Making Smart
Offshore Fields
Smarter

Advanced mesh networking solutions, certified for explosive gas environments, reduce operating costs, deliver productivity improvements, protect data, and reduce risks for offshore workers

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Introduction
Better communication means better business

The oil and gas industry is no stranger to volatility, with an operating landscape characterized by demand fluctuations and price swings. Recent history paints a vivid picture of what this volatility looks like. In 2Q 2020, during the Covid-19 pandemic, the oil price plummeted below $40/barrel. Twenty-four months later, with a war in Ukraine and a boycott on Russian oil, the price had skyrocketed to more than $120/barrel – a change of 400% in a span of two years. Gas prices were comparably volatile over that same period. The natural gas spot price published by Henry Hub on April 20, 2020, was $1.74/MMBtu. By April 20, 2022, it had jumped to $7.12/MMBtu.

Sustainable operations are only possible when organizations manage adeptly through such massive market shifts. Companies must be agile, making rapid operational decisions and nimbly implementing adjustments. Survival is predicated on adopting new technologies, but in the risk-averse oil and gas industry, there is deep-seated reluctance to be the first to employ a new technology. Fortunately, there is a way to transition to smarter, more efficient operations without incurring unnecessary risk.

Rajant is helping companies address offshore oil and gas development challenges with secure reliable networks that enable continuous, efficient operations. And newly introduced components allow the system to be installed in potentially explosive environments.

Companies already are exploiting this technology to enhance operational efficiencies and mitigate security threats to achieve new levels of operational integration and performance.

Keeping Pace with Advances in Technology
Scalability, Flexibility, Reliability

Oil and gas companies increasingly employ sophisticated applications to support equipment and personnel operating in remote, geographically dispersed areas.More apps, services, and assets are connected to oil and gas projects than ever before, with augmented reality, drones, and robots playing increasingly prominent roles. At the same time, companies are transitioning from manned to unmanned assets that are operated from command centers onshore. In conditions like these, reliability and resilience are even more important.

To interact with and manage the growing "network of things," companies need a network infrastructure that is fully mobile and provides optimal broadband connectivity organization-wide. Reliance on the Industrial Internet of Things (IIoT) and machine-to-machine (M2M) connectivity to improve productivity, streamline operations, and control costs have created a demand for private wireless mesh networks.

Increasing interconnectivity requires a network to ensure the security and authenticity of the communications traffic moving in, out, and across it. Mission-critical applications need to run on a communications network that offers reliable, agile, and adaptable connectivity that can thrive in diverse mobility-driven environments. For companies that work in ATEX environments, connectivity is even more critical.

The ideal solution across the board is a "living" mesh network that moves with and adapts to changes in connectivity demand.

Rajant Kinetic Mesh® networks provide this essential level of wireless functionality through a flexible, scalable, robust product that sets the standard in broadband connectivity for reliability, resilience, and adaptability.

As the exclusive provider of private Kinetic Mesh wireless networks, Rajant uses BreadCrumb® network nodes powered by InstaMesh® networking software to deliver a peerless network that is adaptable and scalable, providing real-time data on demand.

BreadCrumbs seamlessly integrate with any Wi-Fi or Ethernet-connected device to deliver low-latency, high- throughput data as well as voice and video applications across a meshed, self-healing network. Any information that can be sent over Ethernet can be sent over a Kinetic Mesh network.

This proven solution consistently meets the demands of the industry's evolving, mobility-driven operating environment and is designed to grow as a company's communication needs change.

Advances in meters, sensors, and other digital tools deliver high-quality, continuous data that experts say is increasing in volume by a factor of five each year. Rajant's Kinetic Mesh network has the capacity to support big data demands today and tomorrow. The high-bandwidth capacity of the Kinetic Mesh network supports big data requirements to enable companies to gather and manage the strategic intelligence needed to achieve operational objectives.

Facing Down Network Challenges
InstaMesh Delivers a New Standard for Performance

Companies face daunting challenges when planning and implementing a communication network that provides site-wide mobile access to vital data, voice, and video. Oil and gas complexes typically span large geographic areas that are subject to noise, dirt, and weather extremes. And conditions are continually changing. Companies are striving to maintain continuous operations, increase productivity, and cut operating costs without compromising safety standards or breaking the bank, but the demands of managing operations and crews across vast areas are time-consuming and expensive. At the same time, production optimization is becoming more sophisticated and more reliant on the interconnectivity of the IIoT to enable the predictive data analytics that improve productivity and safety. The design of the Rajant system improves interconnectivity by allowing devices to communicate in an ATEX environment. Automating and unifying communications across an offshore field or field complex allows companies to capture valuable decision-making information in real time to help increase efficiency, reduce operating costs, and drive the safety culture required to achieve peak operational performance.

Achieving these objectives using traditional systems is compromised by the inability to manage disparate data streams while ensuring system interoperability and cybersecurity across both the IT and OT domains. Day-to-day operations and processes can work seamlessly with Rajant technology in potentially explosive environments. Patented InstaMesh software is the foundation of the Rajant Kinetic Mesh network and the primary reason Rajant networks outperform competitive systems. Most mesh networks rely on a centralized root controller node to manage routing. Some of these system providers claim to use multiple frequencies, but what this means in the context of their systems is that they use one frequency for backhaul and another for client service. Because mobile devices lack infrastructure capabilities, they can connect to only one access point at a time. So, if an access point fails, all nodes connected to that access point are disconnected from the network (break-before-make). This means access points are potential points of failure. In the case of root controller nodes, one device manages the routing for the entire wireless network. If the root node fails, the whole wireless network goes offline.

Packets of data wait in line to be sent, and when the packet in front takes longer to be sent because the network is looking for a connection, the delay impacts all the packets behind it. If the connection takes too long, the attempt to transfer the data times out, and the packet is dropped.

Rajant networks do not use a controller node and have no single point of failure. Using make-make-never-break technology, each radio can have multiple node connections. This any-node to any-node connectivity allows BreadCrumb networks to scale to hundreds of interconnected mobile nodes, eliminating jitter by providing thousands of potential pathways over which data can be sent and received. When interference or signal blockage occurs, InstaMesh dynamically routes communications via the next-best available path to guarantee performance, so there is no downtime and network latency is minimized. The Rajant network allows three or even four times the number of retries—up to three per second—keeping information flowing and eliminating data loss. And since BreadCrumbs automatically form multiple connections with other nodes within the mesh, the network is inherently redundant.

BreadCrumbs operate within a specific band of frequencies and are programmable to certain channels within that band. They support the simultaneous use of 900 MHz and 2.4, 4.9, and 5 GHz frequencies for redundancy and interference mitigation, and custom transceiver configurations and frequencies are available for development.

Most multi-radio wireless networks separate traffic into two types:

- Client access traffic, which includes communications among access points and Wi-Fi clients such as laptops, tablets, smartphones, and sensors

- Backhaul traffic, which connects access points over long distances.

Unlike many competitive wireless technologies, Rajant networks grow stronger and more resilient as nodes are added.

InstaMesh networking software is the mobility enabler for Rajant solutions and responsible for the continuous and instantaneous forwarding of wired and wireless connections within the network. While InstaMesh uses a proprietary routing algorithm, it is fully compatible with IEEE 802.11 wireless computer networking standards. Any information that can be sent over Ethernet, can be sent over a Kinetic Mesh network.

A Rajant network transmits and receives data via satellite, point-to-point wireless, or wired links anywhere an ingress or egress point is needed. It also allows Virtual Local Area Network (VLAN) connection in a novel way, using only endpoints. This design allows up to 4,096 VLANs to be connected to the Kinetic Mesh network and eliminates the need for building precisely planned communication routes.

In traditional systems, a single disabled VLAN node can completely disrupt communications. The Rajant system enables continuous communication even if a VLAN is offline, delivering VLAN-tagged packets via the Kinetic Mesh exactly the way untagged packets are transmitted, using the quickest most reliable route.

Rajant uses the VLAN to deliver Quality of Service (QoS), reduce packet loss and latency and allow packet prioritization, essentially ranking virtual networks within the mesh. The flexibility allows data prioritization – a CCTV feed, asset tracking data, or SCADA data – to ensure critical data is transferred efficiently and prevent nonessential functions from slowing down essential operations.

Rajant networks are designed differently. Individual network nodes can accommodate up to four radios, allowing them to simultaneously send and receive on different frequencies. This is the critical differentiator. The mesh can use any of its multiple radio frequencies at any time, allowing users to maintain access to mission-critical data and applications even in the most challenging environments.

As nodes are added, moved, or removed, InstaMesh adapts, establishing new links in real time while keeping the network available, intact, and secure. The software enables complete network mobility, robust fault tolerance, and high throughput with minimal maintenance and administration.

Because BreadCrumbs work peer-to-peer, each node can be fixed or mobile. This functionality makes InstaMesh the only network that can enable M2M communications to automate wellhead operations.

Kinetic Mesh Enables Seamless Growth

Removing the Impediments to Adopting New Technology

As oil and gas projects expand, networks must keep pace, but in today's offshore operations, increasing demands can outpace the network's capacity, introducing bottlenecks and inefficiencies.

The problem with most wireless technologies is that scaling the network with additional nodes often causes performance degradation. Organizations are often forced to operate multiple networks running in parallel because new applications and updates cannot be run. Overtaxed networks can have applications running in isolation from each other, which decreases productivity and safety.

Rajant solves this problem with an architecture that allows multiple applications to run over a single network and simplifies the transition to new architecture and applications without costly downtime. The network can be scaled to include hundreds of high-bandwidth nodes. This means new, smart field devices can be added and deployed easily without compromising system performance. Once a Rajant system is configured, new BreadCrumbs introduced to the network automatically begin communicating with other nodes in the area.

This capability allows the network to streamline data transfer autonomously using unique any-node to any-node capability that routes traffic over the best available path to compensate for changing network status.

The Kinetic Mesh is a living network that can be expanded easily by adding Automatic Protocol Tunneling (APT), a gateway between wired networks and the InstaMesh wireless network. APT connections eliminate bottlenecks by getting data off the wireless mesh network and onto the wired network quickly. This technology, unique to Rajant, allows APT groups to be placed wherever there is Ethernet access. APT groups create multiple network ingress points, which means there is no single point of failure for data ingress to the wired network and servers.

In an APT group, two or more APT nodes combine to form ingress/egress points without introducing the possibility of a single point of failure. Each APT group elects a master node that encapsulates and decapsulates data, enabling reliable and fast data transfer to and from a wired Ethernet network.

Rajant's SlipStream nodes, specifically designed for APT connections, speed up the data transfer process. SlipStream is a wired BreadCrumb node that provides a high-throughput interface between a wired and wireless network. With SlipStream's high-speed processor devoted to Kinetic Mesh network encapsulation and decapsulation, data moves across the wired/wireless boundary up to seven times faster than a BreadCrumb used as an APT master.

SlipStream nodes integrate seamlessly with current BreadCrumb models and are backward compatible. System flexibility makes it easy to add BreadCrumb nodes and APT connections without sacrificing the continuous connectivity required to manage complex projects in offshore environments and work on both Rajant and non-Rajant wireless networks.

Rajant's cross-generational forward and backward compatibility integrates with existing satellite, LTE, 3G/4G, fixed wireless, and Wi-Fi networks to rapidly optimize and extend coverage.

Differentiated multi-radio architecture makes the Rajant Kinetic Mesh network the only industrial wireless solution to offer high availability for any number of real-time applications, including applications running on new IIoT-enabled field devices powering smart surveillance, automation, real-time production analytics, and autonomous systems.

Having multiple APT groups within a mesh network can:

- Prevent a single APT master from being overwhelmed with multiple data streams
- Enable more efficient load balancing
- Allow fast re-routing should a failure occur
- Greatly increase traffic throughput.

Overcoming IIoT Connectivity and Cybersecurity Worries with

Securing Information for Safe Operations

In the new age of Industry 4.0, oil and gas companies face the challenge of finding the best opportunities to maximize efficiency and minimize costs without sacrificing safety. This is particularly critical in potentially explosive environments. As more complex IIoT applications are introduced, operators must ensure processes and operations can work seamlessly with new technologies.

Information systems enable the implementation of more efficient, agile, and profitable business practices, but they introduce vulnerabilities. As the oil and gas sector continues to address the growing cyberthreat, it is increasingly exposed to potential attacks from multiple attack vectors. Interruptions to operations and threats to personnel are serious business, so having a superior network backed by a cybersecurity policy is essential.

Rajant systems use best-in-class security solutions that are effective in IIoT enterprise networks.

These networks have unique requirements that must be accounted for when creating and integrating security controls. One of the most critical is the need to improve or enhance network efficiency while providing the highest level of security possible. To achieve this, a network must include advanced encryption algorithms and sufficient processing power.

Leadership in this market is directly tied to the significant investment the company has made to provide multi-level, robust security across the entire wireless platform. Rajant BreadCrumb wireless nodes, powered by InstaMesh networking software, offer firmware-embedded security features, including data and MAC address encryption as well as per-hop, per-packet authentication. Rajant assures mesh networks are secure with certified secure booting and secure program updating and provides event logging and reporting to track anomalies.

Network construction prevents rogue access points, the most common threat to wireless security. An unauthorized wireless access point installed on a network permits unwanted access, exposing the network to attack by anyone with a wireless connection who is close enough to gain access.

BreadCrumb security is flexible and can integrate with network security systems that reside on non-Rajant network infrastructure. BreadCrumb nodes can be configured with

multiple, powerful cryptographic options up to 256-bit AES GCM, the highest commercially available encryption standard. Security features can be configured and managed easily using BC|Commander, Rajant's proprietary configuration software. This solution minimizes cyberthreats by minimizing potential attack vectors, safeguarding people and data, and enabling continuous operations.

The network simplifies video surveillance. With multi-transceiver, multi-frequency functionality, a Rajant network ensures video streams always have available paths to the command center, which delivers 24/7 site-wide video in real time.

The Rajant network also ensures security for stored data. A data-at-rest protection mechanism and encryption schemes preserve stored data authenticity. This capability, paired with the robust security features built into the BreadCrumb nodes, enables Rajant to provide reliable radio security and encryption without impacting network efficiency and performance.

> Rajant offers the highest-grade wireless security available commercially and is the only vendor in the world that uses suite-B military-grade encryption on a per-link basis with no license required and no extra costs incurred.

Boost Profits with Better Communications
Less Disruption, More Productivity Improve ROI

Implementing applications like process and production control, machine health, precision drilling, and surveillance represents a significant investment. These can be valuable tools, but simply installing applications does not automatically ensure the anticipated ROI. Systems need to work interconnectedly, communicate seamlessly, and remain free of cyberthreats to deliver value.

Rajant's field-proven networks help drive ROI across the board.

Incorporating well and platform monitoring using cameras, smart meters, and sensors, a Rajant network lets experts monitor conditions and identify problematic issues, often before they cause downtime or production delays. The network also makes it possible for drilling activities to be monitored to help drive down nonproductive time, which industry studies show equates to a loss of approximately one-third of an operation's average annual drilling budget.

Efficient networks empower companies to achieve efficiencies through equipment health monitoring. Using equipment performance data and a predictive maintenance model, companies can keep equipment operating at peak efficiency and extend the service life of offshore assets. Automated predictive maintenance can deliver a 70 percent reduction in breakdowns and 30 percent lower maintenance costs.

Rajant's superior network also improves safety with site-wide coverage, providing a way for site personnel to access vital information and applications, maintain communications with command and/or dispatch, and perform operations more efficiently. These networks allow autonomous vehicles and equipment to be monitored and controlled effectively, even at the network edge.

The ability to provide GPS-based locations and status tracking makes it possible to maintain communication with people anywhere on the asset for greater safety.

Rajant technology can be applied to an existing network, which means, in many cases, companies can capture the benefits of advanced technology without creating a network from scratch. Kinetic Mesh networks enable continuous communications that help optimize every aspect of exploration, extraction, and production, delivering streamlined operations that increase productivity and improve the bottom line.

Proven Solutions, New Applications
Continuous Communication in Potentially Explosive Environments

The Rajant system is safe for hazardous environments.

Electrical equipment operating in an explosive gas atmosphere must be designed to ensure that the equipment does not produce a spark or reach a temperature that ignites flammable gases or vapors. Rajant BreadCrumb ES1-ATEX1 and ES1-C1D1 network devices were developed for use in hazardous locations, including potentially explosive environments. These products meet standards for ES1-ATEX1 - European & IECEX classification: ATEX Zone 1 (gases); and ES1- C1D1 - North American classification: Class 1 Division 1 (gases).

Many onshore assets use IoT protocols like PROFINET, PROFIBUS, FOUNDATION Fieldbus, and HART Industrial Ethernet solutions to enable data exchange between controllers and devices. Controllers can be PLCs, DCSs, or PACs. Devices can be I/O blocks, vision systems, RFID readers, drives, process instruments, proxies, and even other control elements like HVAC units.

They are all Layer 7 (application layer) networks in the ISO/OSI model. The protocols define cyclic and acyclic communication among components, including diagnostics, functional safety, alarms, and other related information (larger footprint 150k). These protocols use standard Ethernet for communication, which allows for high bandwidth, low latency, large message size, and versatility.

They are effective and efficient, but every network expansion requires more cables to be run.

Rajant's BreadCrumb technology, using make-before-break and InstaMesh technology, provides low latency to support high bandwidth applications and can scale easily to the needs of the site.

The system functions as a pipe, just like fiber or an Ethernet cable. Operating at Layer 2 (IEEE-802.3), Rajant BreadCrumbs enable messages on a passthrough basis, and the low latency and high bandwidth enable safety systems down to 100ms or less.

The Serial Protocols are very different, and the latest firmware enables RS-232 and RS-485, Modbus, DNP3, HART, TASE 2.0 and ICCP, CIP, PROFIBUS and PROFINET, FOUNDATION Fieldbus, BACnet.

Rajant has tested and validated IEC 61158, IEC 61850, IEC 61784 with clients, and several are already transporting the protocols.

BreadCrumb ES1-ATEX1 and ES1-C1D1 for Potentially Explosive Environments

Benefits

- Provide compatibility with millions of commercial off-the-shelf client devices via integrated Wi-Fi access point service
- Scalable to hundreds of mobile, high-bandwidth nodes
- Support cryptographic options for data and MAC-address encryption as well as per-hop, per-packet authentication
- Combine Kinetic Mesh backhaul, Wi-Fi access and Layer 2 switching across interfaces in a single device
- Use proprietary software to allow the network to quickly adapt to rapidly deployed and constantly moving network elements

Features

- 2.4 GHz and 5 GHz radio frequencies support a wide variety of applications
- High bandwidth for data, voice, and video applications
- Lightweight and portable with low power consumption
- Outdoor rated for a temperature range of -40°C to 60°C
- IP67 rating guarantees water resistance and 100% protection from dust and sand
- Optional DIN rail mount kit for existing NEMA enclosures

Future-proofing Operations
Safeguarding Data as Technologies Advance

Rapidly changing infrastructure communication must meet the need for greater bandwidth, a higher level of security, and demand for true system resilience. Yesterday's systems for transmitting digital data used for telemetry (low bit count) have been replaced with higher-bandwidth systems that can manage video images in RGB/RGBHV and IR formats. And an enormous volume of data is produced by devices used to enhance oil recovery and improve production. Effectively managing this data will become even more critical as the industry moves toward unmanned facilities.

Rajant Kinetic Mesh enables next-generation capabilities and future-proofs smart field communications. This is accomplished using multi-radio, multi-frequency redundancy to support next-generation application performance. When operations are concentrated on a small area, Wi-Fi or LTE, communication can be plagued by interference and other deployment issues. The compact BreadCrumbs that form the Kinetic Mesh network compensate for that shortcoming by holding multiple connections over multiple frequencies simultaneously to create hundreds of potential paths over which to direct traffic. Regardless of the volume or type of data, the network ensures rapid data transfer without compromising security.

Perhaps most significantly, Rajant solutions provide end-users with networks that can meet changing demands, so advances in technology no longer cause costly disruptions.

The interconnected future requires extremely robust cybersecurity and efficiencies delivered via simplified networks. The Rajant solution offers the seamless and secure integration crucial to a safe and sustainable IIoT system, even in potentially hazardous environments.

As the industry moves toward more unmanned offshore assets, there is a growing need for reliable technologies that enable safe operations. Taurob has responded to that need by developing robots and robotic solutions for environments that require ATEX Zone 1 certification.

Because of the criticality of the functions carried out by these robots, Taurob designs incorporate the Rajant Kinetic Mesh network, which allows the robots to act as the eyes, ears, and nose of the operator in harsh environments, potentially explosive hazardous areas, and locations where reliability is a top priority.

RAJANT
*If it's **moving**, it's Rajant.*
*Industrial Wireless Networks **Unleashed.***

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