Rajant Kinetic Mesh® Networks for Agriculture

Powering Precision Farming of the Future
Agriculture Today:
A Powerful and Indispensable Industry

In 2016, the global agriculture industry was worth close to USD $3.2 Trillion.

The global precision farming market, specifically, is expected to grow by a CAGR of 12.64% from 2016 to 2021.

The global precision farming market is anticipated to reach USD $10.23 Billion by 2025.
Agriculture Today:
A Powerful and Indispensable Industry

In the last 50 years, the world’s population has grown more rapidly than at any other time in human history. **In fact, food production must double by 2050 in order to meet the world’s growing demand.**

Current Global Population: 7.6 billion
2050 Projection: 9.8 billion
2100 Projection: 11.2 billion
IoT Growth by Region: And Its Impact on Agriculture

Leaders Adopting IoT for Agriculture

Australia
In 2017, government allocated AU $60M to encourage smart farming.

France
Launched Agriculture Innovation 2025 project for precision agriculture R&D, allocating €4M / year.

China
Began 4-year plan to maximize IoT in agriculture, initially providing 8 provinces with 426 IoT technologies.

U.S.
Department of Agriculture is providing USD $7.3M in funding for agriculture technologies.
Agriculture Today:

Facing Modern Challenges

**Limited Farmland**
Farmers must maximize existing fields and optimize their output without gaining acreage.

In 2015, only 2% of U.S. farmland was available for new entrants to the farming sector.

**Waning Natural Resource Base**
Leads to less biodiversity, stronger pest resistance, and slower crop yields.

The growth rates of maize, soybean, and sugar cane yield have decreased from 1995 – 2014.

**Strict Sustainability Regulations**
Policies make it difficult to provide food, farm sustainably, and also make a profit.

Across the U.S., complex regulations frustrate farmers who struggle to meet sustainability standards while also maximizing efficiency.

**Water Shortage**
A lack of water is worsened by inefficient irrigation systems.

*More than 40%* of the global rural population use river basins that are considered “water scarce.”
The diverse range of challenges facing the industry is pushing agriculture to become increasingly:

- Productive
- Cost-Effective
- Precise
- Sustainable

**The Question:**
How can farmers achieve **peak productivity** while also keeping **costs low** and using **sustainable practices**?
The Answer:

Precision Farming with IIoT & Automation

Precision Farming uses IIoT devices and other automated equipment to increase efficiency while remaining sustainable, working day and night to produce a higher yield.

This growing industry of automated agricultural robots is projected to reach $16.3 billion by 2020.
The Vision: IIoT-Enabled Across Farming Environments

Real-Time Kinematic (RTK) Satellite Nav
- to enhance precision of GPS position data.

‘Smart Crop’ Sensors
- monitor soil hydration, pH, and nutrient levels.

Autonomous Tractors
- work in tandem to till, seed, and plant.

Ag Robots
- like autonomous milking and weeding machines quickly perform farming tasks.

Drones
- for aerial surveillance and spraying.

Precision Planters
- maintain consistent seed placement and soil depth.

E-Silos
- are optimized to provide constant data on storage condition and volume.

Irrigation Flow Control
- reduces human error and lessens water waste.
Soil moisture sensors can result in a 40% improvement in agricultural water efficiency.

Getting There:
5 Step-By-Step Levels of Automation

Level 1

*Stationary Autonomy*

Remains static to record critical agricultural data and alert farmers to important changes.

- Soil Sensors for moisture, pH, and nutrient levels
- Remote Monitoring of Crop Health / Growth
- Equipment Telematics
- Security Cameras
GPS equipment guidance systems can save farmers up to 7% though the efficient use of seed, fertilizer, pesticides, and fuel.
Getting There:
5 Step-By-Step Levels of Automation

**Level 3**

*Single-Task Autonomous Fleets*

Swarms of farming robots work together to complete simple tasks that would otherwise be done by humans.

- Drones
- Fully-Autonomous UGV
- Autonomous Milking

Some spraying drones cover **7 – 10 acres an hour** to distribute over **2 gallons** of liquid.
Getting There:

5 Step-By-Step Levels of Automation

Level 4

*Complex Autonomous Equipment*

Performs tasks that humans cannot—often multiple tasks at once—and does not require the assistance of a human worker.

- Pruning, Weeding, and Soil-Monitoring AI UGV
- Mobile Power Platforms for Full Autonomy
- Autonomous Irrigation Systems

Chilean researchers developed an autonomous irrigation system that can *save 70% more water.*
Getting There:
5 Step-By-Step Levels of Automation

Level 5

*Fully-Autonomous IIoT Operation*

Advanced agricultural operations invest solely in autonomous equipment that perform all functions to:

- Enhance Speed, Productivity & Yield
- Power Sustainable Practices
- Gather Farm Data for Insight & Visibility
- Keep Costs Low
- Easily Maintain Regulatory Compliance

35% A fully-automated farm in Japan cut energy costs by 35% and
98% recycles nearly 98% of its water.
Networking Challenges:

Environmental Obstacles in Agriculture

Lack of Connectivity
The majority of America’s farms are located in remote, rural areas without a strong signal.

A typical cell tower signal can only reach a 22 – 45 mile radius.

Industrial Interference
Between silos, buildings, and large machinery, signal reflection/refraction is common.

Metal, glass, and water all have the power to reflect and refract Wi-Fi signals.

Rugged Terrain
Equipment must withstand extreme temperatures, weather events, and chemical sprays.

Many farmers view autonomous equipment as a liability rather than an investment.

Legacy Infrastructure
Farmers with wired infrastructures often struggle with new network elements.

Wired networks can’t properly power the IIoT, which requires total mobility.
Rajant’s Kinetic Mesh® Network:
Powering Every Level of Agricultural Automation

Rajant’s solution brings farming assets to life, moving with farm operations to drive IIoT capabilities and enable highly-mobile, highly-secure Precision Farming practices for any level of automation.

Create a Network of Things™
with BreadCrumb® nodes, which affix to static or moving assets and strengthen the greater network by creating additional opportunities for peer-to-peer connections.

Mitigate Interference
with InstaMesh® technology that chooses the fastest available frequency for data, routing around potential industrial interference.

No Single Point of Failure
Thanks to the elimination of root / LAN controllers, infrastructure failures or congestion have little impact on connectivity.
Moving Up the Levels with Rajant:
Long-Term Value for Increasing Automation

The value of Rajant Kinetic Mesh® only grows as autonomous operations become more complex.

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<td><strong>Need:</strong> High bandwidth for sensor data acquisition</td>
<td><strong>Need:</strong> Signal resilience for constant user control</td>
<td><strong>Need:</strong> Mobility for GPS/GIS autonomous guidance</td>
<td><strong>Need:</strong> Connectivity between autonomous equipment</td>
<td><strong>Need:</strong> Fully IIoT-enabled, rapidly scalable network</td>
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Rajant Kinetic Mesh® is a technology that allows for the creation of a network that can adapt and scale as the needs of autonomous operations evolve. As operations become more complex, Rajant Kinetic Mesh® grows in value, providing the necessary connectivity and signal resilience for constant user control and autonomy guidance.
Unlike traditional Break-Before-Make networks, Rajant’s BreadCrumbs® communicate peer-to-peer via multiple, simultaneous connections. This node- and frequency-level redundancy form resilient ‘Make-Make-Make-Never Break’ mobile connectivity for farms.

BreadCrumb® nodes go wherever your farming assets do, **seamlessly connecting hot zones** to provide **ubiquitous coverage over vast acreage.**
Rajant’s Kinetic Mesh® Network:
Ruggedized For Agricultural Environments

Farmers need equipment they can trust to withstand harsh weather, pesticide sprays, and rough conditions.

Rajant’s BreadCrumb® nodes are:
- Built to MIL STD 810G
- IP67 (dust tight, waterproof)
- Protection from shock and vibration
- No fans or other moving parts to break down or wear out
- Lightweight form factor for quick deployment
- 170,000 hours Mean Time Between Failure (MTBF)
- High performance in severe temperatures (-22° to 176° F, -30° – 80° C)

BreadCrumb® nodes provide connectivity for Real-Time Asset Tracking, Management, and Control no matter where your equipment goes.
Rajant’s Kinetic Mesh® Network:

Precision Farming With Fail-Proof Connectivity

- Up to 300 Mbps physical-layer data rate
- Multiple, 2x2 MIMO-enabled antenna ports
- Military-grade security
- Scalable to hundreds of bandwidth nodes
- Multiple radios for interference mitigation
- Less than 1 ms latency
- IP67 rated for rugged environments
- Fully-redundant—no single point of failure
- Multiple transceivers and radio frequencies
- Self-configuring and self-healing operations
- Wi-Fi access
Farmers are under pressure to **increase their yield and improve productivity** across all crops.

Once tractors, fleets, UGVs, soil sensors, and more are connected to Rajant’s peer-to-peer network via BreadCrumb® nodes, they form an **autonomous IIoT environment**.

Rajant’s **unmatched network speed and agility** means that every connected asset can be on the move and always able to communicate with a remote operator, even at network edge.

Experience **zero down-time** with InstaMesh® technology, which uses node-and frequency-level redundancy to identify hundreds of potential paths and dynamically redirect critical data around silos, buildings, and other farming structures with the fastest possible throughput.
Rajant Kinetic Mesh® Use Case:

Eucalyptus Farming

Powering forest-wide remote monitoring applications to optimize yields.

- Sensor-based monitoring of tree growth pace
- Identification of disease via computer vision + AI
- Fire and disaster management

Connecting equipment for operational optimization via precise control.

- RTK to enhance precision of position data from satellite-based positioning systems, i.e. GPS.
- Fuel management for anti-fraud, etc.
- ERP data collection and upload
Bringing connectivity to remote islands and locations with minimal cellular coverage.

Remote monitoring of expansive island plantations

Monitoring & management of soil moisture, water use, fertilizer use and levels, etc.

Measuring & managing seed and crop density

IoT monitoring device data collection enabled by UAV and UGV applications.

Monitoring multiple plantations (480,000+ hectares) using drone tethered in middle of plantation to relay stored data collected from IoT monitoring devices to mobile vehicle equipped with ME4 BreadCrumb driving around plantation perimeter.
Productivity of digitized agriculture can reduce cost-per-acre by $12 over 5 years.

With basic planting tech alone, corn yield has risen from 30,000 plants/hectare in the 1930s to over 80,000 in 2017.

Growers have an average return of 2 to 5 times their investment in digitized ag equipment over 5 years.

A study conducted at a Tennessee tree nursery conservatively estimated a 37.5% ROI for a site-wide moisture sensor network.

**Enhanced Productivity**
Maximize the speed and functional life of all farming assets and decrease downtime due to signal blockage.

**Growing Yield**
Automate precision planting, field mapping, and harvesting to maximize every available inch of fertile land.

**Increased Revenue**
Invest in automated farming equipment and an IIoT-enabled network to save money on labor costs and bring more crops to market.

**Responsible & Sustainable Farming**
Lessen the harmful effect of climate shifts by maximizing existing field space, monitoring soil balance, and creating efficient irrigation systems.
Rajant’s Kinetic Mesh® Network:
Powering Farms of the Future

An Autonomous Mesh Network
*Enabling Next-Gen Ag Environments*

Rajant Kinetic Mesh® has a track record of success:

- Easy to Deploy
- Easy to Maintain
- Proven ROI

Enabling automation and scalability for the future of farming.