Wireless M2M and Sensor Network Applications in Precision Agriculture

Automation technology continues to develop and flourish across critical industries such as oil and gas, utilities, and government and defense. But as high-speed data transmission capabilities improve in both magnitude and security, precision agriculture—is experiencing strong growth in its use of this technology. Industrial-scale agriculture operations are increasingly adopting wireless M2M communication networks as the technological scope and precision needed for an automated farm become more available.

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In industries such as precision farming and agriculture, assets are dispersed across a wide area with the potential for communication interference from tall foliage or buildings, or network failure due to weather events. To circumvent these roadblocks, automation hardware providers have focused on the most important aspects of M2M networking: reliability and secure, high-speed data transmission to enable real-time decision making in the field.

The majority of the precision agriculture industry leverages the use of autonomous machinery and needs to enable four basic areas of automation: precision steering and guidance, irrigation, fertilizer and pesticide application, and feed lot controls. Designed to streamline workflow efficiency and increase productivity through the use of wireless sensor networks, these automated applications are indicative of the present and the future of precision agriculture.

Trends Driving Precision Agriculture

There are several key trends driving the growth and development of the precision agriculture industry. Today, farm managers are harnessing the power of real-time kinematics (RTK) and M2M wireless networking technology to enable the complete automation of private and corporate farming across the world. RTK is a global positioning system (GPS) satellite navigation method used across a broad scope of industrial applications where real-time data corrections provide the accuracy needed to automate successful machine control operations in the field. Operators combine RTK with industrial M2M wireless networking communications to create a wireless sensor network of high-speed data transmission and geo-location capabilities utilized for automated tractors and other applications in the field.

The main high-level propellant in automation today is the explosive growth in Big Data and the myriad applications it serves. From mobile apps used to assist in decision making in the field, to unmanned aerial vehicles (UAVs) used for surveying and location purposes, to aspirational applications such as site- and crop-specific management zones, high-speed data transmitted and applied in real-time is driving continued technology development and industry innovation. In order to best utilize this data, precision farm operators need a reliable and robust wireless M2M communication network infrastructure.

Wireless M2M and Agriculture Automation

Building an industrial-scale wireless M2M communication network requires that farm operators take a number of things into consideration. Operators first need to consider the existing system and how to best integrate new network technologies. Today, providers of these technologies have developed customizable, purpose-built platforms capable of incorporating spread spectrum radio communications and high bandwidth broadband into a single wireless network.

The ability to securely extend high-speed wireless networks into remote locations or locations with interference concerns, while maintaining mobility and end-user device choices, is an important factor for precision farm operators when determining the best fit for an automated network. Combined with broadband, spread spectrum wireless data radios are the leading choices for industrial networking applications that require real-time data and reliable performance, even in the most remote and expansive farm locations.

Ideally, organizations should have the choice to select a network topology or a combination of networks that best suits their applications with a mix of high-speed Ethernet and Serial data ports to integrate these two systems. The latest wireless broadband networking solutions can meet these requirements, integrate with existing networks and require zero retrenching considerations. Combined with ease-of-integration, integrated wireless network systems can be used for a variety of applications in precision farming, such as using pivot communications for sensor monitoring, sending data from chemical soil samples, testing wind speed for optimal watering times, and determining pivot location and power pump usage.

Wireless broadband enables a host of critical infrastructure components necessary for an automated farm, such as cellular backhaul, which provides cellular drop-in when the existing infrastructure goes down in the event of an emergency. This then serves as temporary communications until the existing network can be repaired. Point-to-point and point-to-multipoint networking are ideal for communicating high volumes of data in remote locations with dispersed assets. Applying these options in precision agriculture enables not only a highly reliable and high-speed network, but also serves as a backbone for mesh network capabilities by allowing multiple systems across multiple client points and sites to be connected back to a central point. Mobile mesh, another value point for wireless broadband, provides high speed communication links for multiple access point networks and self-configuring ad-hoc networking capability. For example, mesh networking in an agricultural setting can enable mobile grain carts or automated tractors to communicate with each other, securely, on the same network. Wireless broadband networks have the added benefit of creating Wi-Fi networks in remote locations for connecting people and sensors back to the main data collection point. Additionally, with the expected growth of mobile app usage in the field for process monitoring, it enables network connectivity across the entire geographic location of the farm for continuous, real-time decision making.

Connecting Sensors to the Decision Makers

Across the globe, precision farms are using advanced sensor technology to drive innovation and automation, streamline workflows, increase productivity and lower industrial waste from over-watering or over-fertilizing. Wireless sensor networks incorporate remote sensing, GPS and GIS technologies to generate aerial and topographical maps used for monitoring and process applications. Today, electronic sensors are used for everything from monitoring soil composition, to precision steering and guidance on autonomous vehicles, to monitoring water usage to determine optimal watering times. Across the farm, sensors provide real-time readings that are used to automate a large range of these applications. But without a wireless M2M network to connect these sensors and handle high bandwidth data transmissions, automation efforts would fail.

As with any communication network, these individually small pieces comprise a much larger whole. With the future of industrial precision agriculture dependent upon real-time data monitoring, these sensors, capable of collecting and transmitting data from dispersed assets and large, remote geographic locations, are the cog in the development of automated procedures. A strong wireless broadband infrastructure ensures that these wireless sensor networks help operators achieve maximum operational efficiencies and accuracy within the automated areas.

While autonomous tractors and farm equipment currently exist, the future of the precision agriculture industry depends on the development of technology that allows for site- and crop-specific management zones across a farm. Today, engineers view these management zones as sub-regions comprised of three data layers: aerial imagery, topography and human experience. Aerial imagery depends on the deployment of UAVs and data transmission to develop a real-time aerial view of the farm area. Topographic data maps are crucial for measuring changes in soil makeup, which, in turn, allow for these unique sub-regions to be managed independently and be adaptable to any soil or weather shifts. Human experience relies on the knowledge of the farmers for added insight. The first two of these three data layers depend on sensor technology and data transmission to provide crucial information to farm operators, ultimately aiding in automation decision-making. Without a reliable network infrastructure capable of adapting to weather events, foliage or structure interference, or incorporating multiple methods of wireless communication, the efforts to achieve the next level of precision agriculture will stall.

Conclusion

As an industry, precision agriculture is not far from becoming one of the most important pieces of our global infrastructure. Producing more food for more people will require more land and, as a result, more management and oversight. But as automation technology continues to improve and becomes increasingly available to operators, managing these geographically large swaths of farmland will be possible.

Operators can develop complex sensor networks to monitor all automated functions, and with the wireless M2M communication networking capabilities available today, these sensors can transmit data and information in real-time to operators and autonomous machines across a farm, streamlining the decision-making process, increasing overall productivity, and reducing waste. These networks rely on the reliability, security and robustness of broadband communications and today, the possibilities for a wireless M2M communication infrastructure are greater than ever.

FreeWave Technologies, Inc.

5395 Pearl Parkway, Suite 100, Boulder, CO 80301 TF 866.923.6168 T 303.381.9200
For more information, visit www.freewave.com