

Exhibit C

Infringement of U.S. Patent No. 10,506,454 by the SpiderCloud Enterprise Radio Access Network (“E-RAN”) System

The SpiderCloud E-RAN System including E-RAN small cell systems, such as SpiderCloud services and radio nodes,¹ and all applicable software, including software that implements Self-Organizing/Self-Optimizing (SON) and Multi-Operator features, capabilities, methods and processes, infringes claims 1-3, 5-6 and 8-9 of the '454 patent either literally or under the doctrine of equivalents.

A. Claim 1

- **1[Preamble] A system for dynamically routing signals in a Distributed Antenna System (DAS) operable to communicate with a plurality of signal sources, the system comprising:**

SpiderCloud E-RAN System - Claim 1[Preamble]
To the extent that the Court deems the preamble of claim 1 to be limiting, the SpiderCloud E-RAN System meets this claim element. For example, the SpiderCloud E-RAN System is deployed to support wireless communications in a distributed antenna system (DAS). ² According to Corning’s SpiderCloud product literature, the SpiderCloud E-RAN System distributes UMTS, LTE and LTE-LAA wireless communication, including multiple signal sources. ³

¹ Upon information and belief, SpiderCloud E-RAN services node include, but not limited to, the Corning Spider Cloud Services Node 9000 4G LTE Air Technology and Corning SpiderCloud Services 9000 Dual-Mode 3G UMTS and 4G LTE Air Interface services node models. Upon information and belief, SpiderCloud radio nodes include, but not limited to, the SCRN-310, SCRN-220, SCRN-320, SCRN-330 and SCRN-340 radio node models.

² NDCA-00044204-07 (E-RAN Introduction) at D00044205-06.

³ *Id.* at NDCA00044205; *see also* COCDALI_00000014-15 (Small Cell Technology), COCDALI_00000016-18 (Small Cell Service Nodes).

E-RAN Platform

An E-RAN system is made up of one rack-unit-sized services node that manages multiple single-carrier or dual-carrier radio nodes operating in 3G, LTE, and unlicensed spectrum.

Services Node

The services node lies at the heart of the SpiderCloud® E-RAN solution. It ensures that the E-RAN system is easy to deploy and manage and that it delivers the performance mobile operators expect. The services node is access technology agnostic, supporting UMTS, LTE, and LTE-LAA. It orchestrates the self-organizing network (SON) process, controls the operation of different radio nodes during neighbor discovery, gathers information from different radio nodes, and creates optimized neighbor lists based on information received from the neighbor scans.

SON capabilities include:

- Discovering the macro cells in the area as well as internal small cell and collocated Wi-Fi topologies.
- Assigning UMTS primary scrambling codes, LTE physical cell identifier, and LAA unlicensed channels.
- Setting maximum transmit power levels based on transmit power detected from adjacent radio nodes and surrounding macro signals.
- Automatically configuring cell neighbor lists to make the system operational.



Radio Nodes

Like Wi-Fi access points, radio nodes are small with low profiles. An E-RAN platform offers a wide range of radio nodes for many different applications and mobile operator configurations. All models are powered by PoE+ (802.11at) Ethernet switch ports.

Installation is quick and easy using commonly available PoE+.

1. Pull a structured cable (CAT 5e or greater).
2. Attach the radio to wall or ceiling.
3. Connect Ethernet patch cords at both ends.

- **1[A] one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from the plurality of signal sources, each DAU of the one or more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;**

SpiderCloud E-RAN System - Claim 1[A]

The SpiderCloud E-RAN System meets this claim element. For example, the SpiderCloud E-RAN System provides a services node, e.g., Corning SpiderCloud Services Node 9000 4G LTE Air Interface Technology, that provides “**Multioperator core network support** for UMTS and LTE (MOCN).”⁴ Upon information and belief, the SpiderCloud E-RAN System services node is a Digital Access Unit (DAU) that receives one signal from one operator

⁴ COCDALI_00000023-26 (Spec Sheet LAN-2319-AEN) at COCDALI_00000024.

and a second signal from another operator – i.e., “**Multioperator core network support.**” The SpiderCloud E-RAN System services node provides interfaces with multiple input-output ports⁵:

Interfaces	8 x Gbps Ethernet ports
	2 x Gbps SFP Ethernet ports
	1 x RJ45 console port (RS-232)
	1 x 10/100 management port
	1 x TNC connector for GNSS antenna

- **1[B] a plurality of Digital Remote Units (DRUs) coupled to the one or more DAUs and operable to transport signals between the plurality of DRUs and the one or more DAUs;**

SpiderCloud E-RAN System - Claim 1[B]

The SpiderCloud E-RAN System meets this claim element. For example, the SpiderCloud R-RAN System provides a family of radio nodes, serving as a “Digital Remote Units (DRUs).”⁶

⁵ *Id.* at COCDALI_00000025.

⁶ NDCA-00044204-07 (E-RAN Introduction) at NDCA-00044205.

Radio Node Family



Capabilities	SCRN-310	SCRN-220	SCRN-320	SCRN-330	SCRN-340
Available models	Band 4 & 13 (model -0413) Band 4 & 2 (model -04L2)	Band 4 (66) or Band 2(25) or Band 13	Band 4 + 5 GHz Band 2 + 5 GHz Band 4(66) + 5 GHz	Band 41 (Sprint) or 48 (CBRS)	Band 2 (25) or 4 (66) & Band 13 or 14
Carrier aggregation (CA)	Yes	No	Licensed and unlicensed up to 60 MHz (3 CC CA)	No	Yes
Peak speed (Mbps)	225 Mbps with CA (0413) 300 Mbps with CA (04L2) 150 Mbps without CA	150	270 Mbps (Chan 32 only) 400 Mbps (3 CCA)	Peak DL rate of 100 Mbps with FC2	225 Mbps with CA 150 Mbps without CA
Number of active users	128/band (256 for dual-band)	128	128 (with LAA)	128	128/band (256 for dual-band)
Number of VoLTE users (subset of number active)	64 with CA 128 (64/band), without CA	64	64 (with LAA)	64	64 with CA 128 (64/band), without CA
Support for CAT-M1	No	Yes	Yes	No	Yes
Transmit power	250 mW	500 mW	500 mW	500 mW	500 mW
Coverage	8,000 – 10,000	10,000 – 13,000	10,000 – 13,000	10,000 – 13,000	10,000 – 13,000
Antennas	Internal External as option	Internal External as option	Internal	Internal External as option	Internal External as option

According to SpiderCloud product literature, the SpiderCloud E-RAN System provides multiple radio nodes (communication units) that are connected to a SpiderCloud E-RAN services node using standard Ethernet LAN infrastructure.⁷ For UMTS communications, the SpiderCloud E-RAN system provides “2400 simultaneous sessions” and “250 Mbs aggregate UMTS throughput.”⁸ For LTE communications, the SpiderCloud E-RAN system provides “8000 simultaneous sessions” and “1 Gbps aggregate LTE throughput.”⁹

⁷ COCDALI_00000001-5 (Small Cell Networks).

⁸ COCDALI_00000023-26 (Spec Sheet LAN-2319-AEN) at COCDALI_00000024.

⁹ *Id.* at COCDALI_00000025.

- **1[C] a plurality of sectors formed from the plurality of DRUs comprising a first sector and a second sector different from the first sector, each sector comprising a subset of the plurality of DRUs; and**

SpiderCloud E-RAN System - Claim 1[C]

The SpiderCloud E-RAN System meets this claim element. For example, according to SpiderCloud E-RAN product literature, SpiderCloud's Self-Organizing/Self-Optimizing (SON) algorithms manage various parameters of individual radio nodes creating "sectors."¹⁰ For example, "the services node uses measurements collected over time to fine-tune the network. For example, it might reduce the power level of a **congested cell to decrease the number of users on that cell, while powering up lightly loaded cells.**"¹¹ In this example, the congested cell is one sector, whereas the lightly loaded cells are another sector.

Periodic Optimization and Self-Maintenance

While the system is in operational mode, a power optimization feature is used to periodically adjust the transmit power levels in order to achieve uniform coverage across the small cell deployment. The algorithm takes into account several factors:

- The interference level from macro networks as measured by the radio nodes
- The relative signal strength at which each radio node measures neighboring radio nodes
- Periodic signal quality measurements made by user devices across the network and reported back to the services node

The service node uses measurements collected over time to fine-tune the network. For example, it might reduce the power level of a congested cell to decrease the number of users on that cell, while powering up lightly loaded cells. The system can also be configured to periodically monitor for changes in topology (added or deleted external and internal cells) and changes in the physical RF environment of the deployment area. For example, the system can be configured to go into scan mode during weekends, when no traffic is expected on the network.

Additionally, the SpiderCloud E-RAN services node implements "discovering the **macro cells** in the **area**, discovering the **internal small cell topology**, assigning UMTS primary scrambling codes and LTE physical cell identifier . . . and automatically configuring cell neighbor lists to make the system operational."¹²

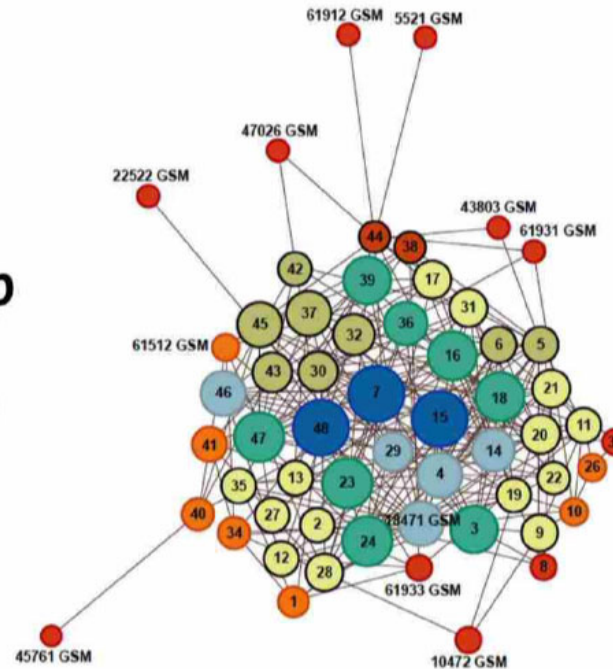
¹⁰ COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000074.

¹¹ *Id.*

¹² *Id.*

Visualization Map

Corning SpiderCloud's SON for
Scalable Small Cell Systems
Includes: UMTS & LTE SON Layers



Thus, upon information and belief, the SpiderCloud E-RAN System provides a plurality of sectors formed from the plurality of DRUs comprising a first sector and a second sector different from the first sector, each sector comprising a subset of the plurality of DRUs.

- **1[D] a traffic monitoring unit coupled to at least one of the DAUs comprising the input port and output port each configured as an uplink/downlink port, wherein the traffic monitoring unit is configured to:**

SpiderCloud E-RAN System - Claim 1[D]

The SpiderCloud E-RAN System meets this claim element. For example, according to Spider-Cloud E-RAN System product literature, the SpiderCloud E-RAN System services node performs SpiderCloud SON algorithms that modify parameters of the SpiderCloud radio nodes for congested cells: “it might reduce the power level of a congested cell to decrease the number of users on that cell”¹³ Upon information and belief, in order to do so, the SpiderCloud services node must be able to identify levels of congestion in the E-RAN system and perform SpiderCloud SON features, and, as such, the SpiderCloud services node contains a “traffic monitoring unit” or its equivalent. Additionally, the SpiderCloud SON

¹³ COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000074.

algorithms “periodically **monitor** for changes in topology (added or deleted external and internal cells) and changes in the physical RF environment of the deployment area.”¹⁴ These features also “uses measurements collected over time to **fine-tune the network**” to adjust for contested cells.¹⁵

- **1[E] determine one or more key performance indicators (KPIs) and a quality of service (QoS) of a network traffic for the one or more DAUs, wherein the QoS is a function of the one or more KPIs; and**

SpiderCloud E-RAN System - Claim 1[D]

The SpiderCloud E-RAN System meets this claim element. For example, according to Corning’s product literature, the SpiderCloud’s SON algorithms make various measurements of the radio environment such as “periodic signal quality measurements made by user devices across the network and reported back to the services node.”¹⁶ The SpiderCloud’s SON algorithms utilize these key performance indicators, such as the periodic signal quality measurements, to modify the radio parameters of the SpiderCloud radio Nodes to achieve some level of service for user devices being served by the SpiderCloud E-RAN System, including to “reduce the power level of a congested cell . . . while powering up lightly loaded cells.”¹⁷

Periodic Optimization and Self-Maintenance

While the system is in operational mode, a power optimization feature is used to periodically adjust the transmit power levels in order to achieve uniform coverage across the small cell deployment. The algorithm takes into account several factors:

- The interference level from macro networks as measured by the radio nodes
- The relative signal strength at which each radio node measures neighboring radio nodes
- Periodic signal quality measurements made by user devices across the network and reported back to the services node

The service node uses measurements collected over time to fine-tune the network. For example, it might reduce the power level of a congested cell to decrease the number of users on that cell, while powering up lightly loaded cells. The system can also be configured to periodically monitor for changes in topology (added or deleted external and internal cells) and changes in the physical RF environment of the deployment area. For example, the system can be configured to go into scan mode during weekends, when no traffic is expected on the network.

The SpiderCloud E-RAN System SON algorithms determine a quality of service which is a function of one or more key performance indicators. Additionally, the SpiderCloud Services Node 9000 Dual-Mode 3G UMTS and 4G LTE Air Interface provides system management performance using “KPIs.”¹⁸

¹⁴ COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000075.

¹⁵ *Id.*

¹⁶ *Id.*

¹⁷ *Id.* at COCDALI_00000074.

¹⁸ COCDALI_00000023-26 (Spec Sheet LAN-2319-AEN) at COCDALI_00000024.

System Management

Configuration: remote management and auto configuration using TR-069

Faults and events: TR-069, SNMPv2c, SNMPv3, Syslog

Performance: 3GPP counters, KPIs, standard MIBs, and SpiderCloud MIBs

Command line interface (CLI) via console port and remotely using SSH

Another key feature of the SpiderCloud services node is “Backhaul network sharing and QoS.”¹⁹ Thus, upon information and belief, a SpiderCloud E-RAN System service node contains a traffic monitoring unit that determines one or more key performance indicators (KPIs) and a quality of service (QoS) of a network traffic for the one or more DAUs, wherein the QoS is a function of the one or more KPIs.

- **1[F] reconfigure the plurality of sectors based on the one or more KPIs and QoS by allocating at least one DRU from the first sector to the second sector.**

SpiderCloud E-RAN System - Claim 1[F]

The SpiderCloud E-RAN System meets this claim element. For example, according to the SpiderCloud SON feature, the SpiderCloud E-RAN System services node performs “Periodic Optimization and Self-Maintenance” including “periodic adjust[ment]” based on “measurements collected over time to fine tune the network.”²⁰ Such fine-tuning includes “reduc[ing] the power level of a congested cell . . . while powering up lightly loaded cells.”²¹ Upon information and belief, the power level adjustments are an example of how the SpiderCloud SON Self-Configuration feature reconfigures sectors based on the one or more KPI and QoS. Additionally, the “centralized SON algorithm also eliminates the need for any careful planning with existing Wi-Fi networks. The channel assignment per Radio Node are **periodically refreshed to accommodate changes in traffic loading and usage within the E-RAN system** as well on the Wi-Fi networks.”²² Thus, upon information and belief, a SpiderCloud E-RAN System services node contains a traffic monitoring unit that reconfigures the plurality of sectors based on the one or more KPIs and QoS by allocating at least one DRU from the first sector to the second sector.

¹⁹ *Id.*

²⁰ COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000075.

²¹ *Id.*

²² *Id.* at COCDALI_00000076.

B. Claim 2

- The system of claim 1 further comprising a plurality of BTSs coupled to the one or more DAUs, wherein each BTS comprises the plurality of sectors.

SpiderCloud E-RAN System - Claim 2

The SpiderCloud E-RAN System meets this claim element. For example, the Spider-Cloud E-RAN services node, e.g., SpiderCloud Services Node 90000, connects to a core network as a “Home Node” or “**multi-sector eNB**.”²³

In UMTS deployments, the Service Node plays the role of a Radio Network Controller (RNC) and connects to the public UMTS Core Network either as an RNC or as a Home Node B.

In LTE deployments, the Service Node acts as a Cloud RAN controller, and connects to the public LTE Evolved Packet Core (EPC) as a multi-sector eNB.

In FirstNet deployments, the Service Node acts as a Cloud RAN controller and manages all pre-emption activities for attached First Responder devices and connects to both the public and FirstNet LTE Evolved Packet Core (EPC) as a multi-sector eNB

Thus, upon information and belief, a plurality of BTSs are coupled to a SpiderCloud services node that is DAU.

C. Claim 3

- The system of claim 2 further comprising a network optimization goal comprising a percentage of users associated with each of the plurality of sectors.

SpiderCloud E-RAN System - Claim 3

The SpiderCloud E-RAN System meets this claim element. For example, the SpiderCloud E-RAN System services node “uses measurements collected over time to fine-tune the network. For example, it might reduce the power level of a **congested cell to decrease the number of users on that cell, while powering up lightly loaded cells.**”²⁴ Furthermore, the SpiderCloud services node “orchestrates the self-organizing network (SON) process, controls the operation of different radio nodes during neighbor discovery, gathers information from different radio nodes, and creates **optimized neighbor lists** based on information received from the neighbor scans.”²⁵ Each sector has a percentage of active users in the sector.²⁶

D. Claim 5

- The system of claim 1 wherein the traffic monitoring unit is provided as a component of each of the one or more DAUs.

²³ COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000075.

²⁴ *Id.*

²⁵ NDCA-00044204-07 (E-RAN Introduction) at NDCA-00044205.

²⁶ *Id.*

SpiderCloud E-RAN System - Claim 5

The SpiderCloud E-RAN System meets this claim element. For example, according to Spider-Cloud E-RAN System product literature, the SpiderCloud E-RAN System services node performs SpiderCloud SON features that modifies parameters of the SpiderCloud radio nodes for congested cells: “it might reduce the power level of a congested cell to decrease the number of users on that cell”²⁷ Upon information and belief, in order to do so, the SpiderCloud services node must be able to identify levels of congestion in the E-RAN system and perform SpiderCloud SON Self-Configuration features, and, as such, the SpiderCloud services node contains a “traffic monitoring unit” or its equivalent that is provided as a component of the SpiderCloud services node.

E. Claim 6

- **The system of claim 1 wherein the traffic monitoring unit is external to the plurality of DRUs.**

SpiderCloud E-RAN System - Claim 6

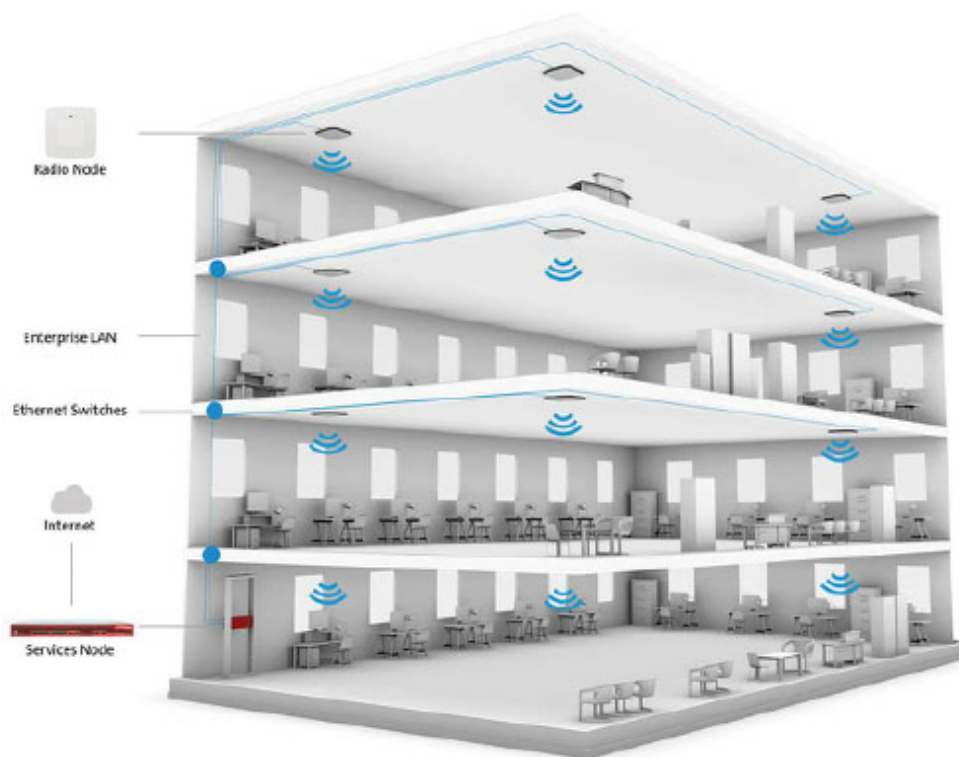
The SpiderCloud E-RAN System meets this claim element. For example, according to SpiderCloud E-RAN product literature, the “E-RAN consists of a service node, which controls, configures, and manages up to 100 UMTS and LTE SpiderCloud radio nodes.”²⁸ SpiderCloud radio nodes “are high capacity, power-over-Ethernet (PoE) capable small cells. In any deployment, multiple RNs are deployed inside an enterprise or venue, and are connected to the Services Node using standard Ethernet LAN infrastructure.”²⁹ An exemplary deployment of an SpiderCloud E-RAN System is shown below such that the SpiderCloud services node is external to the plurality of SpiderCloud radio nodes.³⁰

²⁷ COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000074.

²⁸ COCDALI_00000023-26 (Corning SpiderCloud Services Node 9000 Dual-Mode 3G UMTS and 4G LTE Air Interface) at COCDALI_00000023.

²⁹ COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000076.

³⁰ COCDALI_00000001-5 (Small Cell Networks) at COCDALI_00000004).



Accordingly, upon information and belief, SpiderCloud E-RAN System services node that contains a “traffic monitoring unit” is external to SpiderCloud E-RAN system radio nodes.

F. Claim 8

- **The system of claim 1 wherein the traffic monitoring unit is configured to analyze Key Performance Indicators (KPIs) of the DAS.**

SpiderCloud E-RAN System - Claim 8

The SpiderCloud E-RAN System meets this claim element. For example, according to Corning’s product literature, the SpiderCloud’s SON algorithms make various measurements of the radio environment such as “periodic signal quality measurements made by user devices across the network and reported back to the services node.”³¹ The SpiderCloud’s SON algorithms utilize these key performance indicators, such as the periodic signal

³¹ COCDALI_00000001-5 (Small Cell Networks) at COCDALI_00000004).

quality measurements, to modify the radio parameters of the SpiderCloud radio nodes to achieve some level of service for user devices being served by the SpiderCloud E-RAN System, including to “reduce the power level of a congested cell . . . while powering up lightly loaded cells.”³²

Periodic Optimization and Self-Maintenance

While the system is in operational mode, a power optimization feature is used to periodically adjust the transmit power levels in order to achieve uniform coverage across the small cell deployment. The algorithm takes into account several factors:

- The interference level from macro networks as measured by the radio nodes
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The service node uses measurements collected over time to fine-tune the network. For example, it might reduce the power level of a congested cell to decrease the number of users on that cell, while powering up lightly loaded cells. The system can also be configured to periodically monitor for changes in topology (added or deleted external and internal cells) and changes in the physical RF environment of the deployment area. For example, the system can be configured to go into scan mode during weekends, when no traffic is expected on the network.

The SpiderCloud E-RAN System SON algorithms determine a quality of service which is a function of one or more key performance indicators. Additionally, the SpiderCloud Services Node 9000 Dual-Mode 3G UMTS and 4G LTE Air Interface provides system management performance using “KPIs.”³³

System Management

Configuration: remote management
and auto configuration using TR-069

Faults and events: TR-069,
SNMPv2c, SNMPv3, Syslog

Performance: 3GPP counters, KPIs,
standard MIBs, and SpiderCloud MIBs

Command line interface (CLI) via
console port and remotely using SSH

³² COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000074.

³³ COCDALI_00000023-26 (Spec Sheet LAN-2319-AEN) at COCDALI_00000024.

Thus, upon information and belief, a SpiderCloud E-RAN System service node contains a traffic monitoring unit that analyses Key Performance Indicators (KPIs) of the DAS.

G. Claim 9

- **The system of claim 1 wherein the traffic monitoring unit is configured to analyze Quality of Service (QoS) values of the DAS.**

SpiderCloud E-RAN System - Claim 9

The SpiderCloud E-RAN System meets this claim element. For example, according to Corning's product literature, the SpiderCloud's SON algorithms make various measurements of the radio environment such as "periodic signal quality measurements made by user devices across the network and reported back to the services node."³⁴ The SpiderCloud's SON algorithms utilize these key performance indicators, such as the periodic signal quality measurements, to modify the radio parameters of the SpiderCloud radio Nodes to achieve some level of service for user devices being served by the SpiderCloud E-RAN System, including to "reduce the power level of a congested cell . . . while powering up lightly loaded cells."³⁵

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³⁴ COCDALI_00000074-77 (Self-Organizing/Self-Optimizing (SON) Small Cell Technology) at COCDALI_00000074.

³⁵ *Id.* at COCDALI_00000074.

³⁶ COCDALI_00000023-26 (Spec Sheet LAN-2319-AEN) at COCDALI_00000024.

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Command line interface (CLI) via console port and remotely using SSH

Another key feature of the SpiderCloud services node is “Backhaul network sharing and **QoS**.”³⁷ Thus, upon information and belief, a SpiderCloud E-RAN System service node contains a traffic monitoring unit that to analyzes Quality of Service (QoS) values of the DAS.

³⁷ COCDALI_00000023-26 (Spec Sheet LAN-2319-AEN) at COCDALI_00000024.