

An aerial view of an offshore oil rig and a support vessel. The rig is a complex steel structure with multiple levels and a tall derrick, situated in the middle of the ocean. A red support vessel with yellow equipment is nearby. The sky is blue with scattered white clouds.

# Making Smart Offshore Fields Smarter

Increase productivity, reduce operating costs, and improve worker and data safety with advanced mesh networking solutions.

*Judy Murray, Oil & Gas Strategist*

The logo for RAJANT, featuring a stylized Wi-Fi symbol above the word "RAJANT" in a bold, blue, sans-serif font.

**RAJANT**





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## Introduction

### An Answer to Today's Networking Solutions

The oil and gas industry is no stranger to volatility, but demand swings and the consistently low barrel price have changed the operating landscape. Companies need solutions that allow them to contend with market swings and enable continued profitability through prolonged downturns. Thriving in this changeable environment requires the adoption of technologies that enable new levels of operational integration and performance. Successful, sustainable operations are only possible when companies fully embrace and exploit digital technologies at their disposal and learn to leverage advanced communication technologies to improve operational efficiencies and contend with security threats.

Rajant technology answers these requirements for offshore oil and gas development—creating secure and reliable networks that enable continuous, efficient operations.

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. Rajant 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.



In the **U.S.**  
**1.5 million barrels**  
**of oil** are extracted  
per day.

Source: 7 Fast Facts About Oil Rigs  
<https://sciencing.com/list-7271586-oil-rigs.html>





## Meet Changing Network Needs

### Flexible, Scalable, Reliable

Oil and gas companies increasingly employ sophisticated applications to support equipment and personnel operating in remote, geographically dispersed areas. To interact with and manage this “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 has created a demand for private wireless mesh networks.

More apps, services, and assets are connected to oil and gas projects than ever before, and for many people, network connectivity is critical to job function. Increasing interconnectivity puts pressure on the network to ensure the security and authenticity of the communications traffic moving in, out, and across it. To achieve and maintain peak productivity and efficiency, mission-critical applications need to run on a communications network that offers reliable, agile, and adaptable connectivity that can thrive in diverse and evolving mobility-driven environments. The ideal solution 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. This proven solution consistently meets the demands of the industry’s evolving, mobility-driven operating environment and is designed to grow as the company’s communication needs change.

This means a Rajant network has the high capacity required to support big data demands today and tomorrow. 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. 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.



Some **oil rigs**  
are far as  
**2 kilometers**  
beneath the surface.

Source: 7 Fast Facts About Oil Rigs  
<https://sciencing.com/list-7271586-oil-rigs.html>



# Overcoming Network Limitations

## InstaMesh Changes the Paradigm

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 that are continually changing. In the face of intense economic pressure, companies are striving to maintain continuous operations, increase productivity, and cut operating costs while maintaining safety standards. The increased demands of managing operations and crews today, 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. Being able to automate and unify communications across a development 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. The problem is that achieving these objectives is compromised by system limitations that impede the ability to manage disparate data streams while ensuring system interoperability cybersecurity across both the IT and OT domains.

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.

Rajant networks are different. They do not use a controller node and have no single point of failure. Using make-make-make-never-break technology, each radio, or BreadCrumb, can have multiple node connections. This any-node to any-node connectivity allows BreadCrumb networks to scale to hundreds of interconnected mobile nodes, providing thousands of potential pathways over which data can be sent and received.

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.

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. Because the Rajant network allows three or even four times the number of retries—up to three per second—there is a greater chance of successful data transfer that keeps information flowing and eliminates 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; and
- Backhaul traffic, which connects access points over long distances.

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 capability is the critical differentiator that runs counter to other mesh networks. The mesh can use any one of its multiple radio frequencies at any time. This design allows users to maintain vital access to mission-critical data and applications, even in the most challenging environments.

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 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 mobile functionality makes InstaMesh the only network that can enable M2M communications to automate wellhead operations.

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

added. In addition, the networks can easily transmit and receive data through a satellite, point-to-point wireless, or wired link if a wide area link is required.

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

A Rajant network can easily transmit and receive data via satellite, point-to-point wireless, or wired links anywhere an ingress or egress point is needed. It also allows the 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 routes for VLAN communication.

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

Rajant uses the VLAN to deliver Quality of Service (QoS), reducing packet loss and latency and allowing packet prioritization from one destination over another, essentially prioritizing virtual networks within the mesh. This flexibility allows companies to prioritize data, for example, a CCTV feed from a camera, asset-tracking data, or SCADA data, to ensure important data is transferred efficiently and prevent nonessential functions from slowing down critical operations.



# Kinetic Mesh Delivers Scalability

## Advanced Devices — No Communication Problems

As oil and gas projects expand, networks must keep pace, or the company fails to deliver optimal value from connected assets. 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) that is 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 to the LAN. The APT groups create multiple network ingress points, which means there is no single point of failure for data ingress to the wired network and application servers.

In an APT group, two or more APT nodes combine to form ingress/egress points into the network 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 can move 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. Advanced 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.

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 faster re-routing should a failover occur
- Greatly increase overall traffic throughput.

Additionally, 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.

Through its differentiated multi-radio architecture, a Rajant Kinetic Mesh network stands alone as the only industrial wireless solution that offers high availability for any number of real-time oil and gas applications. This includes applications running on new IIoT-enabled field devices powering smart surveillance, automation, real-time production analytics, autonomous systems, and more.



## IloT & Industry 4.0 = Connectivity & Cybersecurity

### Information Security, Stability, Safety

Information systems have enabled the implementation of more efficient, agile, and profitable business practices, but they have introduced vulnerabilities to cyberattacks. Security breaches can occur in the form of minor business and service disruption to financial system collapse or even catastrophic situations that compromise worker safety. As the oil and gas sector continues to address the growing cyber threat, 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 cybersecurity policy is essential.

Rajant systems utilize best-in-class security solutions that are effective in IloT enterprise networks. These networks have unique requirements that must be accounted for when creating and integrating security controls. At the top of this list of requirements is the need to improve or enhance network efficiency while providing the highest level of security possible. To achieve this objective, a network must include advanced encryption algorithms and sufficient processing power.

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.

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 provide event logging and reporting to track anomalies.

The construction of the Rajant network prevents rogue access points (APs), which are the most common threat to wireless security. A rogue AP is an unauthorized wireless access point installed on a secure network that permits unwanted access to the network, exposing it to attack by anyone with a wireless connection who is close enough to gain access. Rajant system security is such that it prevents rogue APs from making it onto the network.

An important part of this security offering is flexibility. BreadCrumb security features can integrate with network security systems that reside on non-Rajant network infrastructure. The 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 BCICOMMANDER, Rajant's proprietary configuration software. Rajant's solution minimizes cyberthreats by minimizing potential attack vectors, safeguarding people and data, and enabling continuous operations.

The network also simplifies video surveillance to protect facilities and operations from malicious attack. With multi-transceiver, multi-frequency functionality, a Rajant network ensures video streams always have available paths to the command center, which delivers 24x7 site-wide video in real-time.

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





## Cost Benefit & ROI

### Technology Improves the Bottom Line

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

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

By allowing well and platform monitoring using cameras, smart meters, and sensors, a communications network lets experts monitor conditions and identify problematic issues, often before they cause downtime or production delays. The network also makes it possible to monitor drilling activities 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 also allow 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.

They also improve 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. In addition, networks allow autonomous vehicles and equipment to be monitored and controlled effectively, even at the network edge. Meanwhile, the ability to provide GPS-based locations and status tracking makes it possible to maintain communications with people anywhere on the asset for greater safety.



**Oil rigs** are commonly referred to as **“floating cities”**.

Source: 7 Fast Facts About Oil Rigs  
<https://sciencing.com/list-7271586-oil-rigs.html>



# Oilfield of the Future

## Adaptable, Dependable, Progressive

Rapidly evolving 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.

Rajant Kinetic Mesh enables next-generation capabilities and future-proofs smart field communications. This is accomplished by 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 that is crucial to a safe and sustainable IIoT environment.



A **study found** nearly **50% increase in marine life** around rigs compared to marine areas away from the rigs.

Source: 7 Fast Facts About Oil Rigs  
<https://sciencing.com/list-7271586-oil-rigs.html>



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