

Solution Brief

Agricultural Automation
Robotics and Private Wireless Networking



Blue White Robotics and Federated Wireless Enable Agricultural Automation with Private Wireless Networks



Blue White Robotics offers a complete data management platform that connects the robotic components, ingests data for analytics, and centralizes management so that a single operator can run an entire fleet of farming equipment. They also partner closely with growers to optimize the solution and ensure it delivers the results that growers want.



Federated Wireless is the leading innovator of private wireless and shared spectrum services. The company's solutions deliver next-generation wireless connectivity to customers in government, logistics, manufacturing, energy, agriculture, hospitality, education, retail, office space, municipal and residential verticals, with use cases ranging from industrial IoT to bridging the digital divide for underserved communities.

Meeting the growing needs of the world's growers

Computer vision, process automation, and Industry 4.0 data analytics have proven their ability to enhance productivity as they have steadily transformed a number of industries. Agriculture, though, has taken a slower path to adopting data-centric operations. The nature of farming operations presents unique challenges that inhibit the adoption of automation and data analytics.

Still, intelligent edge solutions have the potential to transform food cultivation by helping farmers increase yields and operational efficiency while addressing labor shortages and human error. Data analytics also offer the opportunity to deliver insights that allow farmers to increase yields and improve crop health while reducing the resources they require.

The challenge: Bringing intelligence to the fields

One of the most significant barriers to automation adoption in farming is geography. Most farms are located in rural areas where high-speed, low-latency wireless networks are not commonly available. Public cellular networks are making progress, but coverage and bandwidth can be hard to come by and costly. Most farms are also spread out over a large area with varying topography, which presents a barrier to establishing a wireless network that can consistently achieve the bandwidth and latency required to transmit large volumes of data in a timely manner.

Automation in farming has also been limited by the cost and disruption required to replace tractors, sprayers, and other machines with fully autonomous devices. Most farms don't have the resources to rip and replace their equipment, even if the new systems promise transformative performance.

As a result of these challenges, achieving the infrastructure required to automate farming requires a unique approach capable of tailoring solutions to the needs of individual farmers and growers. Solutions for agricultural automation need to lower the barriers that stand between growers and digital platforms.

The solution: Adaptive robotics technologies paired with private wireless networks

A partnership between Blue White Robotics, Federated Wireless, and Intel has developed a new type of automated agricultural solution. This approach brings together a combination of adaptable networking and robotics technologies that can be tailored to nearly any grower's operation. This scalable solution employs the power of edge computing and a private wireless network to transform a grower's existing equipment into a fleet of autonomous vehicles capable of handling a number of tasks with little human intervention.

How it works

Bringing together the right partners and the right technology

With the mission to alleviate serious and concerning pressures on our global food supply, Blue White Robotics has worked on solutions to bring autonomy and data analytics capabilities to farming. They have found that traditional barriers to networking in agriculture have limited what they could achieve alone. Working with the 5G Open Innovation Lab, they formed a partnership with networking innovator Federated Wireless, who brought their unique approach to engineering private wireless networks. Intel joined this partnership to offer edge computing expertise and industry-leading software tools for AI development and networking.

Together, this team designed a one-of-a-kind solution that was successfully deployed at an operating winery. This cooperative trial proved the value of private wireless networks to establish wireless broadband connectivity and enable automated real-time analytics in farming.

Flexible robotics that preserves the value of existing equipment

Blue White Robotics has developed a unique path to autonomy. This path allows farmers a ramp to the automation required to operate the 21st century farm by transforming their existing tractors into autonomous, intelligent farming platforms. Blue White Robotics' adaptable autonomous kit—which can be installed on nearly any modern tractor—enables full robotic operation and centralized management. It does this while still maintaining manual function. With the flick of a switch, growers can disable the robotics and use their equipment as usual.

Through sensor fusion, the robotics kit combines GPS, lidar, and high-resolution camera data to enable autonomous movement and operation. Blue White Robotics developed a deep learning-based AI model that enables a high degree of perception while overcoming noise and weather challenges. Now able to sense their surroundings and make decisions, these adapted autonomous tractors can perform a number of tasks, including spraying, mowing, disking, dusting, and more without the need for human intervention.

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fleet of farming equipment. They also partner closely with growers to optimize the solution and ensure it delivers the results that growers want.

Private wireless network for automation and analytics

Connecting the robotic tractors to a centralized system for management required a next-generation approach to wireless networking. To enable the Blue White Robotics automation kits, Federated Wireless helps end customers create a private wireless network that broadcasts on the license-free and cloud-managed Citizens Broadband Radio Service (CBRS). This spectrum, ranging from 3,550–3,700 MHz in the 3.5 GHz band, was made publicly available by the FCC with the specific intention of fueling innovative new use cases such as private wireless for Industry 4.0.

Not only does CBRS provide a spectrum that satisfies the data needs of farmers, but it offers a license-free, shared spectrum model. Traditional public cellular networks charge per byte, which can add up quickly for advanced use cases with massive data requirements. With the CBRS model, data usage is unlimited, which helps offset the costs of standing up a customized, private network. Using the CBRS shared spectrum also means that the wireless network is truly private. The data generated on-site never needs to cross the public internet or a shared public cellular network.

Private wireless networks running over the CBRS shared spectrum provide the right mix of long-distance communications and short-wave, high-volume transmissions that helps overcome geographical and topographical challenges in farming. Federated Wireless creates private wireless solutions that are customized to a customer's exact use case requirements, in this case the applications and devices that enable automated agriculture.

The preintegrated wireless solution ensures the connectivity is tailored to support three key components of the automated farming solution. The first is communications for safety mechanisms in the robotic equipment. If a concern arises, the operator can be alerted immediately with information about what's happening. The second component transmits larger-volume data, which provides enhanced insights, such as imaging of the condition of crops captured by the tractors. The third carries real-time data generated by various sensors. This enables real-time analytics that can be used for services that can enhance the productivity of a farm.

Key networking components



Federated Wireless Spectrum Controller



Intel® Smart Edge



Radios



SIM Cards



Wireless modem on Blue White Robotics autonomous tractors

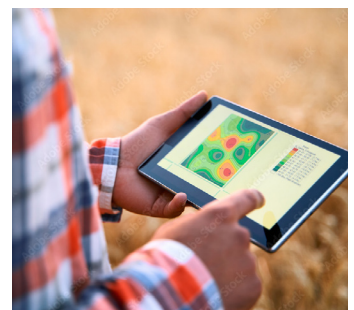
Fast deployment of customized real-time communications

Thanks to skilled preparation and collaboration with networking experts from Intel, Federated Wireless is able to preintegrate components of the solution and customize them to the specific needs of the farm, orchard, winery, or other agricultural operation. In a recent smart agriculture deployment, preintegration and optimization allowed Federated Wireless to deploy a private wireless network in less than three days of work on-site, minimizing disruption for the grower.

Not only has Federated Wireless shown that private wireless networks can supply next-generation wireless connectivity needed for automation and data integration, but their end-to-end solution design ensures the private network is customized for the specific use case requirements of the grower and their site and operations.

Autonomous farming solution overview

Solution highlights



Autonomous Tractors

- Adapted to function autonomously
- Operate with a fusion of lidar, GPS, and computer vision
- Capable of a number of farming tasks

Private wireless network

- Leverages the CBRS bandwidth
- Achieves three levels of connectivity
- Enables real-time connectivity

LTE core edge node

- SuperServer E200-8D featuring a six-core Intel Xeon D-1528 processor
- Processes data to maximize transmission efficiency

Cloud connectivity

- Data analyzed at the edge can be efficiently sent to the cloud
- Creates a simple path to integrating IoT computing platforms

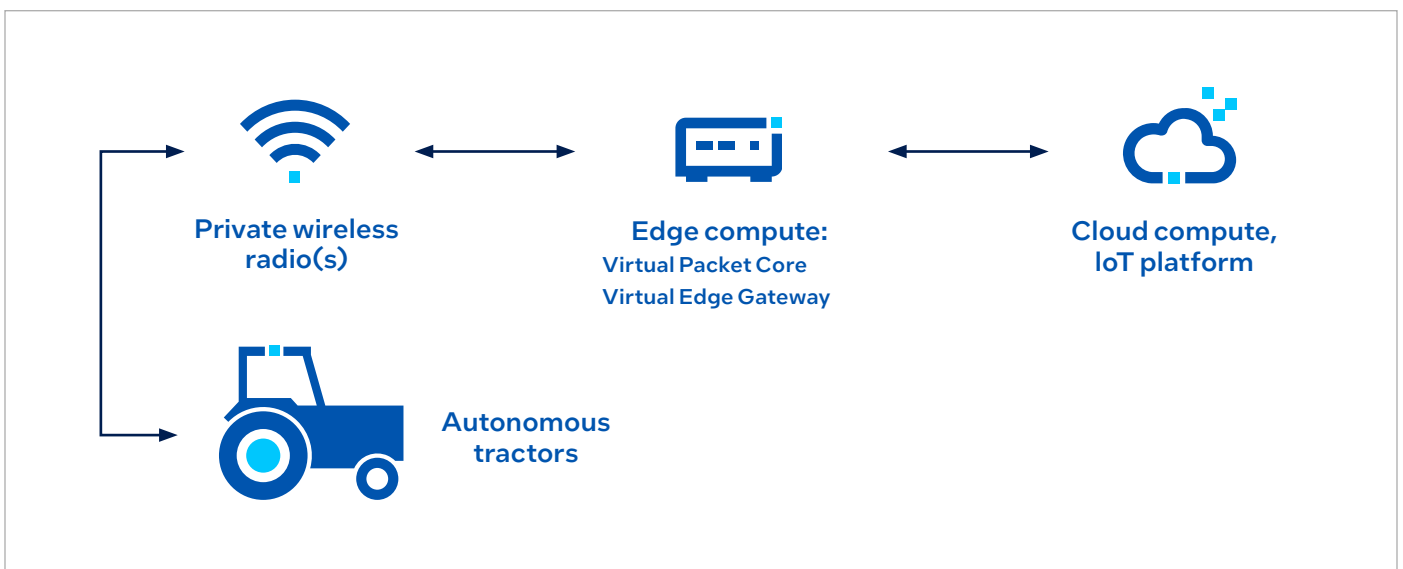


Figure 1: The solution employs private wireless to connect autonomous tractors to the cloud and other IoT analytics platforms.



Deploy high-performance edge platforms

Intel worked closely with all partners involved in developing this solution. Intel Smart Edge provides tools to speed and simplify the deployment of a complete private wireless system at the edge. It allows networking developers to take advantage of microservices for media ingestion, control (real-time transcoding, stitching, content overlay), and distribution.

In a recent real-world trial, the networking solution delivered exceptional networking performance.

Areas covered:

42 fields

Coverage area:

2.1 square miles

Download speed:

55 MBps

Upload speed:

21 MBps

Latency:

43 ms

Enabling new services and capabilities

While the engineering of the robotic farming vehicles enables them to perform tasks without continuous access to a high-speed network, the value of this solution comes as much from the data gathering and analytics as it does from automating tasks. The private wireless networking solution allows the solution to capture large amounts of data from a variety of sensors and sources—from the condition of the tractors to soil samples and weather conditions.

Transmitting this data in real time creates the opportunity for partners and vendors to put the data to use to improve the operations of the farm and the results the growers see. Experts in pest control can advise growers on precise pesticide applications that use fewer resources and reduce pollution. The growing cycles of plants can be closely studied to identify opportunities to maximize yield by harvesting, watering, and planting at exactly the right times.

As more growers adopt private wireless networks for data analytics and gain the ability to put their data to use, the opportunity for data-driven agricultural services will continue to expand. The insights that come from this will help to address the global food supply issues that we face.

Paving the way for more automation in farming

The long-term goal of the partnership is to continue to refine and scale across a wide range of farming environments. This development will also extend the model to other agricultural scenarios to enable more IoT use cases.

The data derived from the solution has tremendous potential to transform food production while breaking down traditional barriers that farmers have always faced. When farmers have precise data and always-on intelligence integrated into their farming equipment and applications available for staff, they can rethink their whole approach to cultivation. This gives them the power to find new ways to produce more while using less.

Explore autonomous agriculture offerings

[Blue White Robotics >](#)

Learn more about private wireless networks

[Federated Wireless >](#)

Get started with Intel Smart Edge

[Explore the features >](#)



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