

Take Control of Your Oil and Gas Operations with High-Availability, Multi-Frequency Kinetic Mesh® Networking

Scalable, High-Bandwidth Networks Deliver Reliable Communications in Rugged, Remote Terrain



The oil and gas industry has a history of volatility with ups and downs being inevitable. While you cannot control the volatility, you can control how you prepare for market swings by optimizing operations. Leveraging the right technologies, starting with the right network infrastructure, can help you switch from traditional manual, non-integrated processes to an automated, integrated, and mobile solution—one that can give you new levels of insight and help you increase operational efficiencies. And, efficiencies built during a downtime can improve your competitive advantage in up times.

Advanced technologies such as the Internet of Things (IoT), machine-to-machine (M2M) communications, and autonomy have allowed industrial organizations to achieve huge gains in productivity and safety. In addition, oil and gas fields comprise vehicles, equipment, and personnel dispersed across vast complexes and rugged terrain – all of which require constant, reliable, high-bandwidth connectivity while on the move. Achieving this high level of connectivity requires a wireless network that allows trucks, graders, drills, wellheads, pumps, laptops, and other equipment to communicate in real time. Continuous operations and safety mandate unwavering network availability with 24x7 uptime in all locations.

Given mobility and the line-of-sight issues posed by rapidly changing topography, the ideal network is one that is easily deployed, endures harsh conditions, and can reliably connect to and communicate with personnel and assets in an ever-changing landscape without constantly moving, adding, or rebuilding infrastructure. For more than a decade, Rajant Kinetic Mesh networks have proven their value in these dynamic environments and stringent conditions. Today, Rajant represents the standard for reliable, resilient, flexible broadband connectivity in some of the largest and most-productive industrial enterprises in the world. As an example, Rajant networks currently provide robust, fully mobile connectivity in 100-plus mines worldwide.

Typical Applications Supported by Rajant Kinetic Mesh Networks

- **Process Control**
- **Production Automation and Control**
- **Precision Drilling and Excavation**
- **Well Monitoring**
- **Video Surveillance and Monitoring**
- **Vehicle and Equipment Health Monitoring**
- **Personnel and Vehicle Dispatch Routing**
- **Autonomous Hauling and Drilling**
- **Employee and Contractor Communications**
- **Personnel Safety - GPS-Based Locations and Status Tracking**
- **TRoIP – Tactical Radio over IP**

Challenges to Achieving the Fully Integrated Oil and Gas Field

Operators face a daunting list of challenges when planning and implementing a communication network that will provide site-wide, mobile access to vital data, voice, and video, including:

- Oil and gas complexes typically span large geographic areas that are dusty, noisy, and subject to weather extremes.
- Field landscapes change over time, and vehicles and equipment move across the landscape constantly.
- Operators face intense pressure to increase productivity and cut costs while maintaining continuous operations.
- Current methods of managing remote wells across the vast areas of rugged terrain are extremely time-consuming and costly.
- Production optimization is becoming more complex as the number of unconventional wells grows.
- The talent gap is expanding – the industry projects that about 50% of the sector's workforce will be lost within five to 10 years as veteran workers retire.¹
- The Internet of Things (IoT) and Predictive Data Analytics can help improve productivity and safety. However, data standardization, systems interoperability, and cyber security concerns are key challenges to achieving their widespread adoption.

Regardless of the challenges, you still have to manage and control all aspects of exploration, extraction, and production to ensure ongoing operations, increase productivity, and reduce costs.

Change the Paradigm and Improve Bottom-Line Profits

It's time to change the existing efficiency model and build profitability. Rajant Kinetic Mesh® networks make that possible with a private, wireless network engineered to connect people and assets with your command center. Once deployed, a Kinetic Mesh network can provide real-time access to vital information across your oil or gas field to help you:

- Manage a predictive maintenance model
- Increase efficiency and reduce operating costs
- Enhance personnel safety
- Supply mobile connectivity that lets you use voice, video, and data site-wide
- Scale to support new applications and changing terrain

Kinetic Mesh Networking: Unparalleled Performance

Rajant Kinetic Mesh networks offer reliable, agile, and intelligent wireless connectivity that survives and thrives in diverse and evolving, mobility-driven environments—a “living” mesh network that moves with and adapts to your communication requirements. Using Rajant BreadCrumb® wireless nodes powered by our patented² InstaMesh® networking software, Rajant private, wireless mesh networks deliver highly-available connectivity that is unmatched by other broadband and mesh offerings. Any Rajant network can scale to hundreds of BreadCrumb nodes providing thousands of possible data delivery paths to make sure your data reaches its destination. The more nodes you add, the more communication pathways you establish, and the more resilient your network becomes.

Rajant mesh networks are self-healing, peer-to-peer networks that can seamlessly integrate with non-Rajant devices and technologies. Whether you have satellite, fiber, copper, cellular, point-to-point (PTP) wireless, point-to-multipoint (PMP) wireless, LTE, or 3G/4G communications, you can leverage your existing investment while taking advantage of the mobility, resiliency, and performance offered by our meshing technology. Even if you have no communications infrastructure, you still can deploy a BreadCrumb-based network. To protect your sensitive information, Rajant networks provide strong cryptographic options for data and MAC-address encryption and per-hop, per-packet authentication.



¹ E&P Magazine, “Workforce Challenges Remain for Oil Gas Sector”

² U.S. Patent 8341289B2

- **BreadCrumb® Wireless Nodes:** Proven to withstand the punishing conditions inherent in oil and gas environments, our industrial-strength, light-weight nodes can be readily deployed on stationary and mobile assets such as vehicles, wellheads, drill rigs, and command centers. BreadCrumbs can be configured with multiple radio transceivers and radio frequencies, including 900 MHz, 2.4 GHz, 4.9 GHz and 5 GHz. Multi-transceiver, multi-frequency capabilities help mitigate interference and allow multiple applications to run simultaneously.

A BreadCrumb-based network can support Wi-Fi and integrate easily with Ethernet-connected devices to deliver low-latency, high-throughput data, voice, and video across the mesh. Anywhere an ingress/egress point is needed, a Rajant network can easily transmit and receive data via satellite, point-to-point wireless, or wired links. If you have configured your wired LAN to use Virtual Local Area Networks (VLANs), BreadCrumbs offer full VLAN support.

- **The Power of InstaMesh®:** InstaMesh networking software orchestrates all network traffic and continuously discovers and updates BreadCrumb information with each packet to direct data quickly and reliably. Because each BreadCrumb can have multiple connections to neighboring nodes, you have fully redundant communications throughout the network. Consequently, there will always be a viable pathway to deliver your information. As nodes are added, moved, or removed, InstaMesh automatically adapts to the changes, establishing new links in real time while keeping the network available, intact, and secure. The software will automatically redirect data packets over available frequencies to mitigate the negative effects of interference or obstructions. For example, if a four-frequency BreadCrumb node encounters interference on one or two frequencies, InstaMesh will redirect packets over frequencies that are not experiencing interference.

No Single Point of Failure (SPOF)

Many competitive mesh networks rely on a root controller node to manage routing. In their design, only access points mesh. While these solutions claim to use multiple frequencies, in reality, they use one frequency for mobile nodes and another for access points. Mobile devices lack infrastructure capabilities and, as a result, connect to only one access point at a time. If an access point fails, all nodes connected to that access point will be disconnected from the network. As a result, access points are potential points of failure. In the case of root controller nodes, one device manages all routing for the wireless network. If the root node fails, the entire wireless network goes offline. In addition, competing mesh networks that depend on controller nodes can experience high latencies and service interruptions when there is a change in network characteristics or physical configuration.

In contrast, Rajant networks do not use a controller node, and have no single point of failure. Each BreadCrumb can have multiple node connections. Should a wireless node go offline, due to a power failure as an example, InstaMesh will forward traffic through the best available, alternate node. Multi-transceiver and multi-frequency functionalities greatly increase network availability and enable the mesh to use the most efficient paths even in a constantly changing network. In addition, the Automatic Protocol Tunneling (APT) feature enables reliable and fast off-loading to a wired Ethernet network. In a large mesh, having multiple ingress and egress points increases your usable bandwidth and delivers data faster.

Scalability

In oil and gas operations, the only constant is change – changing procedures, changing topography, and changing applications. As operations evolve, so must the communication network. In most mesh technologies, adding nodes to scale the network can degrade performance. To fix the problem, applications are ported to additional networks, resulting in disparate networks and limited bandwidth. One of the key advantages of Rajant networks is their ability to scale to hundreds of wireless nodes. As the network grows, the bandwidth availability increases, and the network rapidly adapts to any changes in topography.

Load Balancing

Rajant multi-frequency BreadCrumbs do a better job of load balancing by simultaneously sending and receiving on different frequencies. As a result, data packets traversing Rajant networks get to their destination faster when compared to other wireless networks. Conversely, single-frequency radios receive packets, store the packets, and forward them when a channel is available.

Easy Deployment, Low TCO

BreadCrumbs are self-optimizing and can be deployed quickly, easily, and cost effectively. Ongoing network management is minimal – typically only 3% to 4% of the operational costs (based on a 100-node network). Plus, Rajant mesh networks eliminate the need to deploy and maintain multiple radio solutions on mobile equipment because the network consolidates communications for the applications.

Applications: Manual versus Automated

Rajant Kinetic Mesh® networks can provide connectivity for a wide variety of oil and gas applications and business-enabling technologies such as the Industrial Internet of Things (IIoT) and autonomy. By automating and unifying communications across the field, valuable decision-making information is available in real time to help you increase efficiency and safety, while reducing operating costs. The following scenario illustrates the benefits that can be achieved by managing remote wells via a wireless mesh network.

Managing Remote Wells

Wellheads equipped with flow meters, sensors, and other devices measure and record data on pressures, pump functions, and other critical well operations. That information is only accessible at the wellhead, and, in many cases, there is no communication link to automatically transfer the information to the command center. Typically, technicians have to drive to each well site, manually collect the data from the wellhead, and bring it to the command center for evaluation. Not only is this process time-consuming, inefficient, and costly, the command center cannot effectively monitor the safety of technicians.

After collecting the data, there is a time lapse before the information reaches the command center. So, any revealed problems could have been causing inefficiencies for days or even weeks. Just one pump operating at less than optimal performance can cost a company thousands of gallons in missed oil extraction. Even worse, if the well runs dry, it could cause the down-hole pump to burn up, resulting in significant downtime and equipment replacement expense.

In 2015, 25% of companies said they were investing in IoT, versus 44% in 2016.

Source: The Accenture® and Microsoft® Digital Energy Trends Survey 2016, Accenture



Solution: Boost Efficiency and Cut Costs

With a Rajant wireless mesh network, you can establish crucial links between all your assets and your operations center. Having always-connected communications ensures that you get the information you need to optimize every aspect of field operations. The productivity and bottom-line benefits can be significant.

- Monitor Wells Proactively:** With a wireless communications network, you can monitor well conditions as they occur and instantly spot problematic issues before they cause downtime or production delays. You can save the man-hours and costs associated with sending technicians and vehicles to each wellhead to gather data. So, productivity increases, and technician time can be used most efficiently.
- Achieve Complete Mobility:** A Rajant Kinetic Mesh network brings dynamic mobility to personnel and assets, allowing you to maintain communications throughout the site. Nodes deployed on vehicles and equipment can communicate with your command center, even when these assets are in motion. This level of freedom lets you use voice, video, and data for applications such as real-time data capture, field intelligence, geo-location tracking, and site-wide collaboration.
- Increase Safety:** When needed, you can dispatch technicians to service equipment and supply them with the information they need to ensure a first-time fix. Because the mesh network can give you GPS-based location and status tracking, you can also monitor the safety of roaming personnel.
- Overcome Environmental Challenges:** The enclosures housing BreadCrumb wireless nodes are built to withstand the extremely challenging conditions in oil and gas fields. As a result, your network investment will be protected for the long term. It is not unusual for Rajant's customer networks to operate for several years without environmentally-induced failure.

In addition to managing wells, your mesh network can support several other applications that also provide strong ROI such as:

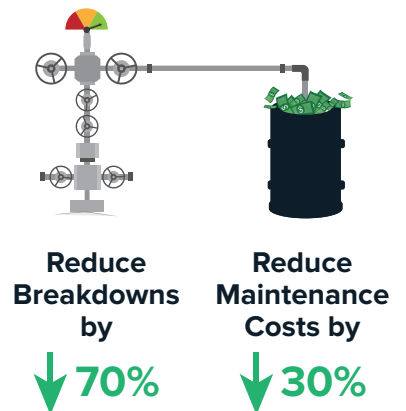
- Vehicle and Equipment Health Monitoring:** With an integrated communication network and a predictive maintenance model, you can have the ongoing information needed to keep vehicles and equipment operating at peak efficiency. An automated predictive maintenance model can result in as much as a 70 percent reduction in breakdowns and 30 percent lower maintenance costs. Plus, it can extend the service life of your assets.
- Monitor Drilling Production:** Industry studies show that non-productive, drilling-time costs equate to a loss of approximately one-third of an operation's average annual drilling budget. When such issues occur, technicians are typically dispatched to the drill rig to diagnose and correct the problem. With cameras and wireless nodes deployed on drilling equipment, you can monitor drilling operations and proactively identify potential problems before incurring production losses.
- Big Data and Predictive Analysis:** Big Data and Predictive Analysis is a proven technology that is projected to revolutionize oil and gas exploration, extraction, and production. Advances in meters, sensors and other digital tools are continuing to deliver increasing amounts of data. In fact, experts say the volumes of data are growing by a factor of five each year. Our mesh networks can provide the high-bandwidth capacity needed to support both current and future Big Data demands, giving you the strategic intelligence needed to achieve your company's objectives.
- Equipment Surveillance and Security:** Oil and gas companies are at risk for potential malicious attacks on pipelines, refineries, and fields. As a result, video surveillance is a mission-critical application requiring high-bandwidth connectivity. Rajant networks can transmit video in real time, allowing you to monitor personnel and assets 24x7. With multi-transceiver, multi-frequency functionality, video streams will always have available paths to the command center, giving you site-wide visibility.

Service and Support

We believe that every installation is important and deserves the best service and support efforts. For more than a decade, we have been providing industrial organizations with reliable, high-performance, and adaptable Kinetic Mesh® networks that operate flawlessly and thrive in diverse, evolving, and mobility-driven environments. During that time, we have amassed a wealth of knowledge and expertise to help you get the maximum performance out of your Rajant network.

Our trained and authorized Rajant Kinetic Mesh Partners are available to assist you with a wide variety of network and application requirements globally, including site analysis and design, installation, configuration, operation, troubleshooting, and diagnostics. Plus, we backup our authorized partners to give you the confidence that your deployment will meet or exceed your requirements.

Implementing a predictive maintenance model can



Nonproductive drilling time costs equating to about



1/3 of an operation's average annual drilling budget

Texas Oilfield Case Study

Environment

- 400+ oil wells, drilling pads, tank batteries, and vehicles (both nomadic and mobile)
- Spread over 42 sq. miles (110 sq. kilometers)

Challenge

- Previously 900 MHz point-to-point network; no fiber; DSL in office
- Network kept dropping as wind knocked antennas out of alignment
- Wanted to run a real-time Intelligent Asset Management Solution for well monitoring, surface and pump data, on-board pump simulation, data histories and searchable database, and load and position data

Solution – Rajant Kinetic Mesh® Network

- The power source was enclosed in a weather-proof sealed and locked enclosure.
- The same enclosure holds the site's data-collection unit which wires directly to the BreadCrumb's POE via an Ethernet cable.
- The majority of BreadCrumbs use omni-directional antennas for easy deployment – no aiming required and mitigates windloading.

Results

- The network has successfully scaled to 438 deployed nodes.
- The customer plans to add video, asset management, access control, and time-keeping applications to the network.

Summary

A private Rajant wireless mesh network can help you revolutionize your operations while preserving your existing infrastructure investment. With site-wide communications, you will be ready to conquer today's challenges and market shifts with a mobile-enabled, future-proof network that helps you take charge of your company's productivity and profits.