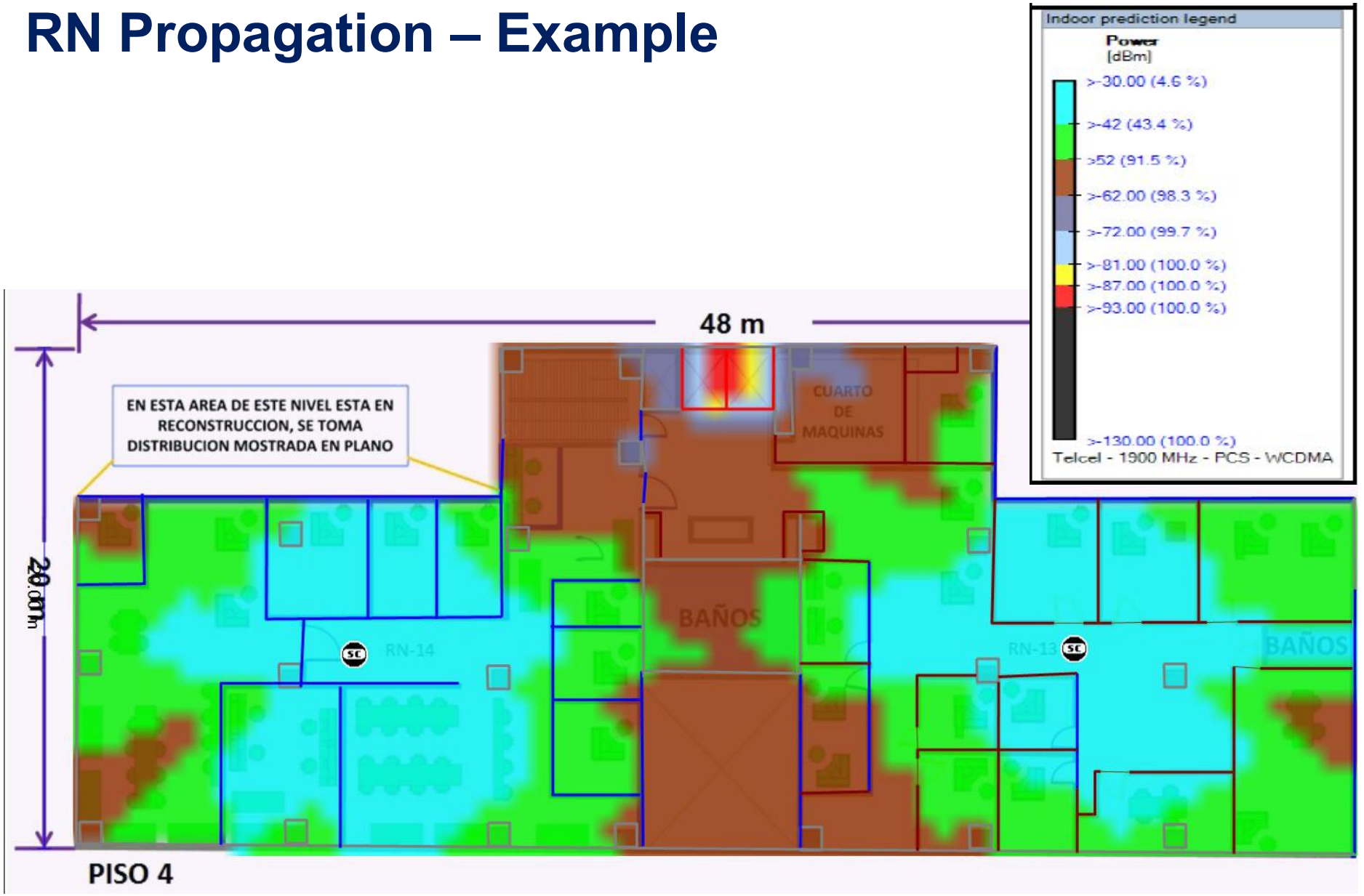
RN Location

- Based on the site survey and system dimensioning tool determine the approximate radio node locations for each floor.
- As a rule of thumb it is recommended to add a radio node in the cafeteria for capacity.
- RN's should be placed approximately 0.5*(Inter RN distance) away from the building boundaries. This avoids unnecessary leakage outside the building. This also ensures that RN's coverage of the RN is fully utilized.

RN Location – Example



RN Propagation – Example



Quiz

Q: How to access the system dimensioning tool?

A: System dimensioning tool is available on Spidercloud support website.

Q: Name three important input parameters for the system dimensioning tool.

A: No. of floors, coverage area per floor, macro interference level, coverage area class.

Q: What are the output parameters of the system dimensioning tool?

A: Number of RN's per floor, coverage area per RN, Inter RN separation

Q: What are goals of RF planning stage?

A: Determine RN locations and determine inter RN distance

Q: What do need to identify boundary cells?

A: Boundary cells will be assigned PSC's from alternate pool.

Network Design

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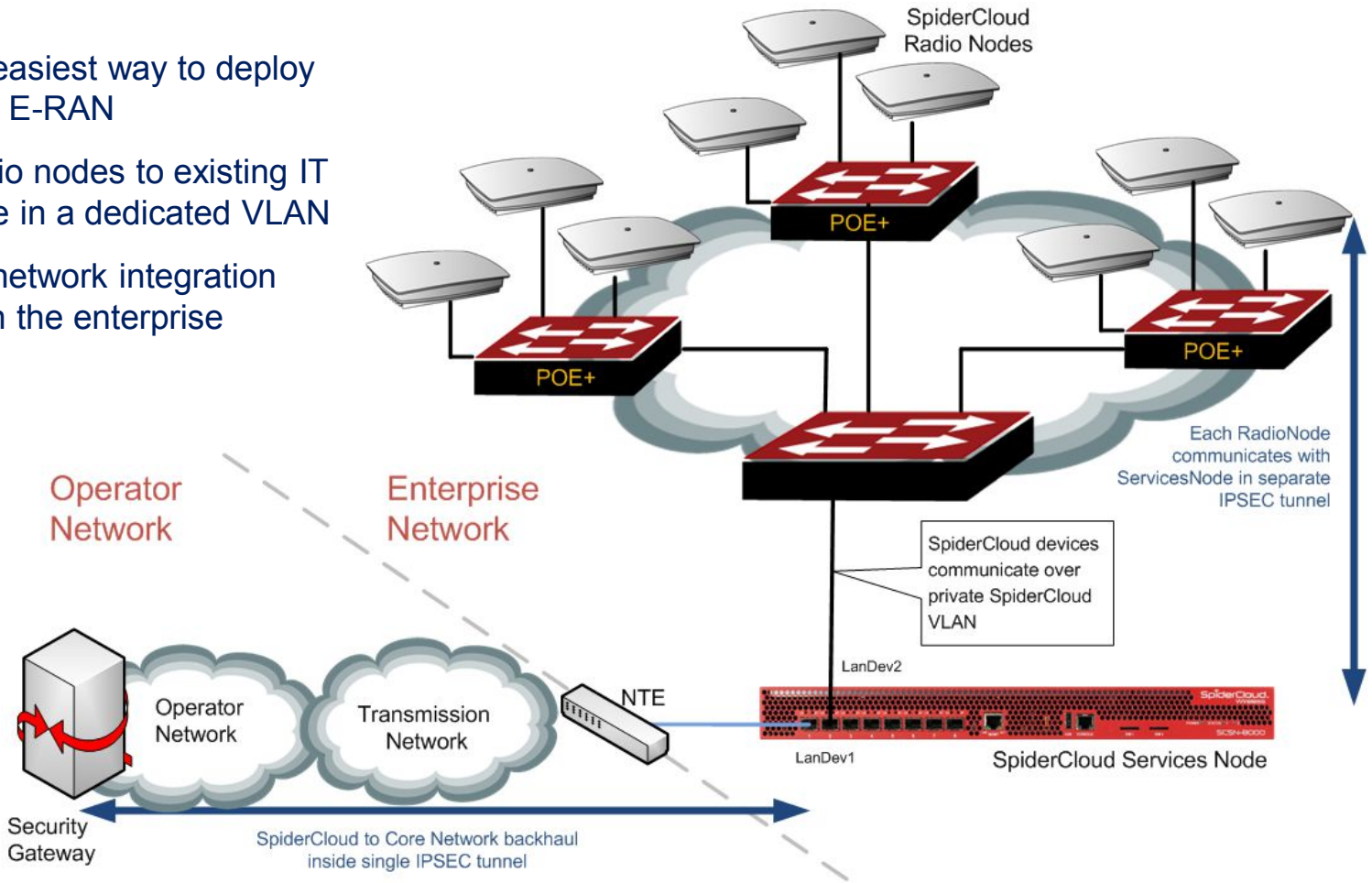
Network Design Choices

- The primary installation method is to add the equipment to an existing Enterprise LAN using a dedicated VLAN. This is Option 1 discussed below.
- At some sites due to the nature of the enterprises network infrastructure, different installation methods are used
  - Option 1: Enterprise VLAN (Layer 2 networking)
  - Option 2: Services node in DMZ (Layer 3 networking)
  - Option 3: New LAN builds

Option 1: Enterprise VLAN (Layer 2 Networking)

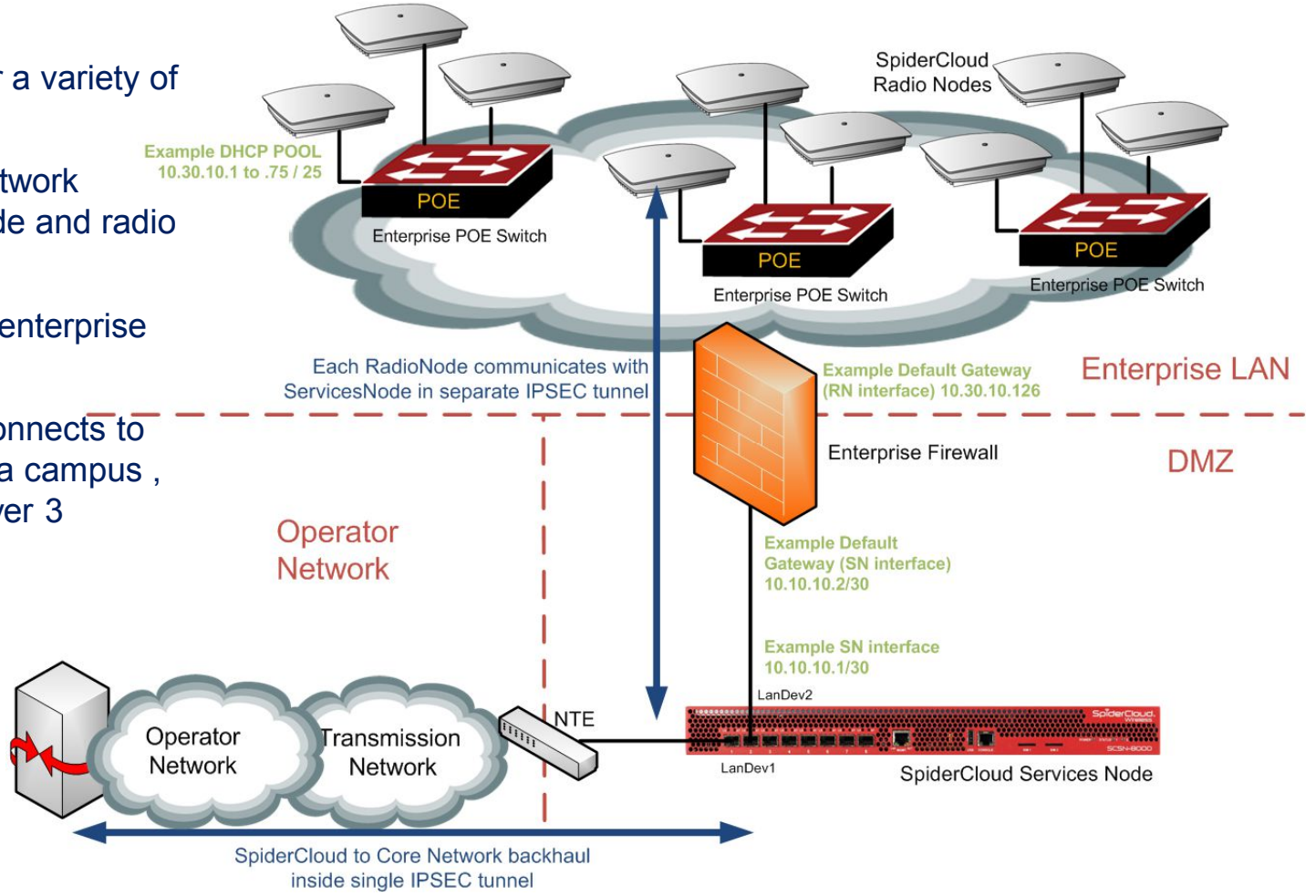
- Usually the easiest way to deploy SpiderCloud E-RAN
- Connect radio nodes to existing IT infrastructure in a dedicated VLAN
- No IP layer network integration required with the enterprise



Option 2: Services Node in DMZ (Layer 3 Networking)

This topology is used for a variety of scenarios, such as:

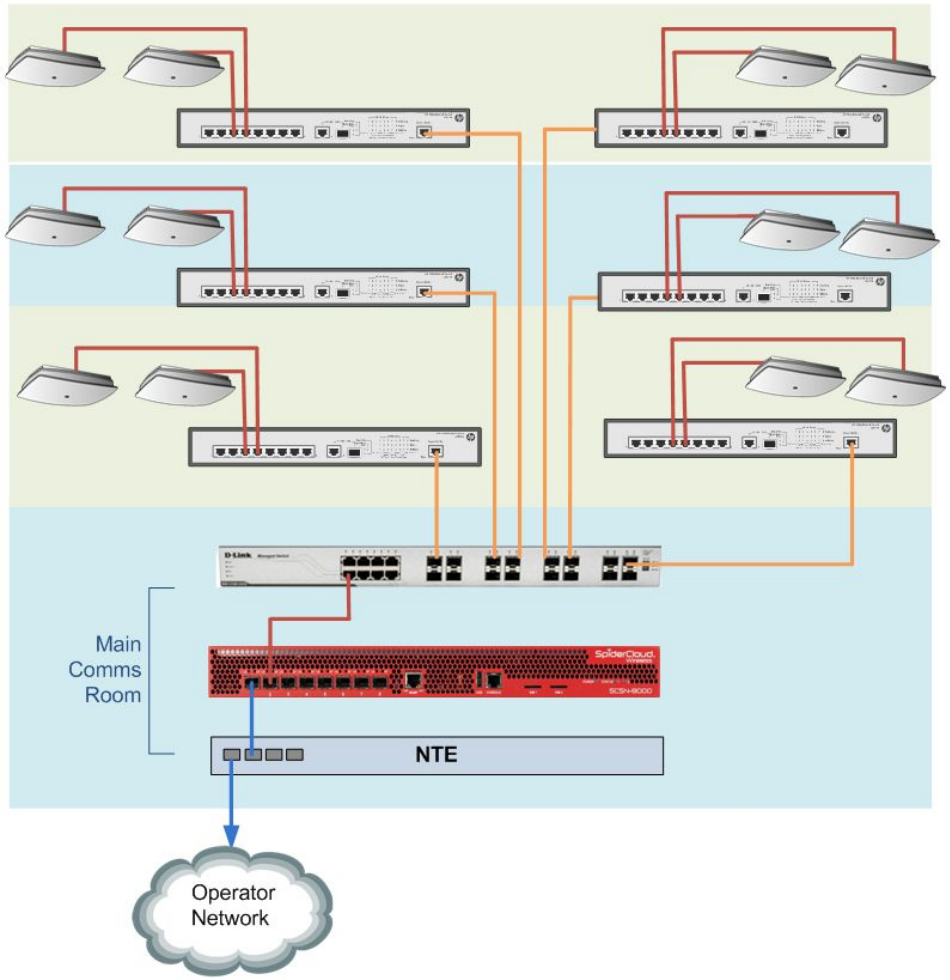
- There is a Layer 3 network between services node and radio node
- Connectivity to other enterprise services is required
- One services node connects to multiple buildings on a campus , each on separate Layer 3 networks



Option 3: New LAN Builds

This topology is used for a variety of scenarios, such as when:

- Enterprise does not have suitable infrastructure in all parts of building or enough free ports.
- Enterprise switches are not PoE. (Either add new PoE+ switches or PoE+ injectors to legacy switches).
- Existing fiber infrastructure can be used to connect switches on different floors.



Option 1: Enterprise VLAN (Layer 2 Networking)

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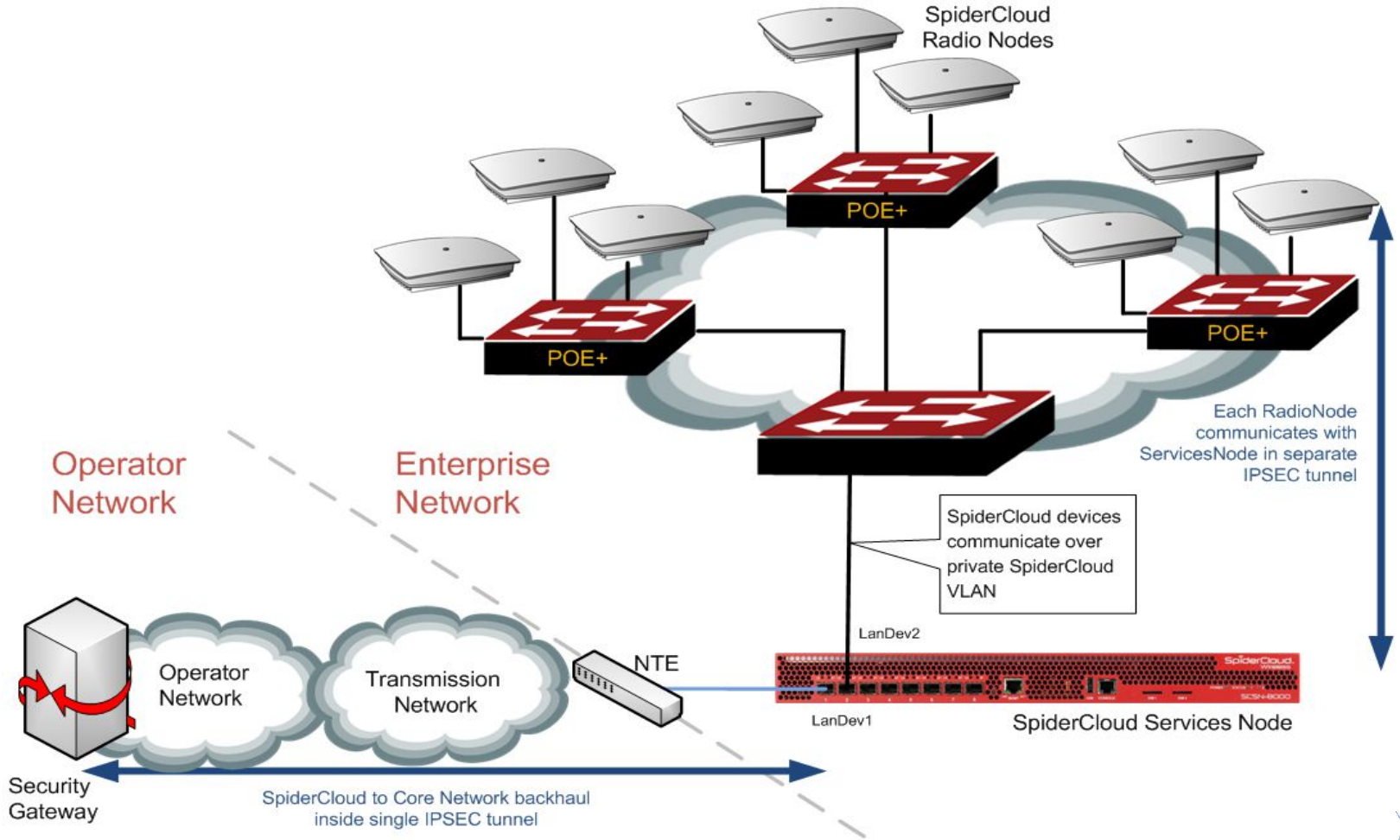
Option 1: Enterprise VLAN Network Design

- Using existing enterprise PoE+ switches.
- Simplest method to deploy E-RAN



VLAN (Layer 2 Networking)

- Virtual LAN (VLAN) technology allows for groups of network nodes with common requirements to be grouped into a single broadcast domain across one or more network switch.
- A VLAN is a single logical switch. Two or more VLANs in a single physical switch make the switch appear to be two or more physical switches. A single common VLAN across multiple physical switches makes all interfaces in the switches in the same VLAN appear to be a single switch.
- RadioNodes are such network nodes that are grouped in a single broadcast domain across multiple physical switches under the same VLAN.

Network Design

- Request enterprise IT manager to create a VLAN for the radio node and to set ports as access ports (untagged)
- Services node LanDev1 is the backhaul to the operator
- Services node LanDev2 connects to the enterprise VLAN
- Services node interfaces are 1000mbps
- Radio node SCRN-310 interface is 1000/100mbps

- LANDevice corresponds to physical Gigabit ethernet ports on the ServicesNode. LANDev 1 and LANDev 2 are different ports on the ServicesNode.

Radio Node and Services Node IP Addressing

- The radio nodes and service node form a self-managed IP network. All user and signalling traffic between them is secured inside an IPsec tunnel. The enterprise does not need to configure or manage this network.
- The switched Ethernet infrastructure between the services node and the radio nodes can use a VLAN running over the existing enterprise LAN.
- Enterprise devices in other VLANs will not have visibility of the IP network used by SpiderCloud.

Services Node Connections *(with example data)*

Services Node Interface	Interface Description	Remote Device - Interface	Patch Details
LanDev1	Backhaul to Operator	*ABC NTE-Ge4*	*Direct Connection*
LanDev2	SpiderCloud Enterprise VLAN	*Enterprise-Switch-B17-Ge9*	*Via Patch Rack SER7/H6*

Radio Node Connections *(with example data)*

Radio Node	Building / Floor	Switch Name / Port	Patching between Switch and Radio
SCRN1	*Site1 / Floor1*	*EM-VZN001 / Fe11*	*Direct Connection*
SCRN2	*Site1 / Floor1*	*EM-VZN001 / Fe12*	*VZT-518 to VZT-COB9*
SCRN3	*Site1 / Floor2*	*EM-AS002 / Fe22*	*VZT-516 to VZT-COB10*
SCRN4	*Site1 / Floor2*	*EM-AS002 / Fe9*	*VZT-589 to VZN-COB15*
...	*...*	*...*	*...*
Up to SCRN75	*Site1 / Floor18*	*EM-AS018 / Fe33*	*VZT-595 to VZN-COB12*

Option 2: Services Node in DMZ (Layer 3 Networking)

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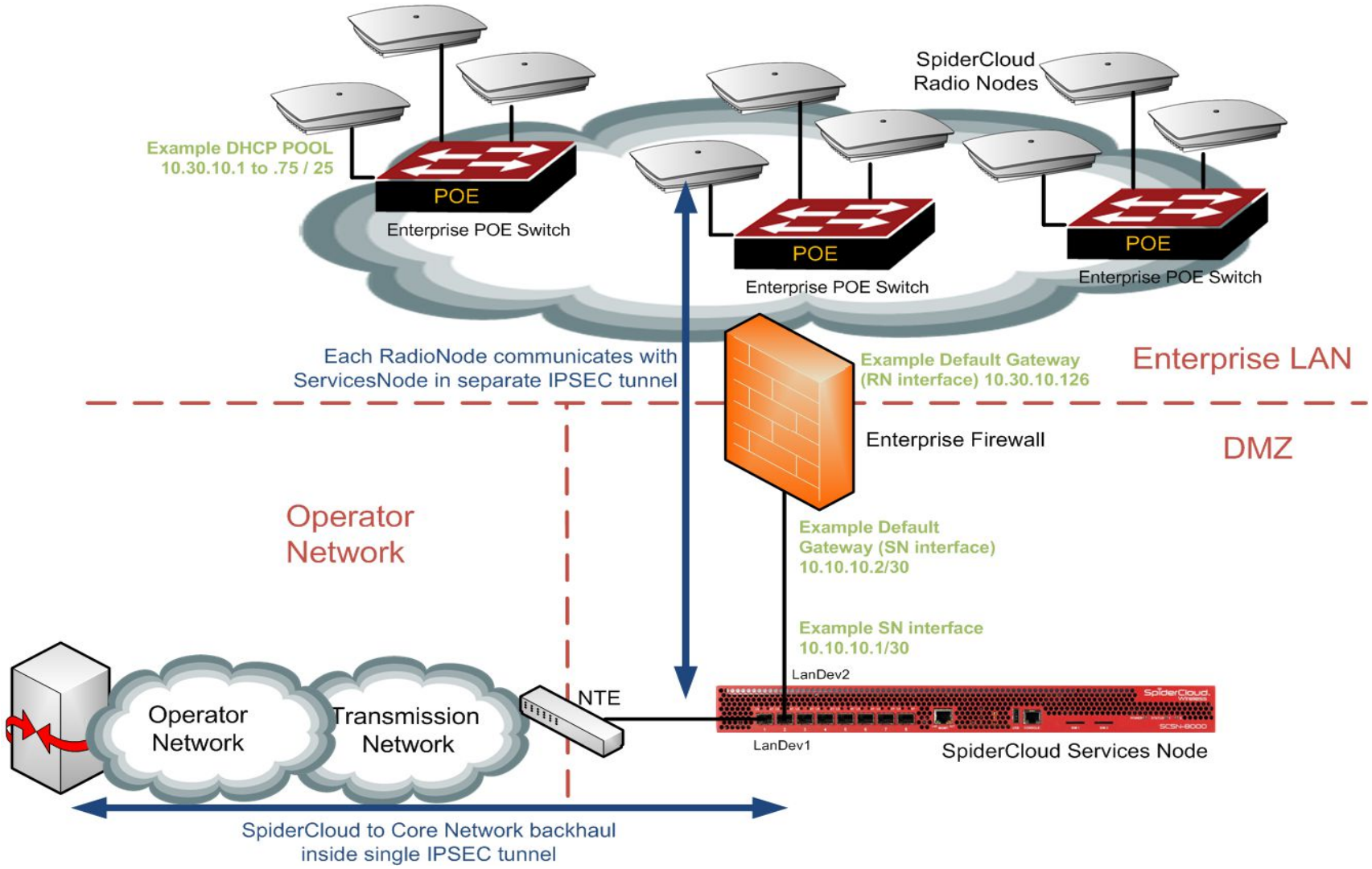
Option 2: Services Node in DMZ (Layer3 Networking)

Sometimes it is not possible to deploy the simple VLAN scenario, because:

- There is a Layer 3 network between services node and radio node.
- One services node connects to multiple buildings on a campus, each on separate Layer 3 networks.
- There is no continuous Layer 2 network across the area to be covered by radio node.

Network Design



Services Node in DMZ: Network Design

- In this design, since the services node is in the enterprise DMZ, there is a firewall between the SpiderCloud services node and radio nodes.
- The following additional steps are required by the enterprise:
  - Define an IP interface between services node and enterprise switch or firewall.
  - Assign DHCP range(s) for radio node.
  - Enable DHCP relay on enterprise switches.
  - Implement firewall rules for SpiderCloud ports.

Services Node in DMZ: Enterprise Interface

- Enterprise allocates an interface and gateway for the services node LanDevice2.
- Example:
  - Network 10.10.10.0/30
  - ServicesNode 10.10.10.1
  - Gateway 10.10.10.2
- Port speed = 1000mbps default (or 100mbps)
- VLAN untagged

Services Node in DMZ: DHCP Scopes *(with example data)*

Network	Subnet Mask	Minimum	Maximum	Gateways
10.30.10.0	255.255.255.128	10.30.10.1	10.30.10.75	10.30.10.126
10.40.10.0	255.255.255.128	10.40.10.1	10.40.10.75	10.40.10.126
10.50.10.0	255.255.255.128	10.50.10.1	10.50.10.75	10.50.10.126

- For each DHCP scope: define the network, mask, range of IP addresses to allocate and the default gateways for that network.
- Any IP address ranges can be used except those defined for the core facing interfaces 10.254.0.0/24, 10.78.100.0/22.
- Each radio node requires one IP address.

Services Node in DMZ: Firewall Rules

- If the deployment has a Firewall between the services node and radio node, apply the following rules:

Direction	Source	Destination	Protocol	Detail
RN > SN	68	67	UDP	DHCP (bootp)
SN > RN	67	68	UDP	DHCP (bootp)
RN > SN	Any	62000	UDP	SpiderCloud booting
RN <> SN	500	500	UDP	IKE
RN <> SN	4500	4500	UDP	NAT traversal
RN <> SN	n/a	n/a	ESP	IPsec
RN <> SN	319	319	UDP	PTP

Option 3:
New LAN Builds

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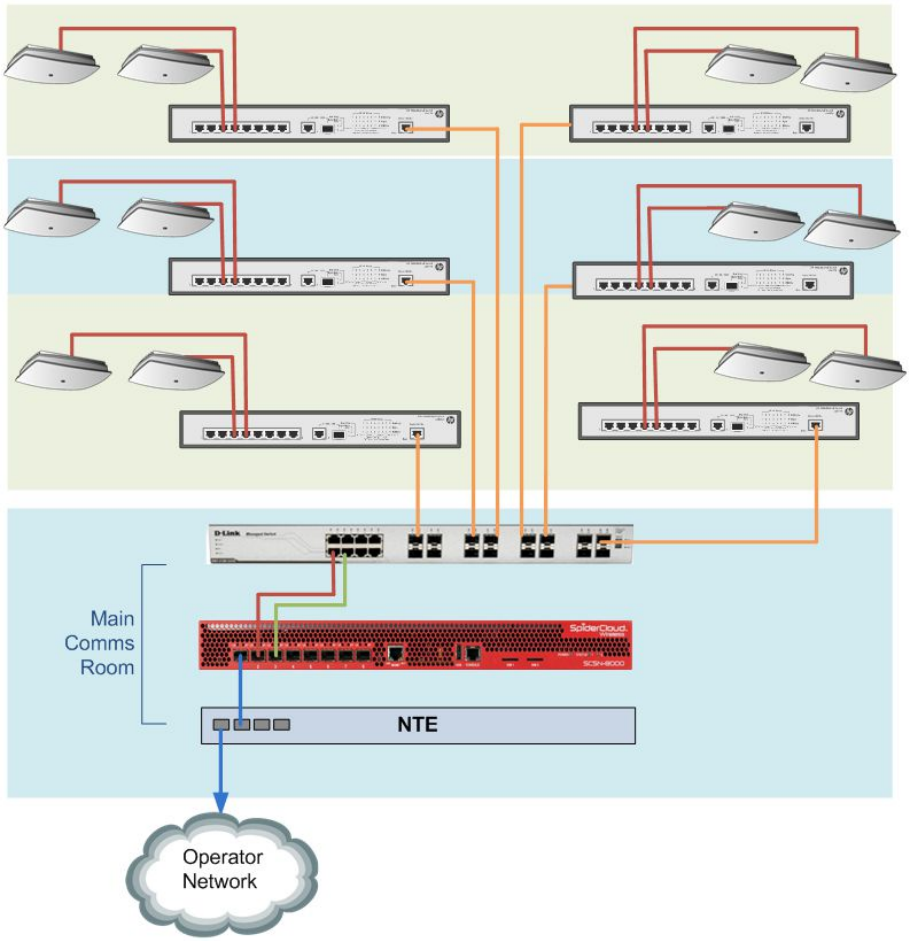
Option 3: New LAN Builds

This topology is used for a variety of scenarios, such as when:

- The enterprise does not have suitable infrastructure in all parts of building or enough free ports.
- The enterprise switches are not PoE.
- Deployments where operators want to control the E-RAN network.

Option 3: New LAN Builds



- New switches interconnect the services node and radio nodes.
- Usually existing interconnect fibers between switch rooms patch panels can be used to build the network.

New LAN Builds - Design Guidelines

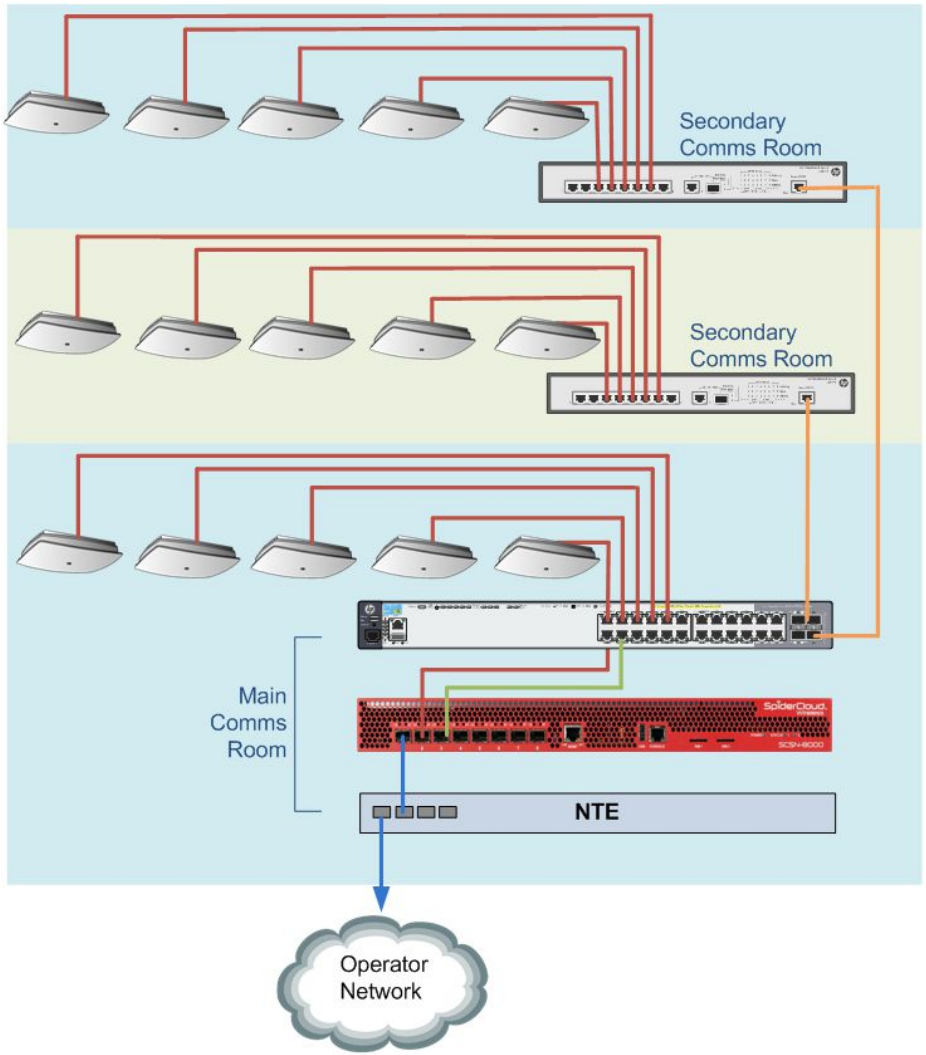
- SpiderCloud system is very flexible and can use any manufacturers Ethernet switch hardware to distribute traffic over any sort of modern IP network.
- Try to reuse the design and same hardware wherever possible at different sites.
- Prefer fiber to copper when interconnecting switches.
- Remember 100m rule is from the switch to the radio node.

New LAN Builds – Example Designs

- The following slides show two common types of designs that can be used depending upon the scale of the area to be covered by radio node.
  - Small / Dense Network
  - Large / Sparse Network
- An example port, VLAN and IP design is then illustrated.

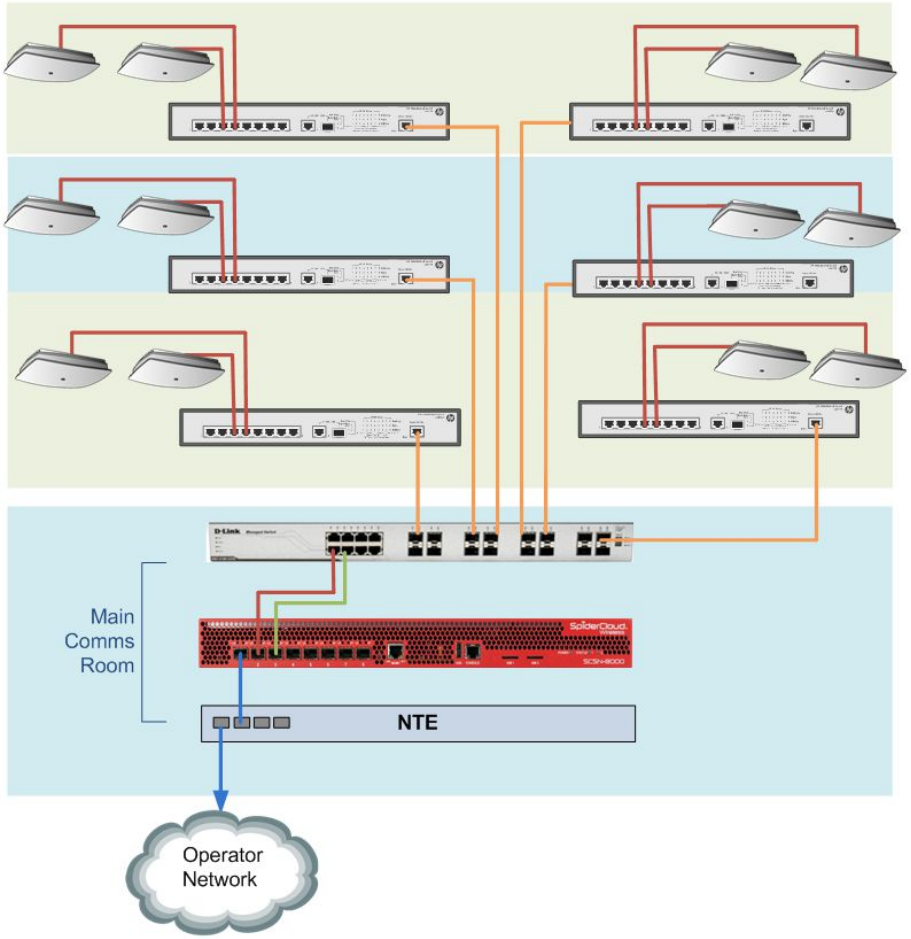
New LAN (Small/Dense)

- 5 or less total comms rooms
- Main switch can supply PoE and distribute fiber up to 4 secondary comms rooms
- May use small number of PoE switches, but with large port density, supporting up to 22 radio nodes per switch

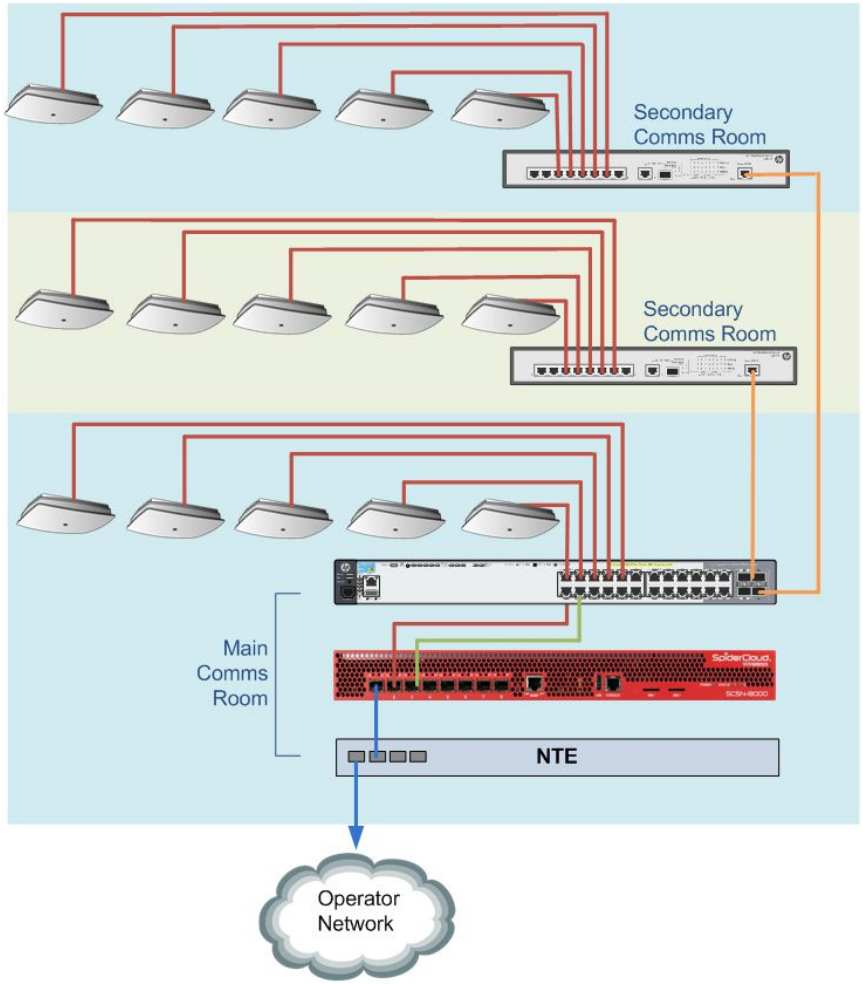


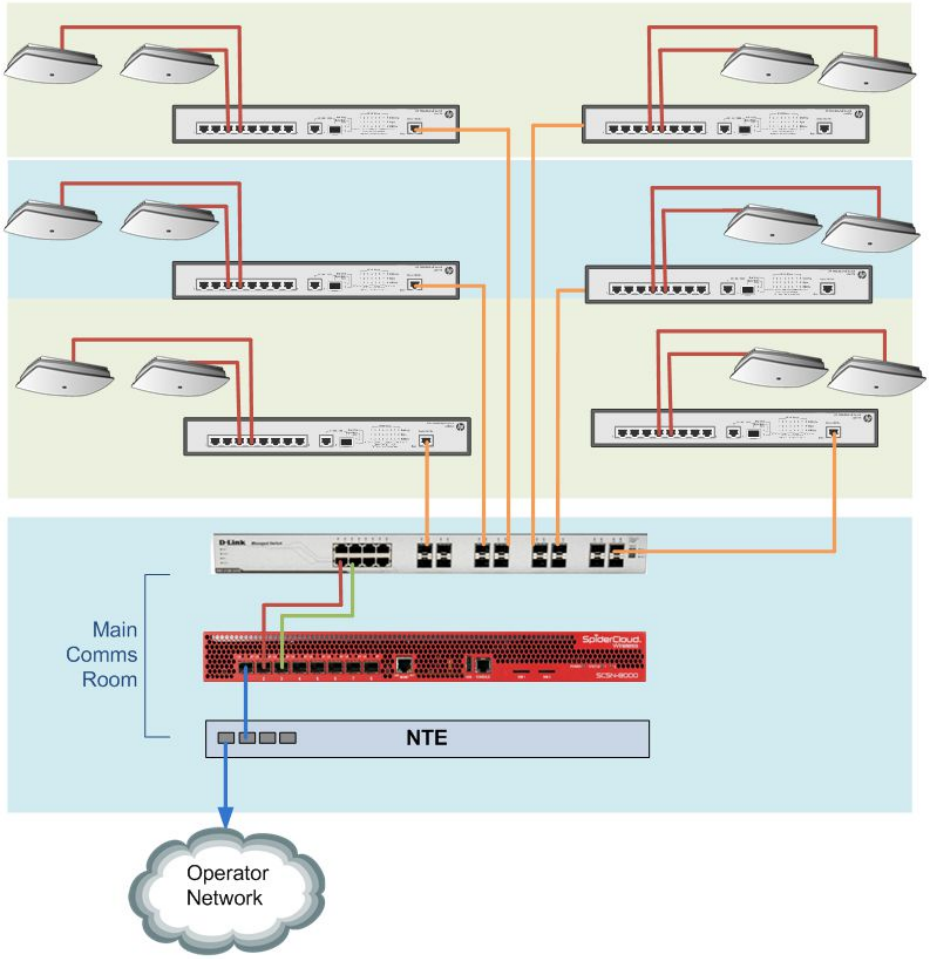
New LAN (Large/Sparse)

- 5 to 17 total comms rooms
- Main switch doesn't supply PoE
- Main switch distributes by fiber to up to 16 secondary comms rooms
- Larger number of PoE switches but typically with small port density supporting up to 7 radio node
- Sometimes more than one comms room per floor



Comparison: Dense vs. Sparse





Core Network Design

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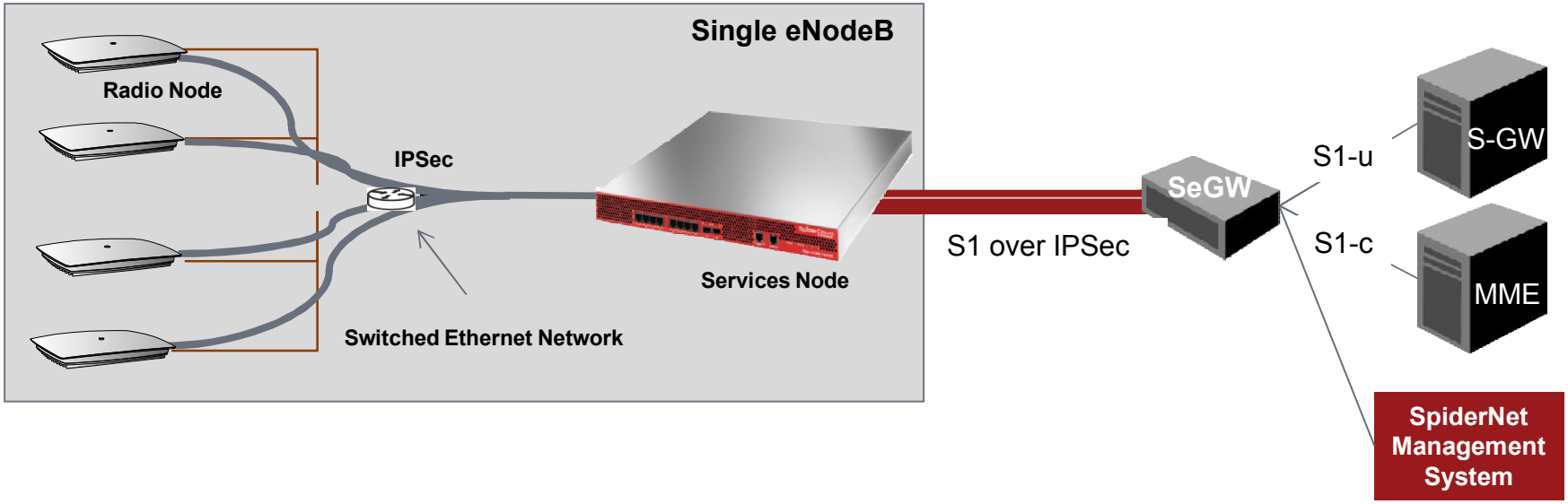
CN Diagram



System appears as a single eNodeB to the EPC

Core Network Design

- Services node connects to eUTRAN CN in S1AP mode(MME) over a secure IPSEC tunnel.
- Certain core network configuration parameters are common where as certain parameters are specific per site – TAC/eNodeB Id etc.
- CN parameters can be configured via LCI but during deployment phase these are pushed down from the Spidernet.

Core Network Design – SeGW Configuration

- Services node can connect to the SeGW with PSK based authentication or certificate based authentication.
- Operators always prefer to use certificate based authentication for real deployment.
- For certificate based mutual authentication, both the SeGW and services node are pre loaded with the root certificates of the other entity.
- All parameters for certificate based authentication are common and can pre-configured with the LCI profiles.

LTE: Core Network Design

- Services Node connects directly to the MME using S1AP protocol.
- From the core network point of view, the services node acts as a single eNodeB
- Parameters which need to be configured on the services node when connecting to a MME:
  - **`MME IP address`**
  - **`TAC`**
  - **`eNodeB Id`**
- CN Parameters are pushed down from the Spidernet once SeGW connection is established and SN is connected to Spidernet

Quiz

Q: Which is the easiest and quickest way to deploy E-RAN RNs?

A: Option 1 using existing ethernet infrastructure with a different VLAN.

Q: When using enterprise VLAN, how does the RN get IP address?

A: Either from SN DHCP server or enterprise DHCP server.

Q: When do we install complete new LAN infrastructure?

A: The enterprise switches are not PoE or enterprise request.

Q: How many IPSEC tunnels can the SN have?

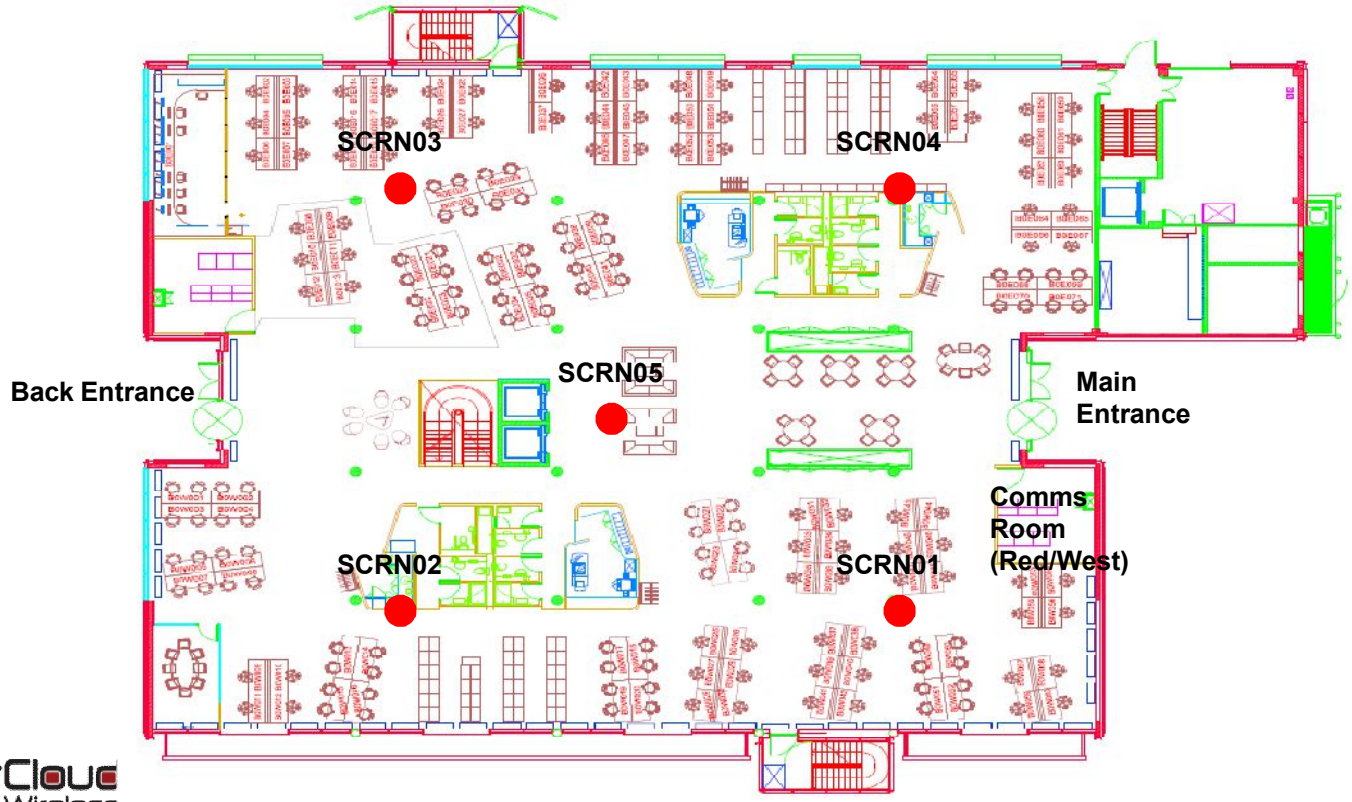
A: 2

Q: How does the CN parameter configured on the SN?

A: CN parameters are pushed down from the Spidernet.

Floor Plan Creation

- This steps follows once RF Design, System dimensioning and LAN design has been completed
- To create the floor plans:
  - Ensure you have the final approved site design
  - System dimensioning has been completed
  - Use RF planning guide and best practices for RN locations for every floor
  - PoE+ switch location should be identified on each floor based on the network design and site survey
  - Make sure ethernet cable length between RN and PoE+ switch is < 100m



Installation

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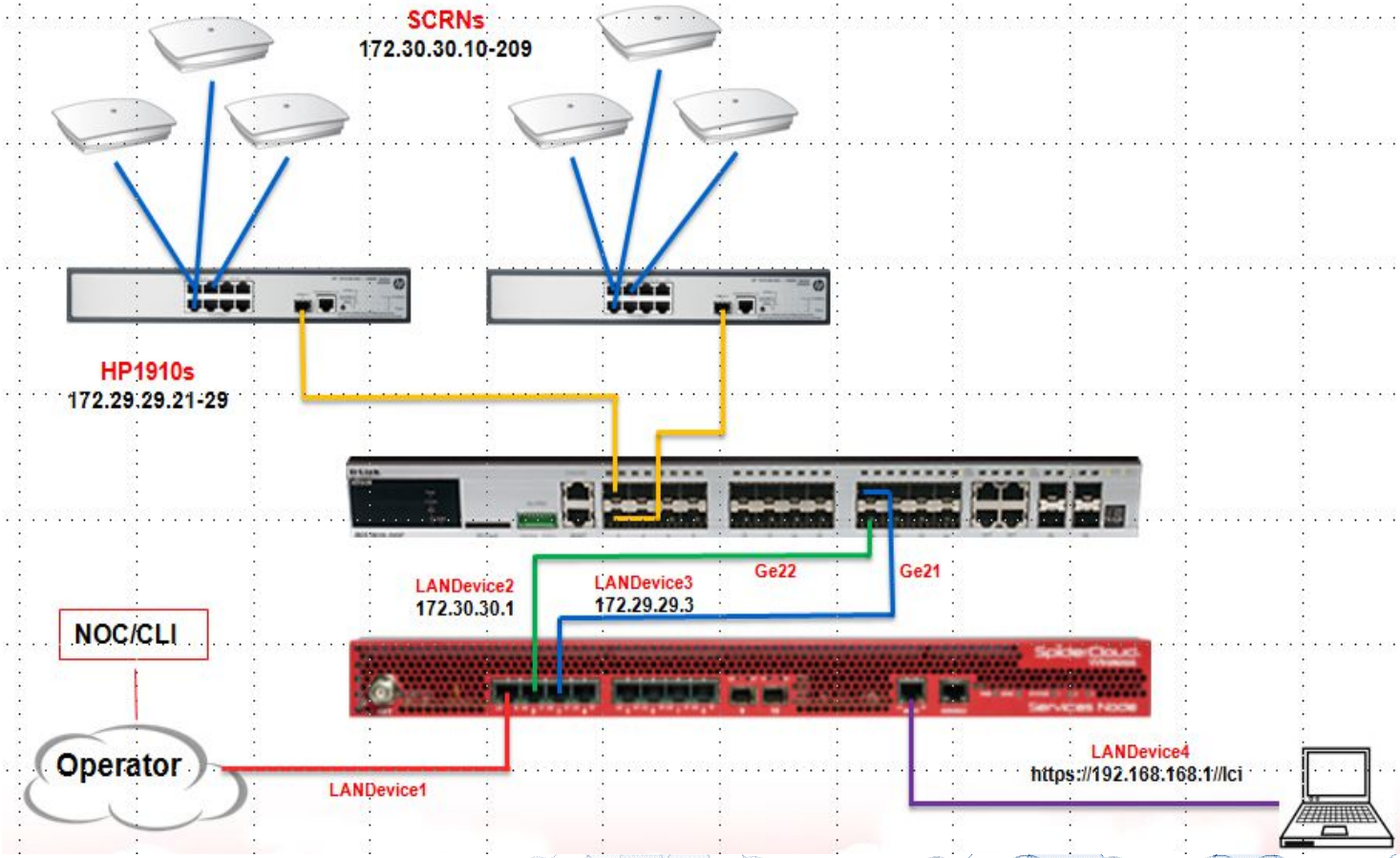
Installation Phase

- Similar installation to enterprise Wi-Fi.
- Installation personnel expected to have basic IP networking skills (specialized RF skill not required).
- Site access must be pre-arranged.
- Radio Nodes should be installed as per RF design(done in previous stage).
- RN's should be installed at the locations indicated on the floor plan. If RN's cannot be installed a specific location(due to any reasons), the floor plans should be updated. This is important from a field maintenance point of view.
- Update the RN bulk provisioning file(csv file) with RN number and RN mac address based on floor plan

Recommended E-RAN Setup

- CN Interface should be on LAN Device 1
- RNs should be connected to LAN Device 2
- LAN Device 2 is configured with 172.30.30.1 ip address and has DHCP enabled by default.



RN Bulk Provisioning File

- This file should be created during the installation process.
- Installer should note down the MAC addresses as he is installing the RNs.
- All fields of the bulk provisioning file could be pre provisioned.
- The filename must end in .csv. It cannot contain special characters or blank spaces.
- This file will be imported using LCI during the commissioning process.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	RN Type	RN ID	RN MAC	RN Name	RN Description	Cell1 ID	Cell1 Name	Cell1 Descriptio	Phy CellId / Alt PSC	Location Type	Cell2 ID	Cell2 Name	Cell2 Descriptio	Phy CellId /	Location Type (Optional)
2	2	1	00:24:48:01:2c:01	ap1	DESC	1	lte-1	DESC	0						
3	5	2	00:24:48:01:2c:02	ap2	DESC	2	lte-2	DESC	110		3	lte-3	DESC	150	
4	1	3	00:24:48:01:2c:03	ap3	DESC	5	umts-5	DESC	FALSE	["Atrium"]					
5	2	4	00:24:48:01:2c:04	ap4	DESC	4	lte-4	DESC	10						
6	3	5	00:24:48:01:2c:05	ap5	DESC	7	umts-7	DESC	TRUE	["Cafeteria"]	9	lte-9		504	
7	4	6	00:24:48:01:2c:06	ap6	DESC	6	lte-6	DESC	500		8	umts-	DESC	TRUE	["Basement"]

Installation Videos

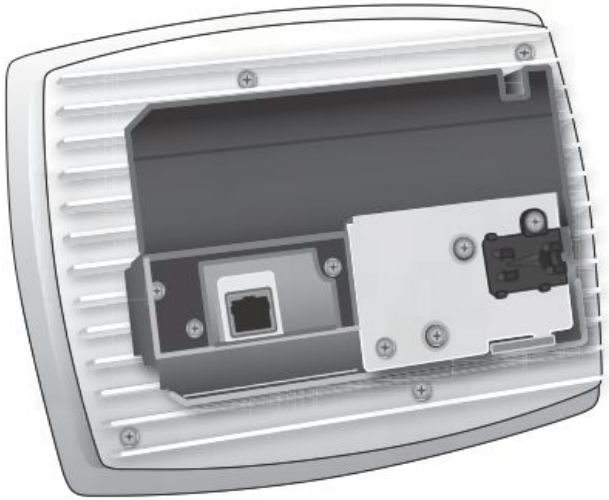
https://www.youtube.com/watch?v=gUkHsAuxsqc&feature=youtu.be

https://www.youtube.com/watch?v=Q8V070ggyuA

https://youtu.be/qVONNy3Nhxc

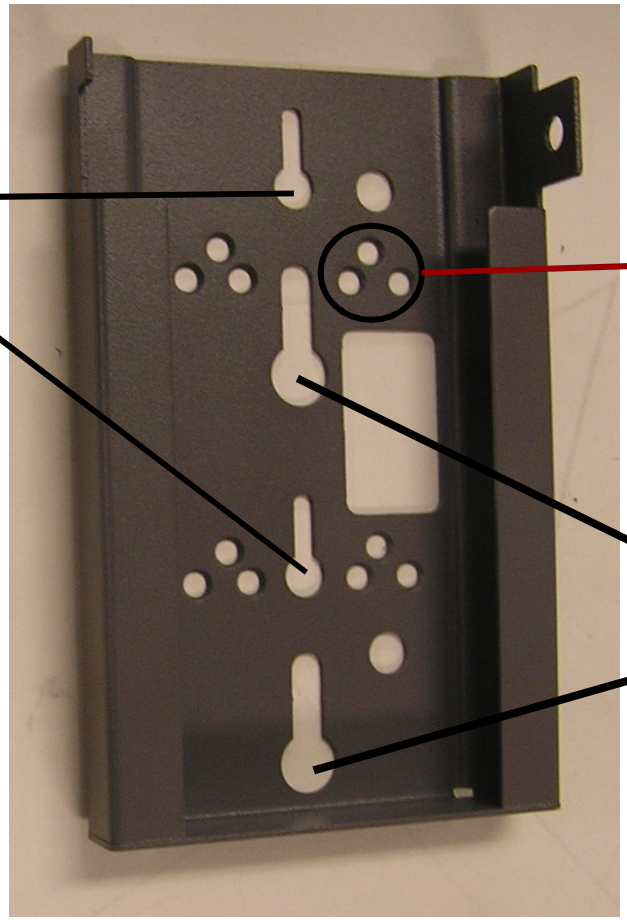
https://youtu.be/SDoqlP1apXA

SpiderCloud Radio Node (SCRN) Installation

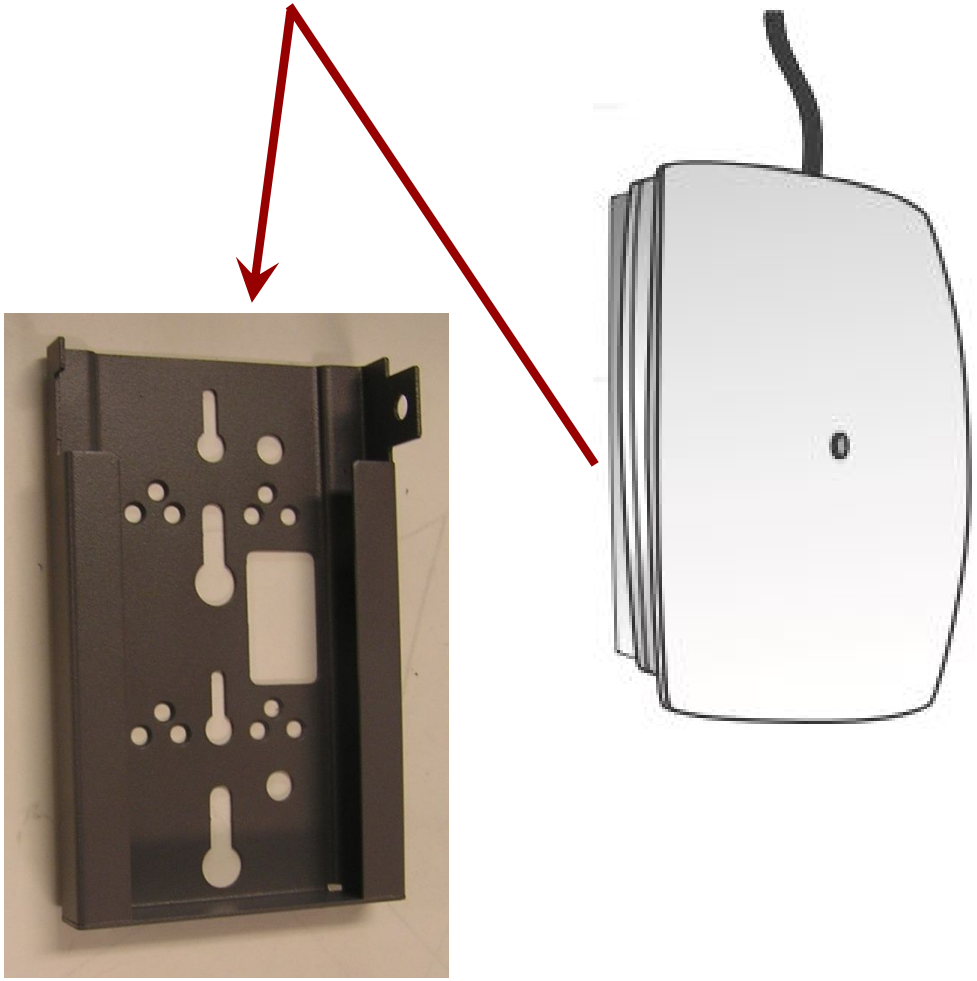


- **Height:**
  - 4.9 centimeters (1.9 inches)
  - 8.1 centimeters including mount bracket assembly (3.2 inches)
- **Width:**
  - 19.0 centimeters (7.5 inches)
- **Length**:
  - 23.8 centimeters (9.4 inches)
- **Weight:**
  - 0.91 kilograms (2 pounds)
  - 1.41 kilograms with mounting bracket (3.1 pounds)

SCRN Mounting Bracket



SCRN Mounting Bracket



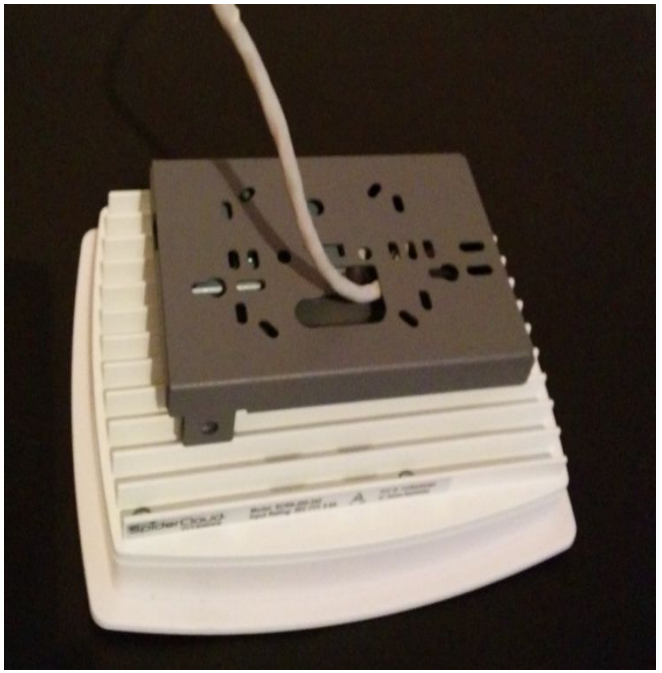
SCRN Mounted On Light Grill

- M6x30 bolts, nut and washers are used to secure the unit
- With so many holes in the grill, you can just keep moving the SCRN until the grill holes line up with the mounting bracket holes

SCRN Mounted On Drywall Ceiling

SCRNs have been mounted directly to the drywall (either sheetrock or plasterboard) ceiling using screws as shown below along with washers

SCRN Horizontal Ceiling Installation



If horizontally installing on a ceiling:

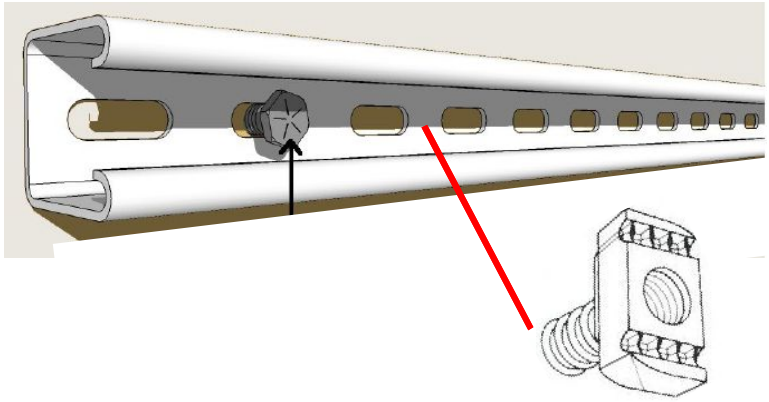
- Ensure the bracket using at least 2 x fixing points.
- Make a hole no bigger than the bracket cable feed hole.
- Feed the cable through the hole and insert into the RJ45 housing.
- Ensuring the cable is free from any snagging insert the SCRN onto the bracket until it locks into place.

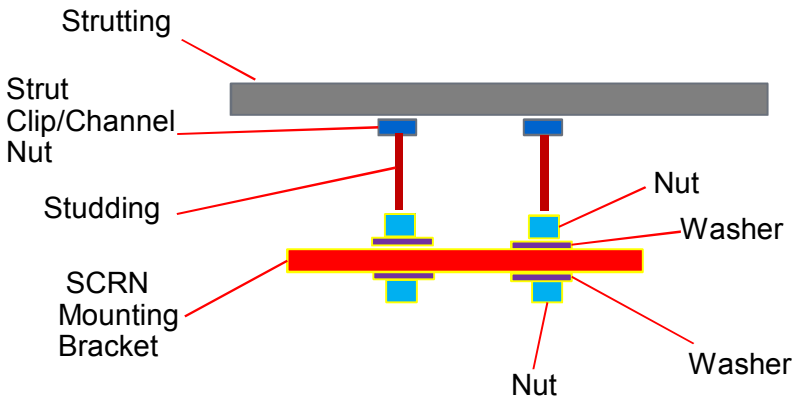
SCRN Vertical Wall Installation

If vertically installing on a wall:

- Ensure the bracket using at least 2 x fixing points.
- Insert the RJ45 into the housing.
- Clip the cable into the cable clip to keep free from any snagging.
- Insert the SCRN onto the bracket until it locks into place.

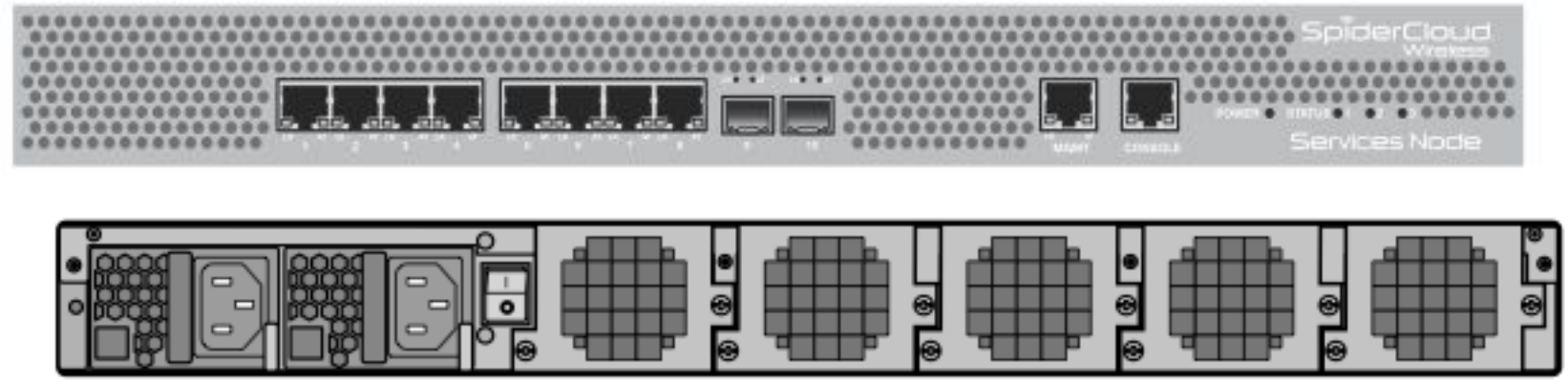
SCRN mounted using Strut Clip/Channel Nut fixings





- SCRNs are installed using existing strutting that was used for heavy hanging equipment.
- Insert the strut clip nut so it sits under the lip of the strut then screw in M8 studding until it tightens against itself.
- Then add a nut onto the studding to the height you want the hang, followed by a washer, then the SCRN mounting bracket is attached followed by another washer and finally another nut.
- The two nuts are then tightened so they work against each other to secure the mounting bracket.

SpiderCloud Services Node (SCSN) Installation

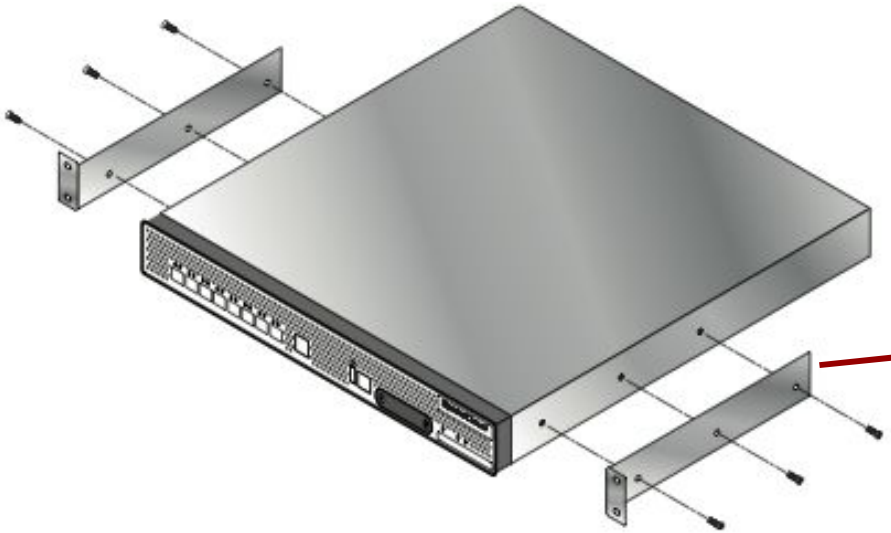


- Height: 4.37 centimeters (1.72 inches)
- Width: 44.83 centimeters (17.65 inches)
- Length: 60.33 centimeters (23.75 inches)
- Maximum weight: 11.4 kilograms (25 pounds)

SCSN Installation

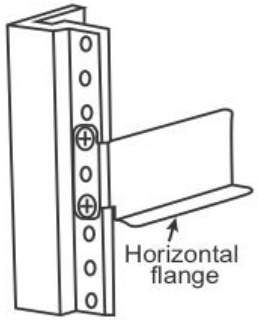
- Equipment
  - SCSN
  - Front mounting brackets
  - Rear mounting brackets
  - 8 x cage nuts, bolts & washers
  - Appropriate lengths of Cat 5e interlinking LAN cables
- Tools
  - Basic Hand tools (screwdrivers, cable cutters, zip ties, punch tool and etc)
  - P-Touch Labeler

SCSN Installation Mounting



2x brackets for front-mounted or center-mounted configuration

Rear bracket for option support for front-mounted installation



SCSN Installation – Transmission Rack

- SCSN is designed to fit in a standard Transmission Rack. It is important that rack measurements are taken during the site survey so that the installation team can ensure they have the correct equipment so the work can be carried out as planned

Available U-Space	1 RU: 1.75“ (44.45 mm)
Width Of Rack	19”/23”/other non standard.
Power Supply Type	Standard UK or North America
Length Of Power Supply Cables Required	1m, 1.5m, 2m, 3m

PoE+ Switch

- A standard PoE+ switch is needed to provide power for radio nodes.
- Each radio node takes one port in switch, and service node takes one port as well. If the plan is to use same switch for CN connection and other computers, extra ports should be reserved.
- The total power consumption of all planned radio nodes should be less than total PoE+ output of the switch. Please refer to "Radio Node SCRN-310 Data Sheet" power consumption.
- Suggestions of PoE switch: HP1801, HP1910, HP2620-24-PoE+, Cisco WS-C3750X-24P

Commissioning

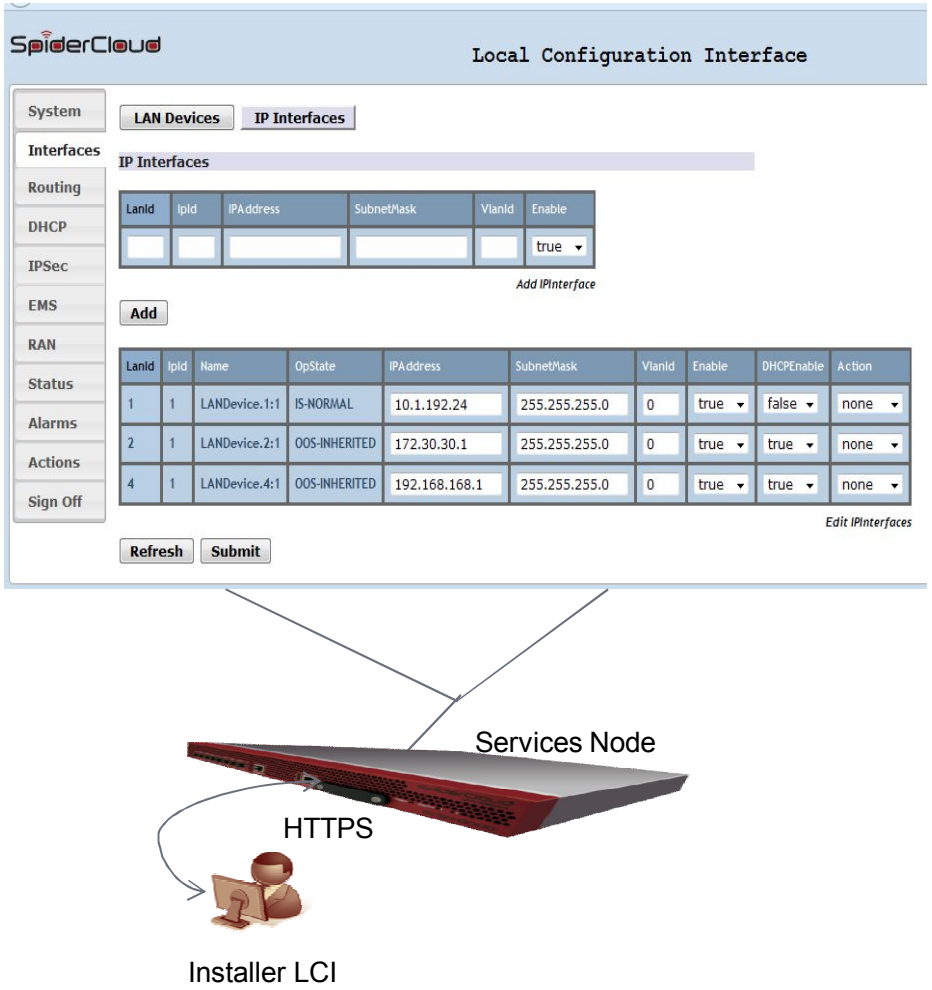
SpiderCloud Wireless

Commissioning Process

- After all the equipment is installed
- Done by the local installer at the site using Local Configuration Interface(LCI)
- At the end of this step:
  - IPSEC tunnel is established between the SN and SeGW
  - SN is connected to the Spidercloud HeMS(Spidernet)
  - Spidernet pushes CN parameters and other operator default parameters to the SN
  - LCI Management port could be disabled by the operator

Local Configuration Interface (LCI)

- Local Configuration Interface using management port
- Management port provides ip address to the local installers laptop
- HTTPS connection to default IP address (192.168.168.1)



LCI Configuration Sequencing

SpiderCloud Wireless recommends following this sequence in configuring E-RAN with the LCI:

Step 1 Log into the LCI with the administrator username and password.

Step 2 Import configuration profile for a specific region/market.

Step 3 Import .csv file for bulk provision of radio node and cells.

Step 4 Configure site specific parameters

Step 5 Verify the system configuration using the **Status** tab.

Step 6 (Optional) Execute a topology scan and link & connectivity tests.

Step 7 (Optional) Generate installation reports.

Step 8 (Optional) Manage certificates, images etc.

Logging into the LCI

- Ensure that your laptop has all wireless connections disabled and is not connected to a VPN or any other source that would issue it an IP address.
- Log into the LCI by connecting an Ethernet cable to the services node management port and entering the IP address*:* *https://192.168.168.1/lci* into a browser.
- The factory default login is set to the following:
  Username: *localadmin*
  Password: *lciadmin*

LCI Configuration Sequencing

SpiderCloud Wireless recommends following this sequence in configuring ERAN with the LCI:

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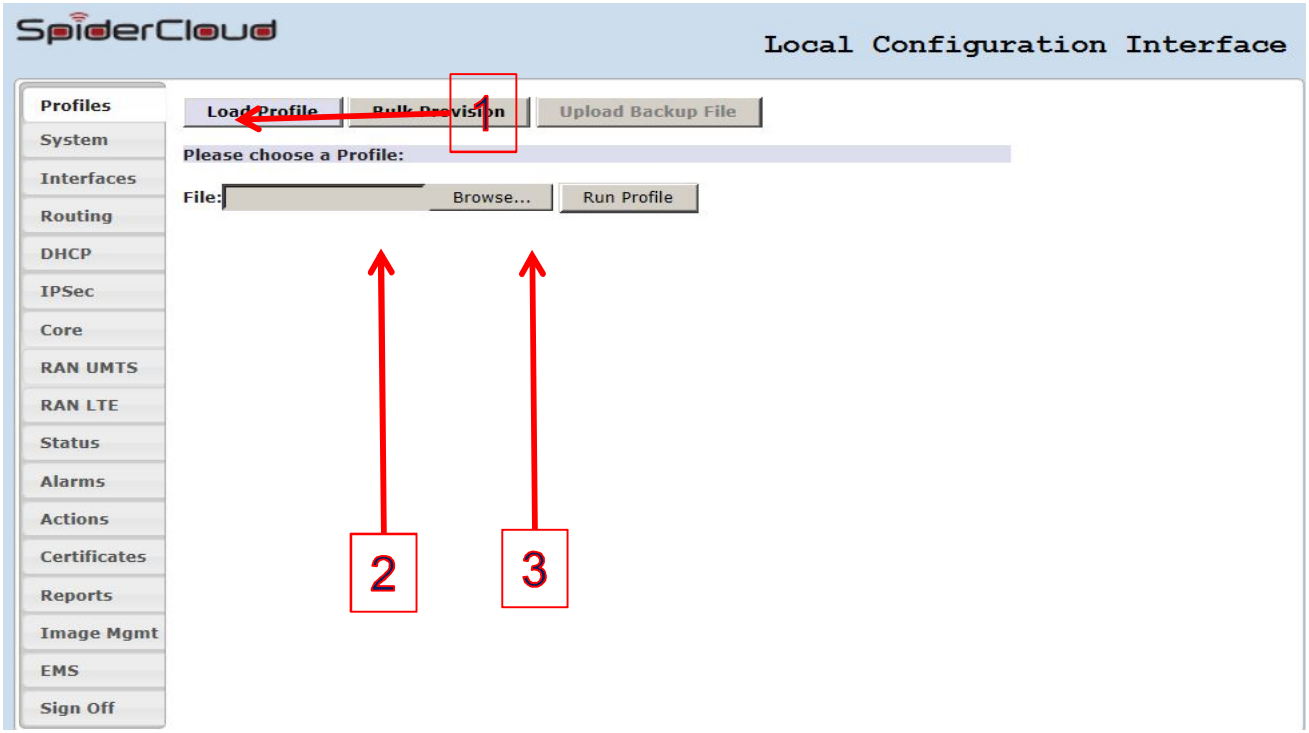
Load a Configuration Profile



- **Load Profile** button**:** For speed and consistency, services nodes can be provisioned through imported configuration profiles containing pre-defined data model objects and attribute values. Profiles are text files with a *.profile* extension containing commands to add, set, and delete objects and system attributes. Each set of commands is separated by a *commit* command on a separate line.
- SpiderCloud tech support will assist in creating the first site specific file, that can be imported.

Attributes in the Configuration Profile

List of data model objects in the configuration profile:

#General system attributes
#LANDevice 1,2,3 attributes
#Layer3Forwarding Forwarding.1. attributes
#System DHCPServer Subnet 1 attributes
#FAPService 1 FAPControl UMTS Gateway attributes
#FAPService 1 FAPControl LTE Gateway attributes
#FAPService 1 Transport Tunnel SecGWServer 1 attributes
#FAPService 1 Transport Security CryptoProfile 1 attributes
FAPService 1 Transport Tunnel VirtualInterface 1
#ManagementServer attributes
#DeviceInfo attributes
#FAPService 1 CellConfig UMTS RAN FDDFAP RF attributes
#FAPService 1 CellConfig LTE RAN RF attributes
#REM SCAN Attributes

Configuration Profile Sample

```
#
#
# Copyright 2008-2014, SpiderCloud Wireless, Inc.
# All Rights Reserved.
#
# Pound sign in the first column indicates a comment.
# This file contains all the objects you can add/set/delete using this file.
#
# LANDevice 1 attributes
add LANDevice.1.
add LANDevice.1.LANHostConfigManagement.IPInterface.1.
set LANDevice.1.LANHostConfigManagement.IPInterface.1.IPInterfaceIPAddress = "192.10.1.1"
set LANDevice.1.LANHostConfigManagement.IPInterface.1.IPInterfaceSubnetMask = "255.255.255.0"
set LANDevice.1.LANHostConfigManagement.IPInterface.1.Enable = "true"
set LANDevice.1.LANHostConfigManagement.IPInterface.1.VLANID = "0"
add LANDevice.1.LANEthernetInterfaceConfig.1.
set LANDevice.1.LANEthernetInterfaceConfig.1.Enable = "true"
COMMIT
#
#
```

Site specific value

Commit the configuration

Data model object

Operator/Region Specific Parameters

- These parameters are common for every site in the city/county/region.
- LCI Profile will have these parameters and will not require updating
- Operator specific parameters:
  - FAPService 1 FAPControl LTE Gateway attributes
  - FAPService 1 Transport Tunnel SecGWServer 1 attributes
  - FAPService 1 Transport Security CryptoProfile 1 attributes
  - FAPService 1 Transport Tunnel VirtualInterface 1
  - ManagementServer
  - EARFCN
  - REM Scan parameters

Site Specific Parameters

- Some site specific parameters will need to be configured using LCI
  - LAN Device IP address
  - Location, Host Name
- Site specific parameters:
  - General system attributes (such as site ID is configured in ServicesNode.{i}.HostName)
  - DeviceInfo attributes
  - LAC
  - RAC
  - SAC
  - LTE REM scan attributes could be different
- Some site specific parameters could be pushed to the services node through SpiderNet.

LCI Configuration Sequencing

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Step 4 Configure site specific parameters

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Step 7 (Optional) Generate installation reports.

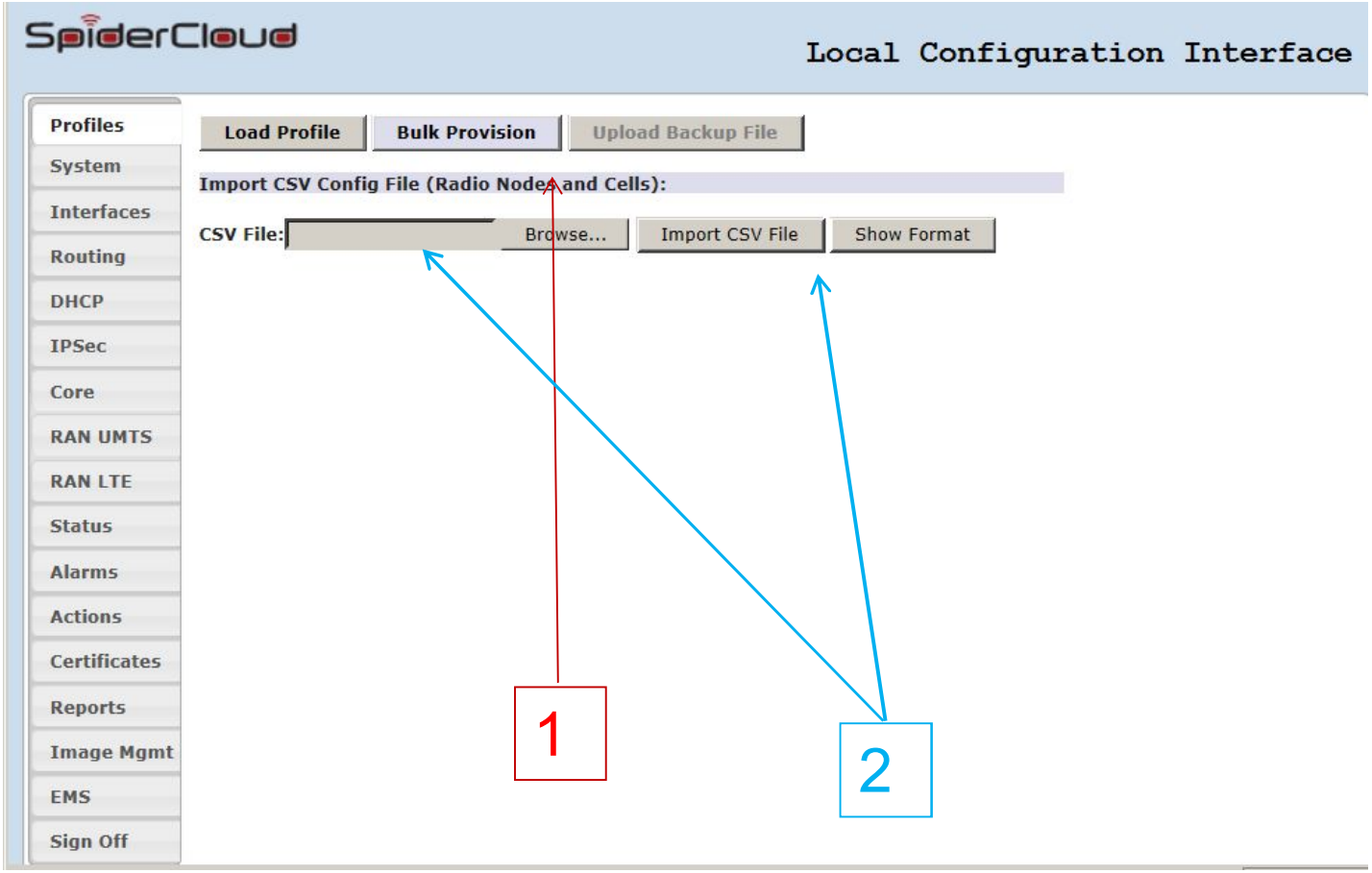
Step 8 (Optional) Manage certificates, images etc.

Bulk Provisioning (1)

- **Bulk Provisioning** button can be used for speed and ease of commissioning, radio node configurations can be auto-provisioned by entering the information into a CSV spreadsheet application in the specified format before system turn-up, and uploaded to the LCI when the system is being brought up.
- Refer to the *SpiderCloud System Commissioning Guide* for detailed information about the required CSV file format.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	RN Type	RN ID	RN MAC	RN Name	RN Description	Cell1 ID	Cell1 Name	Cell1 Descriptio	Phy CellId / Alt PSC	Location Type	Cell2 ID	Cell2 Name	Cell2 Descriptio	Phy CellId /	Location Type (Optional)
2	2	1	00:24:48:01:2c:01	ap1	DESC	1	lte-1	DESC	0						
3	5	2	00:24:48:01:2c:02	ap2	DESC	2	lte-2	DESC	110		3	lte-3	DESC	150	
4	1	3	00:24:48:01:2c:03	ap3	DESC	5	umts-5	DESC	FALSE	["Atrium"]					
5	2	4	00:24:48:01:2c:04	ap4	DESC	4	lte-4	DESC	10						
6	3	5	00:24:48:01:2c:05	ap5	DESC	7	umts-7	DESC	TRUE	["Cafeteria"]	9	lte-9		504	
7	4	6	00:24:48:01:2c:06	ap6	DESC	6	lte-6	DESC	500		8	umts-	DESC	TRUE	["Basement"]

Bulk Provisioning (2)



LCI Configuration Sequencing

SpiderCloud Wireless recommends following this sequence in configuring ERAN with the LCI:

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Step 4 Configure site specific parameters

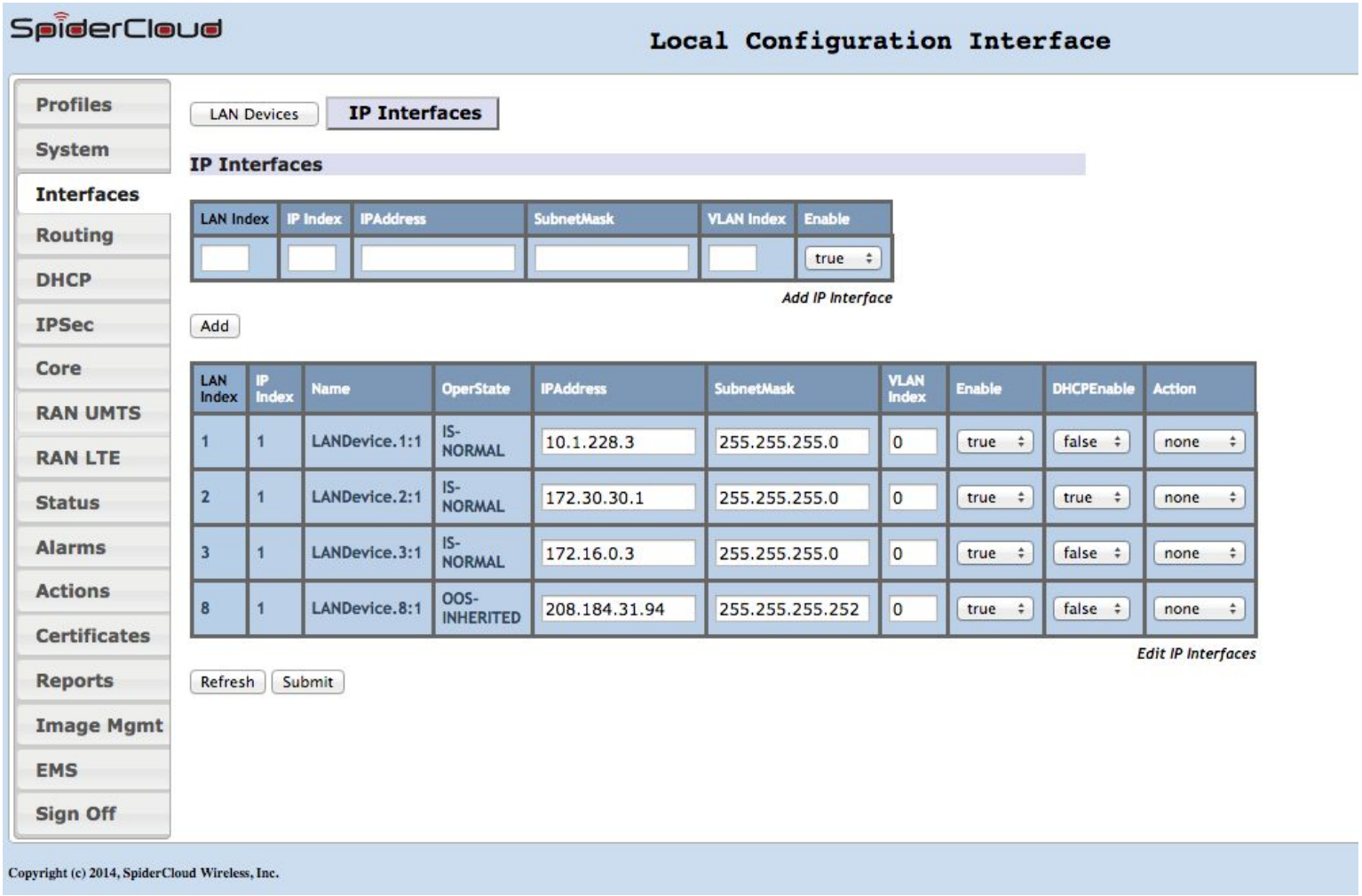
Step 5 Verify the system configuration using the Status tab.

Step 6 (Optional) Execute a topology scan and link & connectivity tests.

Step 7 (Optional) Generate Installation reports.

Step 8 (Optional) Manage certificates, images etc.

Site Specific Parameters



- Configure site specific parameters. CN facing interface ip address is the only mandatory site specific parameter that needs to be configured.

LCI Configuration Sequencing

SpiderCloud Wireless recommends following this sequence in configuring ERAN with the LCI:

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Step 4 Configure site specific parameters

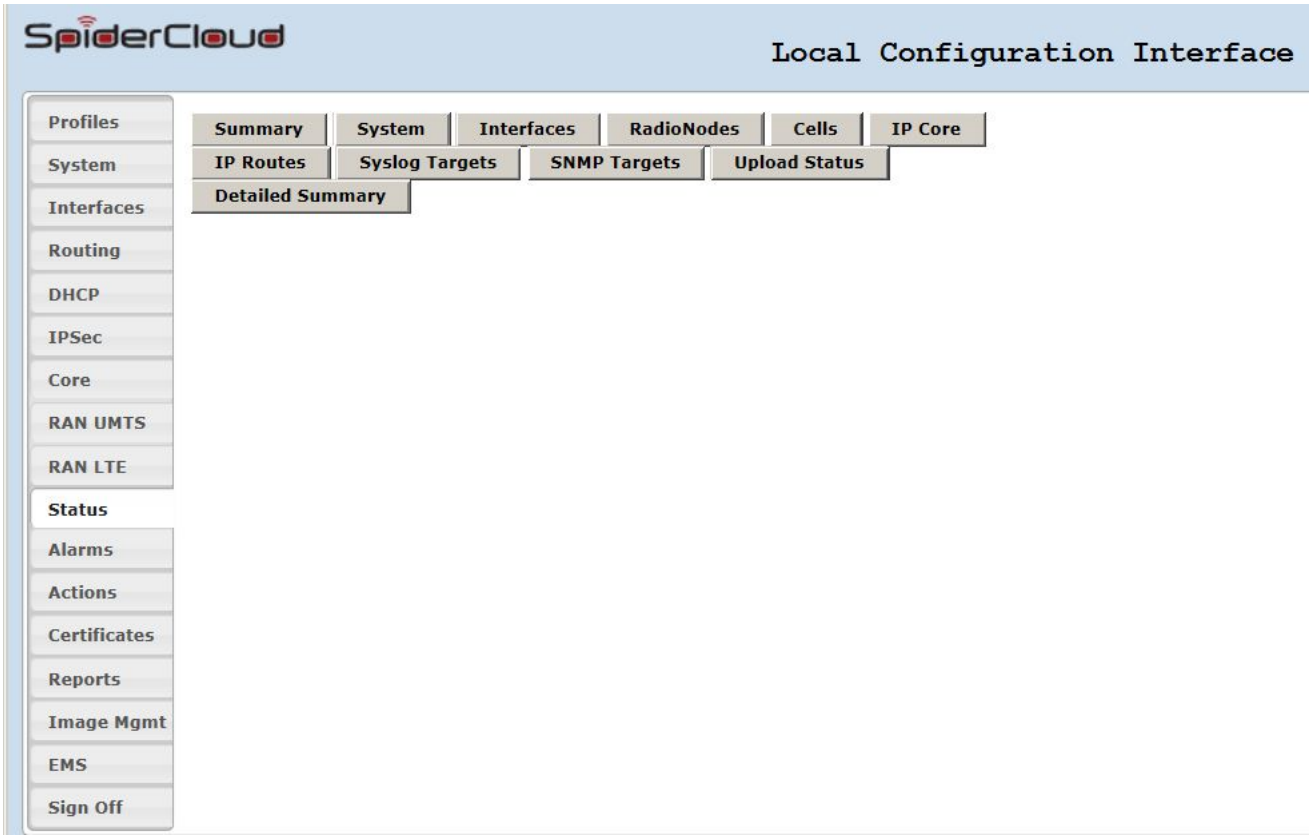
Step 5 Verify the system configuration using the Status tab.

Step 6 (Optional) Execute a topology scan and link & connectivity tests.

Step 7 (Optional) Generate Installation reports.

Step 8 (Optional) Manage certificates, images etc.

Status Screen



- The **Status** tab contains many buttons that display read-only status information about key components of the SpiderCloud system. Use this valuable information displayed on screen to monitor the health of the system and to troubleshoot issues during or after commissioning the E-RAN system.

LCI Configuration Sequencing

SpiderCloud Wireless recommends following this sequence in configuring ERAN with the LCI:

Step 1 Log into the LCI with the administrator username and password.

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Step 3 Import .csv file for bulk provision of radio node and cells.

Step 4 Configure site specific parameters

Step 5 Verify the system configuration using the **Status** tab.

Step 6 (Optional) Execute a topology scan and link & connectivity tests.

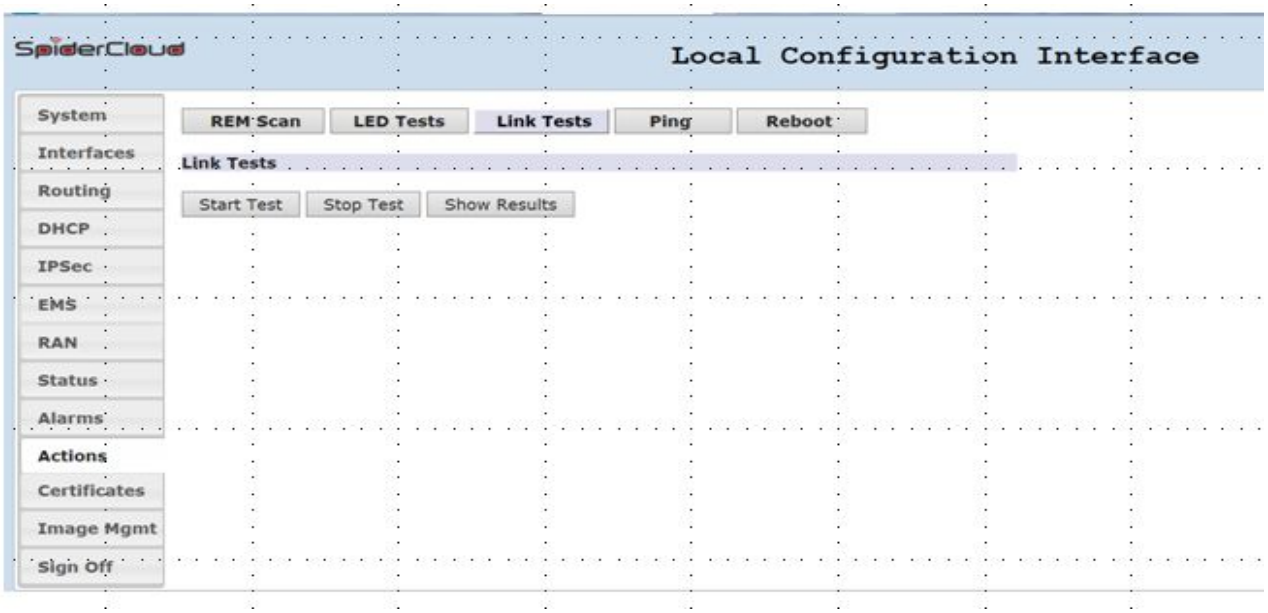
Step 7 (Optional) Generate installation reports.

Step 8 (Optional) Manage certificates, images etc.

Actions Screen – REM Scan

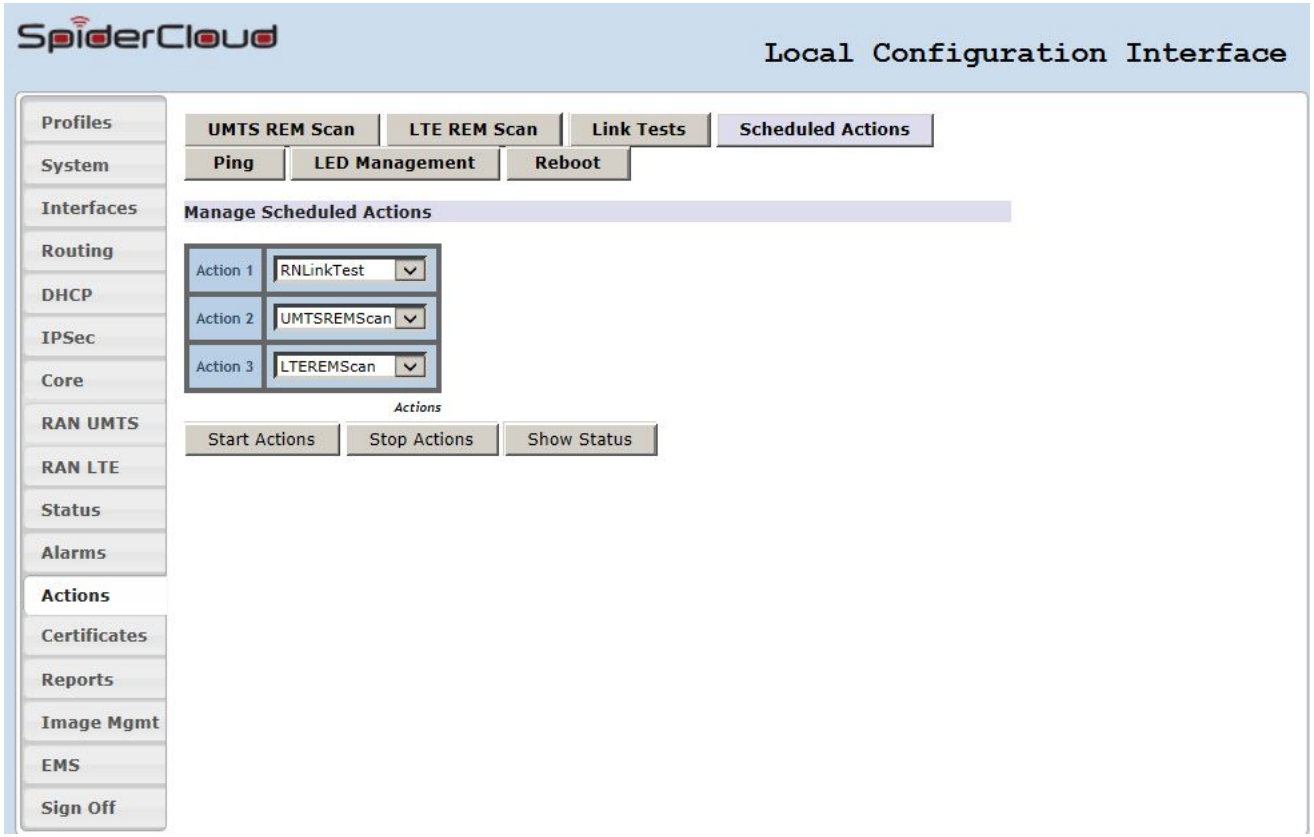
- Once all radio nodes are installed, the installation team can start the SON process from the **Actions tab.**
- To start the REM Scan, click on the **Actions** tab on the left, followed by the **REM Scan** tab on the top. Then click **Start Scan**.
- Monitor the progress of REM scan by clicking the **REM Scan -> Start Scan button** on the **Actions** tab.
- The services node then begins a process to auto-detect external macro cells on the same LTE channel and to determine the internal topology of the SpiderCloud E-RAN deployment.
- REM scan will also search for additional UMTS, LTE, and GSM channels as per the configuration.
- CN Connection is not required to run REM scan.

Actions Screen – Link Tests



- The **Link Tests** button inspects the IP connectivity of the services node link to all active radio nodes in the cluster. The **Link Tests** tab contains: **Start Test** - Initiates link testing, **Stop Test** - Immediately stops all link testing.
- To start the Link Test, click on the **Actions** tab on the left, followed by the **Link Tests** tab on the top. Then click on **Start Test.**
- **Show Results** button displays the results of the link tests.

Scheduled Actions



- The **Scheduled Actions** tab allows you to schedule up to three radio node link tests and UMTS and LTE REM scans to run in sequence.
- This can save time at installation and reduce site installer site visits.
- You can view the summary status on demand by selecting the **Show Status** button after the task has begun.

LCI Configuration Sequencing

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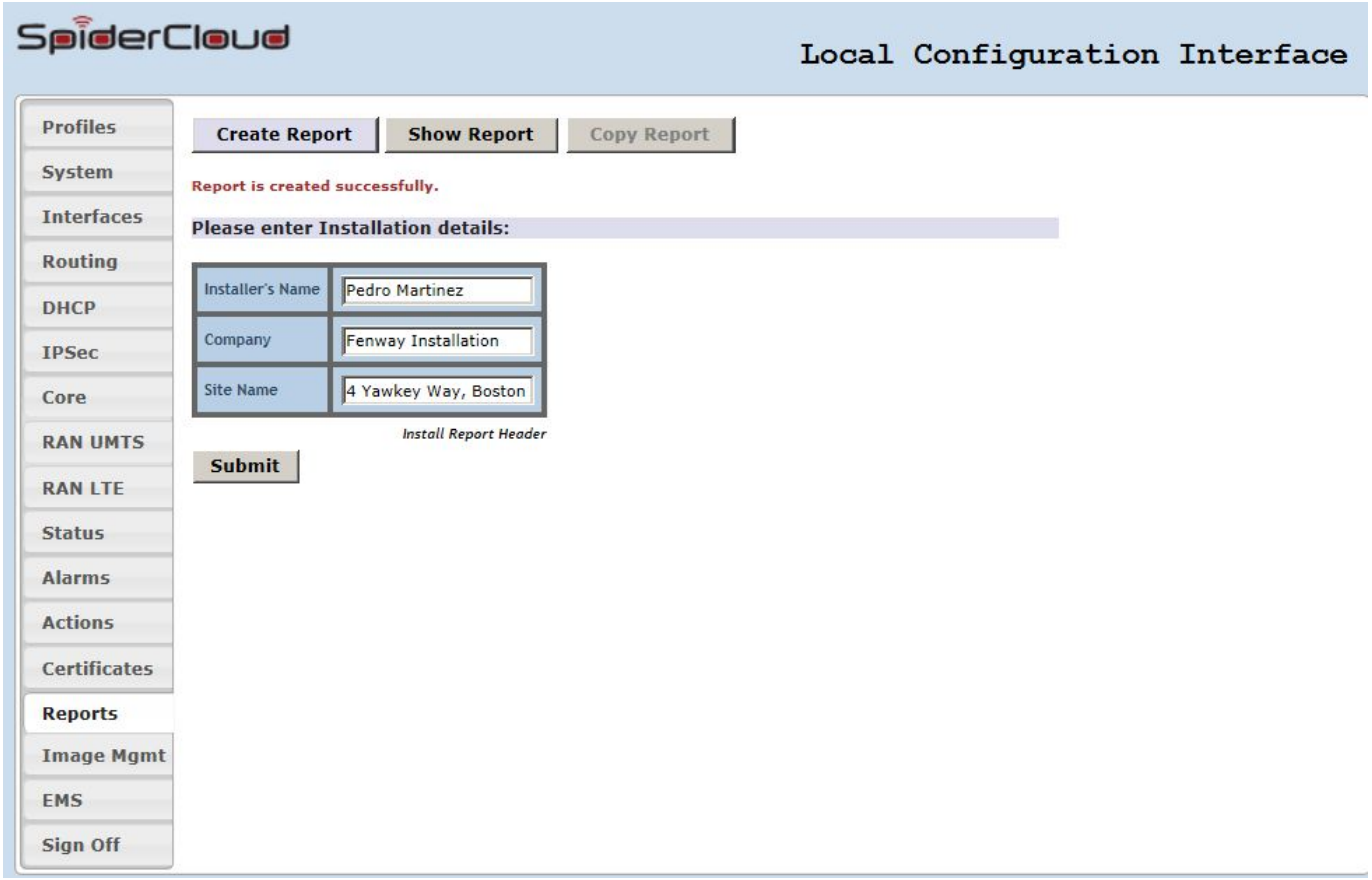
Step 6 (Optional) Execute a topology scan and link & connectivity tests.

Step 7 (Optional) Generate installation reports.

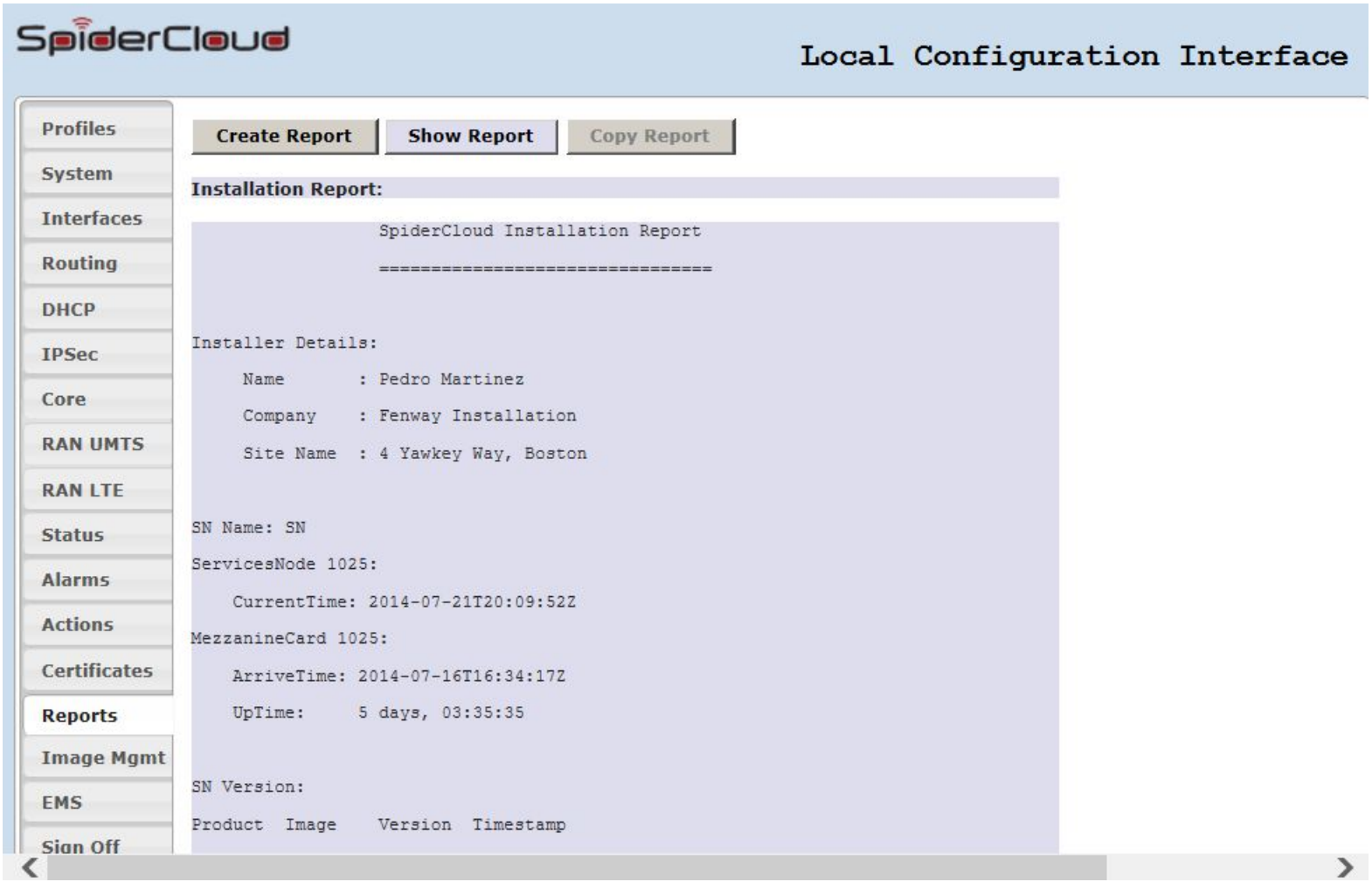
Step 8 (Optional) Manage certificates, images etc.

Installation Reports



- The **Reports** button can be used to generate an installation report that can be used to list all the tasks completed by the commissioner on the services node.

Installation Report Sample



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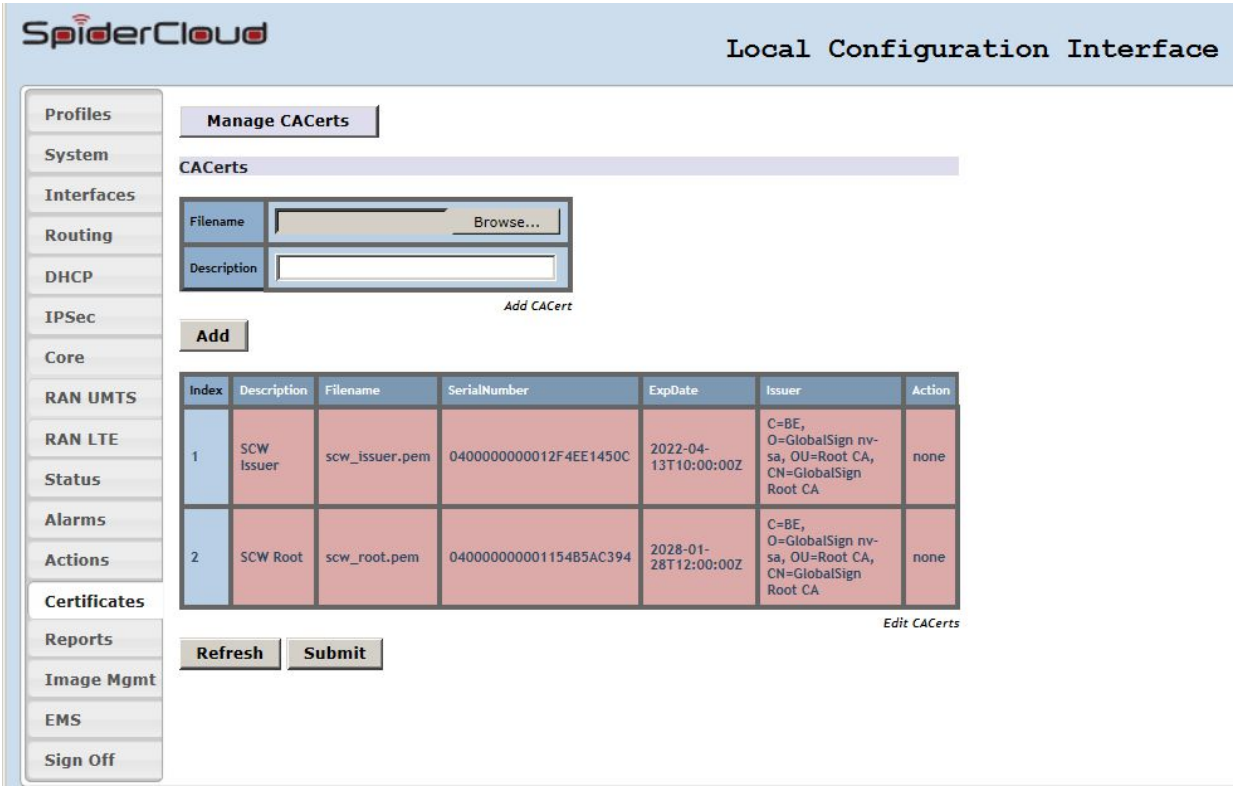
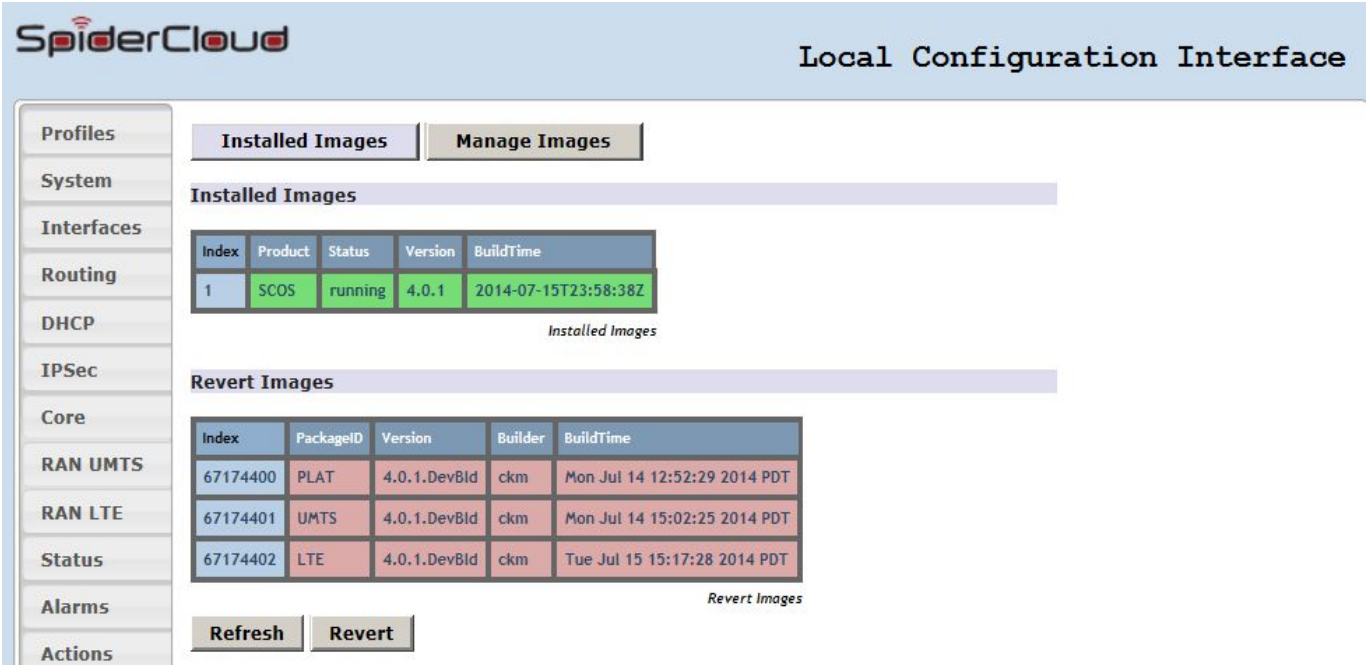
Step 8 (Optional) Manage certificates, images etc.

Manage Services Node and SeGW Certificates



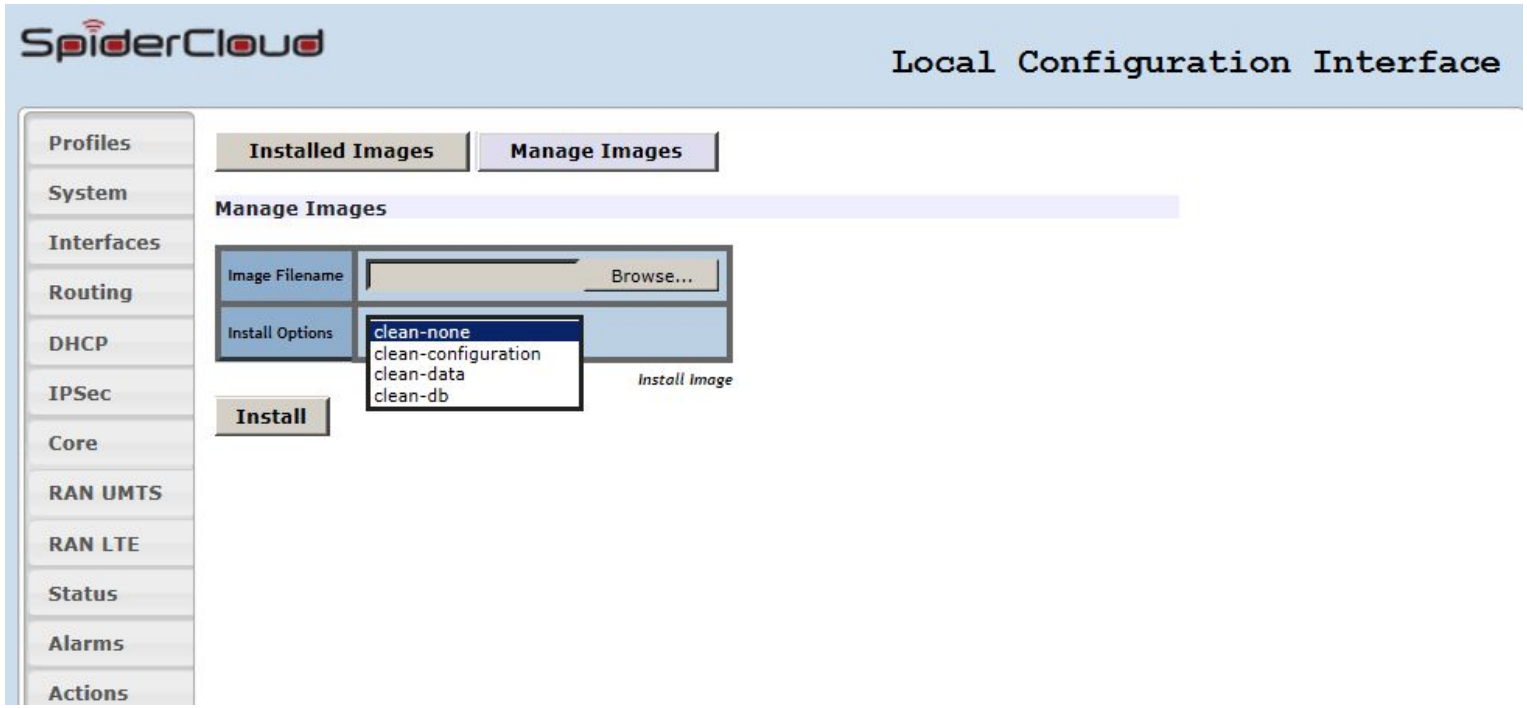
Certificates tab gives the flexibility to the commissioner to import root certificates onto the services node. This is very useful to import security gateway certificates onto the services node (for example, if its not loaded already at manufacturing) for successful mutual certificates based authentication for services node <-> SeGW IPsec tunnel establishment.

Image Management



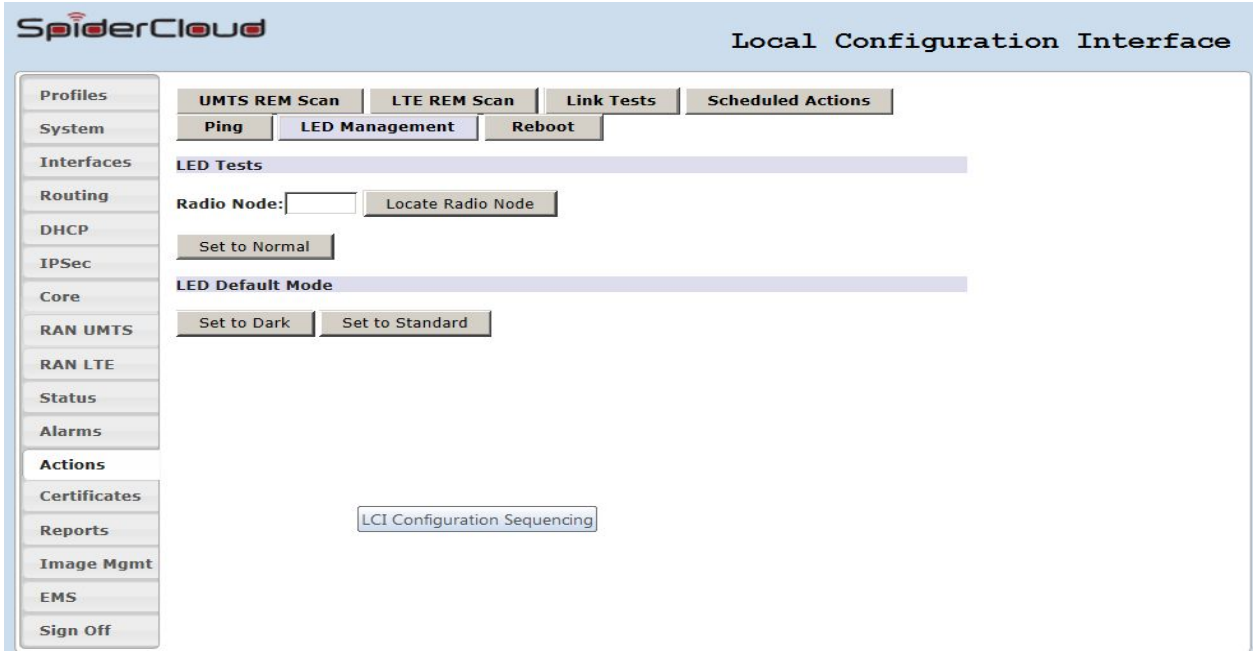
- **Image Management** can be used to view installed software version on the services node and the available revert software version on the services node.
- The **Revert** button can be used to downgrade the services node back to the previous software version.

Image Management



- The **Image Mgmt** tab has **Manage Images** button that allows the user to upload a new software image on the services node from the local machine on which LCI is running. It also allows to install with the different clean options.

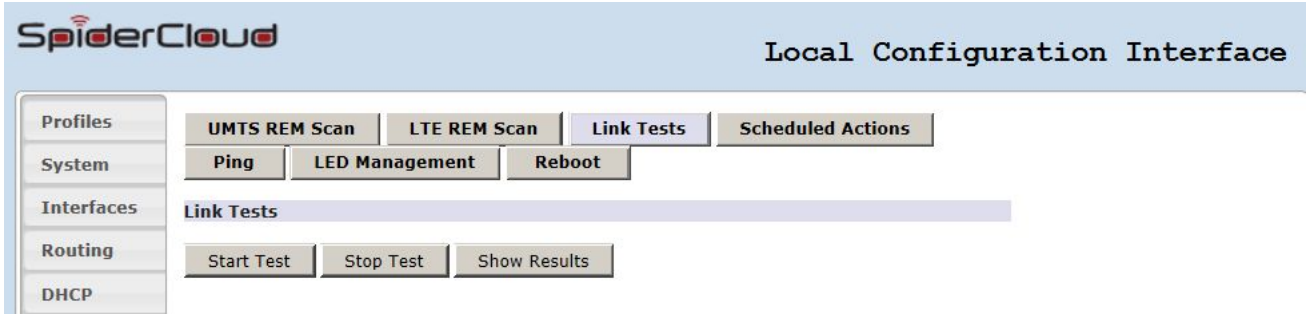
LED Management Tab



LED Management button has three LED-related actions:

- A method of identifying a specified radio node by entering its number to trigger a fast blue LED flashing pattern. Installer needs to enter the RadioNode number as per the csv file to locate specific RN.
- A **Set Normal** button that clears the LED testing.
- A **Set to Dark** and **Set to Standard** toggle that configures the default LED mode.
- LED turns green when a RN has been successfully installed. This is “standard” mode. But once all the link tests look good, we recommend toggling to “set to dark” before leaving so that there aren’t bright lights glowing all over the building.

Ping and Reboot Screens



- **Ping** button contains a text box for entering the IP address of the object to ping. Enter the IP address and click **Ping**.
- **Reboot** button opens a confirmation page and will reset the services node upon confirmation.
- Reboot gives the installer an option to revert back to factory default.

Site Acceptance Tests

- Site Specific
- Acceptance process may vary from operator to operator
- If applicable, verify 3GPP and System Performance Metrics satisfy thresholds set by operator
- Upon completion, a *Site Acceptance Report* should detail at a minimum:
  - KPIs over a pre-defined period (if applicable)
  - Final network design (incl. RF coverage maps, Equipment locations, LAN plan, etc)
- Obtain approval of *Site Acceptance Report* from the operator

Quiz

Q: How do you connect to LCI?

A: Connect to management port and https://192.168.168.1/lci

Q: Should you import configuration profile or RN bulk file first?

A: Import the configuration first followed by the RN bulk file.

Q: When is the RN bulk provisioning file created?

A: At the time of RN installation.

Q: Who provides the Operator specific profile?

A: Spidercloud support team will provide the operator specific profile.

Q: What is accomplished at the end of the commissioning process?

A: IPSEC tunnel to the SeGW is configured and SN is connected to the Spidernet server.

Troubleshooting

SpiderCloud Wireless

RadioNode Boot LED sequence

State	LED Colour	Description
PowerOn/ Reset	Green Flashing	Initial start up test, should only be for a few seconds, followed by LED lamp test colour cycle
DHCP	Red Solid	RadioNode requesting IP address from Services Node DHCP server
Join	Blue Solid	RadioNode has IP address and sends Join request to Services Node
TFTP	Blue Flashing	RadioNode is downloading its software from Services Node
OS Boot	Green Flashing	RadioNode is loading the software
Running	Green Solid	RadioNode is operational

Using RadioNode LED during Installation

LED Colour	Description
Any LED colour	The RadioNode has PoE power
LED off	The RadioNode has no PoE power
Boot sequence, then LED stuck Red Solid for over a minute	RadioNode cannot communicate with ServicesNode

- Note that if RadioNode is ‘stuck’ for several minutes and cannot proceed to next stage in boot cycle, it automatically reboots and tries again

Triage: LED off

- If LED is off then RadioNode is either not patched through all the way to PoE switch or the PoE switch port is disabled
  - Try to use a different switch port in the SpiderCloud VLAN
  - Verify physical patching
  - Verify Switch configuration
  - Walk back along cable with RadioNode (start by plugging it close to the switch then go to each patch hop and see if LED lights)

Triage: All RadioNode stuck (1/2)

- If all RadioNodes on one PoE switch are stuck in ‘red solid’ and cannot communicate with ServicesNode:
  - Verify the connection between the PoE switch and the ServicesNode in OSI Layer order 1,2,3. Complete the step, before proceding to verify next Layer
  - **Verify Layer 1** physical path is ok between Switches and ServicesNode
    - If no LED is lit on LANdevice2, verify the physical port speed is set correctly. Default is 1000mbps, some customers use 100mbps.
    - The speed can be changed on LCI.

Triage: All RadioNode stuck (2/2)

- **Verify Layer2 (VLAN)**
  - The default configuration is to set the LANDev2 IPInterface1 as untagged. If the corresponding interface on the switch is tagged, delete IPinterface1 and create a new IPinterface2 and set the VLAN number supplied by the customer.

- **Verify Layer3 (IP)**
  - Use ping command to verify Layer3 connectivity.
  - Also check the DHCP protocol is assigning IP addresses to the RadioNodes

Triage: One RadioNode stuck

- If one RadioNode on a PoE switch is stuck in ‘red solid’, but other RadioNode on same switch boot ok:
  - Unplug RadioNode at the switch and verify LED on RadioNode goes out (ie is it really connected to the switchport you think it is)
    - If LED stays on, then RN is getting its power from a different PoE switch
    - If LED goes off, try and plug RadioNode into a different spare switchport allocated to the SpiderCloud VLAN, verify the switch is configured correctly.

Triage: Example

- If RN2 is working but RN1 is faulty, try eliminating the issue of cable or patch panel by “walking the RN” back towards the POE switch at each connection point in a systematic manner