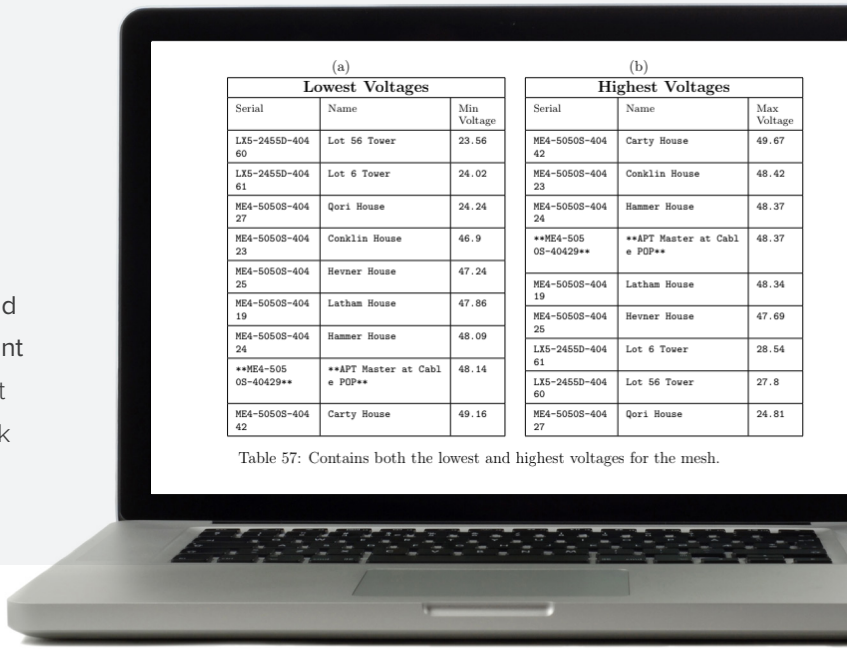
BC|Assurance

An Opportunity to Prevent and Ensure Peak Efficiency of Your Mesh Network

BC|Assurance is for Kinetic Mesh networks running version 11.22 or newer of Rajant's InstaMesh firmware and is an advanced technical support offering that provides the tools and information needed to assess and monitor the health of a Rajant Kinetic Mesh® network. The program provides access to Rajant technical experts to assist in identifying and addressing network performance issues before they impact operations.



(a) Lowest Voltages

Serial	Name	Min Voltage
LX5-2455D-40460	Lot 56 Tower	23.56
LX5-2455D-40461	Lot 6 Tower	24.02
ME4-5050S-40427	Qori House	24.24
ME4-5050S-40423	Conklin House	46.9
ME4-5050S-40425	Hevner House	47.24
ME4-5050S-40419	Latham House	47.86
ME4-5050S-40424	Hammer House	48.09
ME4-5050S-40429	**APT Master at Cable POP**	48.14
ME4-5050S-40442	Carty House	49.16

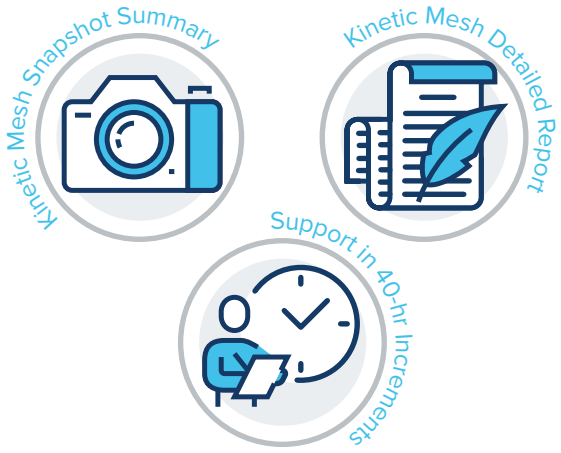
(b) Highest Voltages

Serial	Name	Max Voltage
ME4-5050S-40442	Carty House	49.67
ME4-5050S-40423	Conklin House	48.42
ME4-5050S-40424	Hammer House	48.37
ME4-5050S-40429	**APT Master at Cable POP**	48.37
ME4-5050S-40419	Latham House	48.34
ME4-5050S-40425	Hevner House	47.69
LX5-2455D-40461	Lot 6 Tower	28.54
LX5-2455D-40460	Lot 56 Tower	27.8
ME4-5050S-40427	Qori House	24.81

Table 57: Contains both the lowest and highest voltages for the mesh.

All networks experience gradual change over time. Many times, these changes cause the network to diverge from the original design and have a negative impact on overall performance. This phenomenon is known as "Network Drift" and can have many different causes. Changes to geographical topology, RF interference, additions of new equipment, application updates, inconsistent configuration, and general outdoor wear and tear can all cause network performance to slowly degrade over time.

While a well designed mesh network can withstand a certain amount of change, the insidious nature of Network Drift will eventually overcome the best design. BC|Assurance was developed to help our users understand and track these gradual changes. By understanding the changes as they occur, BC|Assurance can provide proactive solutions to keep your mesh network operating at peak efficiency, before network failure events occur.



BC|Assurance Elements

- **Kinetic Mesh Snapshot Summary (KMSS)** - Analytic information gathered from a mesh snapshot containing key elements related to Kinetic Mesh health, such as Rajant's InstaMesh® statistics, shown on a per-device level. Network operators can interpret these values to make timely decisions that improve reliability and performance.
- **Kinetic Mesh Detailed Report (KMDR)** - A detailed version of a KMSS, with additional information that addresses network degradation to keep your mesh running smoothly, categorized by important and critical priority. For quick fieldwork, the included Recommendation Summary lists Rajant's suggestions in a concise way. The report also lists possible federal RF compliance issues and BreadCrumbs® running out of normal specifications. Following these recommendations ensures that evolving networks do not fall victim to Network Drift and equipment is running optimally.
- **Hourly Support Purchased in 8-hour Increments** - Provides access to Rajant engineers who are able to diagnose and help resolve Kinetic Mesh issues remotely. With Rajant's improved support system, you can expect a quick response from Rajant experts dedicated to improving your network.

KMSS comes as a single statistical report, while the KMDR comes in two—a recommendation overview and a detailed data summary. Recommendations are summarized in a separate concise overview, then include more detailed recommendations throughout what is essentially a KMSS.

Report Contents at a Glance

Snapshot Synopsis	InstaMesh® and Networking	Configuration Inconsistencies	Hardware Analysis
• 1.1 Snapshot Information • 1.2 Total Reporting BreadCrumbs • 1.4 Uptime • 1.5 CPU Usage • 1.6 Frequency Usage • 1.7 MAC Stats • 1.8 MegaBits per Second (Mbps) • 1.9 Radio Busyness • 1.10 Highest Noise • 1.11 System Level Events	• 2.1 Top Ten InstaMesh® Stats • 2.2 Edge to APT Wireless Hops • 2.4 Undeliverable Packets • 2.5 TTL Exceeded • 2.6 BCAPI Connections • 2.7 Wireless Link Health	• Dynamically generated based on inconsistencies found in the mesh	• 4.1 Voltage • 4.2 External Device Health

There are four overarching sections of the report that contain sub-sections of specific measured values.

1 Snapshot Synopsis is the first segment of the report. This includes an overview of important mesh characteristics, such as number of BreadCrumbs captured in the snapshot, firmware information, and frequency usage across the network.

- Total Reporting BreadCrumbs: For BCIAssurance reports to be accurate, the snapshots sent to us should include all BreadCrumbs within the network. Unfortunately, this is very rarely the case. This section shows not only the number of BreadCrumbs that reported into the snapshot, but also the number of BreadCrumbs that had empty log file data and the number of BreadCrumbs that did not report in to the snapshot but were seen by other BreadCrumbs that did report into the snapshot.
- Firmware: Upgrading firmware is one of the easiest ways to improve network health, but it can be easy to miss a few BreadCrumbs in the upgrade process. This section shows how many BreadCrumbs are running which firmware.
- CPU Usage: BreadCrumbs can become overworked, but it is difficult to find out which ones are constantly being overused. This section flags all BreadCrumbs using too much CPU power on the process level.
- Frequency Usage: Sometimes sites are not aware of the number of different frequencies and channels used throughout the mesh. This section details each channel and frequency used, along with its total routes.
- MAC Statistics: Client devices are one of the biggest aspects of a network. Using the APT Master as a proxy for the rest of the network, this section shows important information for client devices on a per MAC basis and details packet rates for various categories, indicating the most often used devices.
- Megabits per Second: BreadCrumbs can send and receive a lot of data, but it is important to not overwork any unit. This section details both sent and received Mbps for both wired and wireless connections.
- Radio Busyness: BreadCrumbs are resilient, but no BreadCrumb should be busy all the time in order to keep some reserve capacity available. This section points out the top BreadCrumbs with highest noise, busyness, transmitting rates, and receiving rates.
- Highest Noise: External factors can have a large affect on any network. This section not only lists the top BreadCrumbs with the highest noise, but also the wireless port affected by that noise, helping to determine noisy channels and possible need to change frequencies.
- System Level Events: System level warnings or hardware errors sometimes happen inside of a BreadCrumb and can indicate several different problems. This section shows the rate of different types of errors on a per BreadCrumb basis.

2 The next section, Instamesh and networking, contains crucial information about wireless performance, InstaMesh statistics, radio failures, and APT characteristics. The statistics in this section provide insight into the health of the mesh on a networking level.

- Top 10 Instamesh Stats: It can be intimidating to analyze a network on a per-packet basis, but also very insightful. This section contains network-wide packet rates for many Instamesh-specific categories, including Flood Packets (i.e Gratuitous ARP's, Broadcasts, etc.), and undeliverable packets, which can indicate major holes in the network.
- Edge to APT Hops: It is important for packets of any wireless network to be able to go on and off the LAN very quickly. This section shows the most number of hops a packet will take to

get to an APT Master or Slave (and hence the LAN), and can show issues in BreadCrumb placement or holes where another APT Slave would be useful.

- APT Master Cost (To and From): The APT Master is in charge of all packets coming on and off of the LAN, making it crucial for all BreadCrumbs to have good cost to and from the APT Master. This section details the highest costs of BreadCrumbs to and from the APT Master.
- Undeliverable Packets: Packets returning to their sender are never a good sign of a healthy network. This section details rate and percentage of packets which are sent back on a per device basis.
- TTL Exceeded: Another indicator of issues are packets that are dropped due to being on the network for a very long time. This section shows percentages and rate of packets which are dropped on a per device basis because their time to live exceeded the set amount for the mesh.
- BCAPI Connections: Sometimes a network has many BC|Commander instances running at the same time, with not all of them being used. This sections lists the BreadCrumbs with many BCAPI connections and can indicate unexpected instances of BC|Commander running on your network.
- Wireless Link Health: BreadCrumbs need enough great connections to other BreadCrumbs to guarantee healthy pathing. This section categorizes all BreadCrumbs based on their connection quality and indicates BreadCrumbs that need adjusting to improve network performance.

3 The third section notes inconsistent BreadCrumb settings. Incorrect configuration can become a critical point of failure when radios are not able to communicate with each other. To address this, the report dedicates an entire section to relevant inconsistencies in comparison to the rest of the mesh. This section is dynamically generated based on the settings used in each snapshot, but follows the following guidelines:

- Each subsection is categorized by the type of setting it is (General, InstaMesh, Wired, Wireless, etc.).
- Each relevant inconsistent setting of each subsection includes a description of the setting (if available) and a table containing subsetting name, the value of the setting, and the number of BreadCrumbs at that value.
- Note: A subsetting is either the setting itself if not port specific or the setting specified on a particular port. For example, the subsetting for instamesh.gcThresh is instamesh.gcThresh (itself), but a subsetting for wired[].mode is wired[0].mode (indicating eth0).

4 Finally, the last section of BC|Assurance reports lists observations made in regards to network hardware.

- Voltage: Many times BreadCrumbs have issues because they are either being overpowered or underpowered. This section shows those BreadCrumbs with the lowest and highest recorded voltage.
- External Device Health: Customer devices connected through Ethernet can experience issues if there is a problem with the connection. This section displays Ethernet link state changes on a per-port per-BreadCrumb basis, reporting those ports having the most issues.

With this combination of RF, networking, setting, and hardware analysis, Rajant can provide robust, overall network health analysis as a smart network monitoring and preventative maintenance solution.

Awareness of Network Drift combined with the benefits of Rajant technical analysis through BC|Assurance can improve network quality and reliability by preventing network downtime and application performance loss. All Rajant customers receive the following BC|Assurance elements and associated educational materials.

- An initial KMSS at no extra charge and no hourly support contract.
- Network Drift Awareness PDF with a link to a technical training video.
- Sample generic KMDR.

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