

RAJANT KINETIC MESH® NETWORKS

THE KEY ENABLER OF PORT-WIDE MOBILITY

Many of the world's major ports have been in operation for decades and are now faced with the challenge of aging, mobile-limited network infrastructure in an environment more dynamic than ever before.

Data volume demands for SCADA, RFID, CCTV, and related applications have increased and the need for mobile communications has become essential. The explosion of Industrial Internet of Things (IIoT) devices, autonomous equipment, and robotics platforms offer further opportunities for port terminals to achieve transformative productivity and efficiency gains, but to take advantage of such applications they must rapidly modernize their largely wired networks.

Today, ubiquitous mobile coverage is vital to keep up the constant flow of goods in and out of a port and to the proper functioning of semi- and fully autonomous equipment. By adding wireless technology, whether cellular/LTE, point-to-point (PTP), or point-to-multipoint (PtMP) solutions, port operators are realizing incremental mobility gains, but the capabilities of such wireless solutions still fall short when trying to bring reliable, rapidly scalable mobile connectivity to every corner of the port terminal.

Traditional wireless networks were simply not designed to provide reliable connectivity over widespread areas such as port environments, especially when the assets within that environment are highly mobile.

A 'BROKEN' APPROACH TO CONNECTIVITY

In Wi-Fi and standard mesh networks, mobile nodes can only communicate with infrastructure nodes, and via only one connection at a time. These networks therefore must employ a "make-before-break" paradigm of connectivity. Mobile nodes continually break and re-establish connectivity as they move between access points, and each break results in a temporary loss of communications.

If personnel or port equipment are sending data to each other or to the

command center during these periods of broken connectivity, the information is at best delayed, but more likely completely dropped. That may be sufficient for delay-tolerant monitoring applications, but is a significant issue for autonomous platforms. If there is latency or delay in data transmission to an autonomous piece of port equipment, the machine will stop functioning, effectively nullifying its productivity benefits.

THROUGHPUT PERFORMANCE CHALLENGES

Traditional networks dedicate one frequency for mobile clients to communicate to infrastructure nodes; another is used for infrastructure nodes to communicate with each other. Dedicating frequencies to a single purpose greatly limits total bandwidth availability for Wi-Fi communications.

Additionally, to comply with IEEE standards, each Wi-Fi access point must equally divide its available bandwidth among its connected clients. If 20 mobile clients are connected to a single access point, they will each only receive 5% of the bandwidth. For port operators looking to scale the number of moving assets they have deployed across their terminal, throughput and latency will quickly become a challenge.

INABILITY TO EFFECTIVELY ADDRESS INTERFERENCE

Networks that dedicate frequencies to a single purpose also have increased potential for slowed or dropped traffic because data can only travel one way to reach the application server. They assess routes based only on RSSI, not accounting for other significant performance factors like congestion, node outages, or interference—and would have no way to route around these issues even if they were detected.

Networks like these can be specifically arranged to avoid such signal interferences, but only in a static, predictable environment. Such configuration is unrealistic in ports, where large metal equipment and cargo containers, key culprits of signal blockage

and interference, are constantly in motion.

The above shortcomings of traditional network infrastructures culminate in a lack of agility to support the mission-critical mobility requirements that today's dynamic port terminals demand.

MISSION-CRITICAL MOBILITY

Designed to Autonomously Adapt to Changing Port Conditions

Rather than retrofitting mobile-limited network technology in environments that demand total movement, Rajant's Kinetic Mesh® private wireless network solution uses a totally fresh approach.

It has been designed from the ground up to give industrial operators, like those in ports, the ability to rapidly deploy fully mobile, highly adaptable, secure connectivity with a network that works autonomously to deliver robust applications in real-time, no matter how the network topology or port conditions change.

A 'MAKE-MAKE-MAKE-NEVER-BREAK' APPROACH

Employing a one-of-a-kind connectivity paradigm, a Kinetic Mesh network's ruggedized, wireless BreadCrumb® nodes communicate peer-to-peer and can maintain hundreds of connections simultaneously, even while in motion. These nodes can be interchangeably fixed or mobile, and can direct traffic via multiple peer connections at the same time. BreadCrums are equipped with the intelligence of Rajant's patented InstaMesh® networking protocol, which performs continuous path switching of wireless and wired connections over the best available link, autonomously calculating the path that enables the fastest time to delivery at the given moment.

InstaMesh enables BreadCrums to dynamically make new connections to other nodes as they come into range, and no connections must be broken for new ones to be made. Communications to and between port equipment, personnel, and

command center remain continuous—a critical requirement to support the 24/7/365 functioning of autonomous platforms that will drive transformative productivity gains for a port.

EXTREMELY RELIABLE REAL-TIME COMMUNICATIONS

In addition to making multiple simultaneous connections, BreadCrumb® nodes can also support up to four frequencies. This further increases the usable spectrum for bandwidth-intensive applications like those related to M2M and autonomy. With hundreds of potential paths to direct network traffic, InstaMesh® dynamically selects the fastest connection, leveraging all available frequencies and paths for all network functions. Data from one peer can be forwarded to another on a different frequency at the same time, resulting in extremely low latency that supports the real-time flow of data, voice, and video that mobile and autonomous port assets require.

Because adding more nodes establishes more pathways, network resilience actually increases with scale. This is a key benefit for future-looking ports that plan to continually deploy new digitally-driven applications aimed at further increasing efficiency and cost savings.

AUTONOMOUSLY MITIGATING INTERFERENCE

The multi-transceiver, multi-frequency redundancy built into a Kinetic Mesh® network removes any single point of failure and virtually eliminates downtime, as the network can easily route around challenges that cause reliability issues in real-world port environments. There are many elements around the portside that can create signal blockage and interference, not the least of which come from tower-stacked and constantly moving cargo containers. InstaMesh enables a Kinetic Mesh network to react in real-time to changes in network topology, load, and environmental conditions, ensuring equipment and personnel maintain connectivity as they move between stacks of interference-causing metal.

InstaMesh automatically performs path evaluations and refreshes thousands of times a second. No manual intervention is needed because the network self-heals and self-optimizes automatically. If one path is not available or interference is identified, the information is dynamically redirected over a redundant available path or paths to ensure



it rapidly reaches its final destination.

Rajant's Kinetic Mesh network is the only technology to incorporate 'make-make-never-break' connectivity and multiple layers of redundancy, making it the only fully mobile and mission-critical network on the market today. It provides the continuous connectivity that autonomous equipment requires to remain operational as it moves, and the reliably high throughput performance demanded by efficiency- and productivity-enhancing real-time applications.

A DYNAMIC NETWORK

Rajant Kinetic Mesh® delivers the robust, mobile-enabled connectivity required to help port operators fully capitalize on the opportunities of evolving autonomy, IIoT, and robotics applications, because the network is the assets: everything that must connect and communicate to power transformative insights, efficiencies, and revenue gains.

The mobile coverage of Kinetic Mesh can be deployed port-wide by equipping vehicles and equipment like cranes and material handlers with ruggedized BreadCrumb® nodes—essentially transforming those assets into mobile network infrastructure. This allows for easy augmenting or creation of infrastructure ad-hoc, seamlessly connecting hot zones to provide ubiquitous coverage throughout the portside.

The robustness of the network ensures support for all the applications a port may be

running today, as well as those it may add in the future as it explores new opportunities to advance operational efficiency.

These applications may include:

- Fleet and Asset Management: to enable real-time data collection for telemetry; cargo, container, and equipment tracking; and equipment health monitoring
- Wi-Fi Asset Tracking: to locate containers, equipment, and people instantaneously
- Unmanned Ground Vehicles (UGVs): to patrol port perimeters and enable remote surveillance
- Drone Communications: Rajant offers a BreadCrumb module that can be attached to a single drone or a fleet of drones to collect and transfer video surveillance footage securely
- Autonomous Networking: to communicate with and control semi- and fully autonomous equipment

The level of port-wide mobile connectivity enabled by a Rajant Kinetic Mesh network not only helps operators maximize efficiency and productivity in every part of the terminal, but to also truly transform their business model. It provides the adaptability needed to support next-gen applications enabling the port to predict equipment health and performance, create autonomy, and deliver new services.

ENQUIRIES

Web: www.rajant.com/connectedports