TECHNICAL BRIEF

Rajant Kinetic Mesh™ Networks Have **Changed the Paradigm** for Enabling Network-Wide Mobility

Whether traditional network providers describe their approach to mobility as "Break-Before-Make", "Break-Then-Make", or with their own variation of the term, such as "Make-Before-Break", they all mean the same thing: that their network **must** break connectivity as people and assets move. Every industry sector has mission-critical applications for which continuous connectivity is an absolute requirement—so they will never be fully supported by these approaches or with anything less than a mission-critical network.

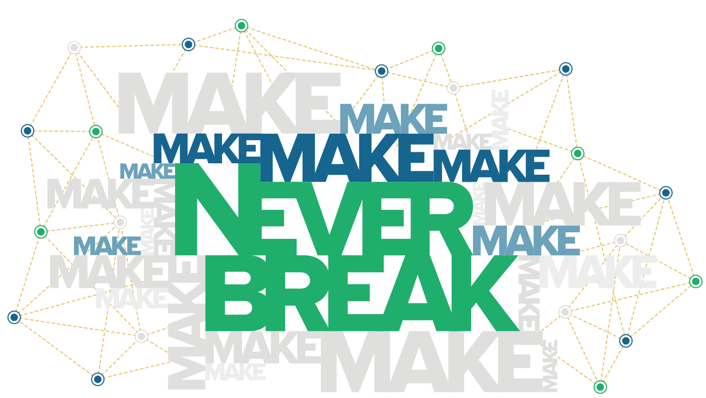
In traditional 'break' infrastructures, only one connection can exist between a node and an access point, so nodes must continually break and re-establish connectivity as they move between access points. Even if these networks are able to scan for and determine next best-available paths prior to handoff, they cannot use their newly 'made' connection until the old connection is broken.

Traditional networks also assess routes based only on RSSI, not accounting for other significant performance factors like interference or congestion. This, combined with the need to break connectivity over and over, leads to dropped data packets, high latency, and compromised application performance. These issues are made exponentially worse in large-scale environments where hundreds of equipment assets, people, and devices are constantly in motion over hard-to-connect terrain.

It's easy to see why networks with traditional or even incrementally evolved connectivity paradigms simply cannot support the demands of today's dynamic industrial operations. Network operators must look to wireless solutions that employ a totally new approach to meet growing business and mobility requirements, with a time-based focus on delivering continuous, redundant, unwavering access to critical communications and business data—anytime and anywhere, without fail.

Rajant Kinetic Mesh™ Networks: Transforming Connectivity for Industrial Enterprises

Rajant Kinetic Mesh™ networks leverage a transformative paradigm of 'never break' connectivity, making them the only broadband wireless solution able to satisfy industrial operators' mission-critical demands with a significantly higher degree of reliability everywhere across their mobile environment. This technical brief compares Rajant's one-of-a-kind "Make-Make-Make-Never-Break" connectivity approach to the "Break-Before-Make" approach employed by most Wi-Fi, LTE, point-to-multipoint (PtMP), and meshing systems, showing how Kinetic Mesh™ networks overcome the challenges and potential for failure that plague traditional wireless solutions.



Connectivity Evolved.

The Shortcomings of Traditional Wireless: Using a "Break-Before-Make" Approach

In traditional Wi-Fi, LTE, and mesh system architectures, infrastructure nodes and mobile nodes function differently. Mobile nodes cannot connect to each other directly, so communications can only be routed to an infrastructure node or access point. This creates the need to employ a "Break-Before-Make" connectivity paradigm. When a mobile node moves out of range of its current access point, connectivity to that access point is lost and the node must try to connect with a new one. Even if the new access point is readily available, the node's previous connection must be broken before a new one is formed, resulting in a temporary loss of communications, higher latency, and dropped packets.

This break in connectivity can last for an extended period of time if the node cannot easily identify its next access point due to terrain and line of sight issues, or if there is congestion at the master controller node. Even more critically, each infrastructure node becomes a potential point of failure and an opportunity for communications breakdown.

The majority of traditional solutions also use layer 3, which requires more administrative chatter and further adds to latency issues. For example, when a node in a Wi-Fi network roams from one access point to another, it has to request a new IP address from the controller node. Even if the network is using a static IP address, the controller node must keep track of the access point to which the node is currently connected. The process of roaming requires even more administrative communication—between the node and the new access point; the new access point and the controller node; the controller node and the old access point; the old access point and the controller node; and finally the controller node and the new access point. This administrative chatter consumes ever-increasing amounts of valuable bandwidth as networks grow larger and larger.

Mobile Client Node — 5.8GHz — Localized Interference
Infrastructure Node — 2.4GHz — ›››› "Data Flow" Direction

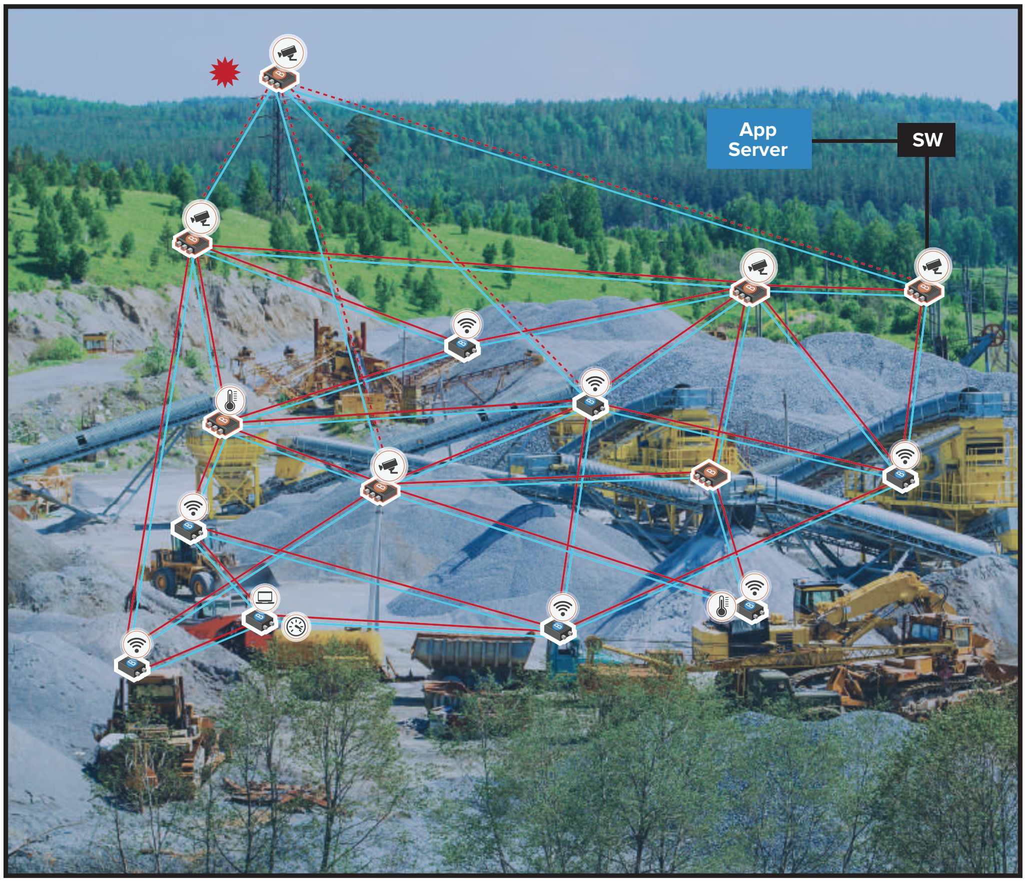
In a traditional wireless network as shown to the left, mobile nodes never communicate directly with one another. The mobile node transmits to its infrastructure node, and then the data has to travel either clockwise or counter-clockwise to get to the switch and application server. This slows traffic while increasing the potential for interference and congestion. Also, if an infrastructure node becomes unavailable, none of its mobile clients can access the network.

Some PtMP networks have attempted to evolve the traditional connectivity paradigm by using a controller node to evaluate all potential connections among subscriber modules and assign peers accordingly. The controller makes assignments based on the best path it sees at the moment of evaluation, but once set these paths cannot be re-evaluated until the network is reset or an update command is sent. The network is still unable to proactively synchronize peer assignments with changing operational and network dynamics to continually ensure optimal connections and performance.

Using these traditional approaches, the network can never be truly mobile, and application performance suffers as a consequence. The issues are exacerbated at an industrial scale, where operations mandate the need to continually connect hundreds of constantly moving equipment assets, devices, and people.

Achieving 'Adaptable Mobility' with Rajant: Using a "Make-Make-Make-Never-Break" Approach

Unlike traditional wireless offerings, all nodes in a Rajant Kinetic Mesh™ network are equal and all can direct traffic via multiple peer connections simultaneously. Rajant BreadCrumb® wireless nodes with patented InstaMesh® networking software can be used interchangeably as fixed or mobile nodes, and can communicate peer-to-peer with any other fixed or mobile nodes. There is no need for a controller node, which eliminates any single point of failure or bottleneck. ~~InstaMesh provides continuous path switching of wireless and wired connections over the best available link, calculating the path that enables the fastest time to delivery in that moment.~~ Each link between nodes can have up to four frequencies over which traffic can be sent and received.



In a Rajant Kinetic Mesh™ network as shown to the left, any node can receive data packets from one peer and direct them to another via multiple simultaneous connections. This example shows BreadCrumb nodes with two frequencies, although each BreadCrumb can support up to four frequencies. If interference occurs on one frequency, the network still has another frequency available over which information can be forwarded, providing a great number of potential paths to bypass bottlenecks while maximizing throughput.

BreadCrumb LX5 Wireless Nodes | BreadCrumb ME4 Wireless Nodes | 5.8GHz | 2.4GHz | Localized Interference on 5.8GHz

If and when a node moves, InstaMesh dynamically establishes new connections with its neighboring nodes. The network does not have to break a connection before a new one is made. ~~The connections that were previously used continue as alternately available paths until which time the path no longer meets the criteria for a radio link to be established.~~ If one path is not available or interference is identified, the information is dynamically redirected over a redundant available path, with the network automatically optimizing itself as conditions naturally change.

Through this unique "Make-Make-Make-Never Break" approach, Rajant enables complete network mobility and ensures reliable, real-time flow of data, voice, and video at low latency. As nodes move and the network topology changes, InstaMesh dynamically identifies the latest best-available routes, and will automatically begin directing packets to those connections. Connectivity remains continuous so that communications are seamless even while assets roam or are moved to a different location.

The redundancy of multiple simultaneous connections virtually eliminates downtime, and the functionality is also readily scalable to hundreds of nodes. in fact, adding more nodes establishes more pathways to increase network resilience. By adding a mobile wireless backhaul, or additional wired LAN connections as needed, the bandwidth of a Rajant Kinetic Mesh™ network can be readily scaled as well.

Summary

Using an innovative Make-Make-Make-Never-Break paradigm, Rajant Kinetic Mesh™ networks present an exciting solution for industrial enterprises to overcome network mobility, stability, and agility challenges while truly capitalizing on the intelligent applications they deploy to optimize operations. Because every node in the network has peer-to-peer networking capabilities and the ability to make multiple simultaneous connections, no connections need to be broken for new ones to be made.

Rajant Kinetic Mesh™ networks with Make-Make-Make-Never-Break capabilities provide smart, scalable, reliable wireless broadband connectivity that meets industrial operators' mission-critical requirements – and seamlessly adapts as those requirements continue to evolve.

To learn more about Rajant's game-changing paradigm, visit www.rajant.com/neverbreak.

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