

Getting Started with Wireless Local Area Networks (WLAN) on Farms

How Can Wireless Networks be Used Farms?

Wireless networks on farms can be used to remotely monitor and control both conditions and activities at various locations. Commercial sensors are available to monitor a wide variety of conditions including temperature, relative humidity, moisture, insect activity, electrical use, motion, light, on/off activity, open/closed position. Wireless networks can also incorporate separate signals to control activities at remote sites such as switching motors on and off. Wireless networks also provide opportunities for wireless Internet access throughout the farm area. Wireless Internet beyond the farm yard requires an additional network with more powerful radios and repeater stations.

A sensor you can include in a wireless network is a camera. Most people probably would not consider a camera to be a sensor but it fits the definition so it is included here. Network cameras are practical and can be flexible. Cameras can be used for security purposes around fuel tanks and chemical stores, and to monitor such diverse activity as irrigation pivots or livestock yards, and can even monitor crop growth in fields. Cameras allow visual monitored and if the network is connected to the Internet, it is possible to view cameras from almost anywhere in the world. Some camera models can also flip switches allowing you to control electrical devices at the camera location.

Unlike a webcam which requires a computer to be attached to it, a network camera can work all by itself because it has a built-in processing unit. It just needs a source of power and a network connection.

Wireless technology is a method of sending data between electronic devices using radio waves. Wireless Local Area Networks (WLAN) allow computers and other electronic devices to communicate with each other. The Institute of Electrical and Electronics Engineers (IEEE) sets standards for wireless technology. The most common wireless communication technology used on farms is 802.11. The IEEE established various subsets of 802.11 which are identified with letters resulting in wireless technology names such as 802.11a, 802.11b, etc.

Basic Components of Wireless Networks

The basic components of farm wireless networks include a radio base station connected to a computer, and three pieces of equipment at the remote location: a remote radio modem, an electronic data logger, and the electronic sensor. A search of the Internet will provide several sites that market wireless sensor networks. Internet addresses are listed on the NDSU Wireless Technology web site at: <http://www.ageng.ndsu.nodak.edu/wireless>

The radio base station is connected with a serial or USB cable directly to a computer that could be located in the farm office. The base station is used to transmit and receive data from the remote sensing locations. Using whip antennas data can be transmitted up to approximately two miles. Directional antennas, also called Yagi antennas, increase the usable distance of wireless networks up to several miles. Transmitting distance is affected by physical conditions and electronic interference so the actual working distance is unique to each application and location so it is necessary to experiment with equipment on site. Directional antennas can be used both at the base and remote stations.



Directional Antenna

Radio Base Station



The radio modem is the remote radio that receives data from the data logger and transmits it back to the radio base station. The radio modem, which can be powered with batteries, must be located at the site where data is being sensed and collected. It is important to locate the modem, or at least the modem antenna, in a location above obstacles to maximize transmission distance.

The data logger receives and records the data from the electronic sensors. Data loggers have electronic memory storage space so the data can be stored and transmitted to the base station at user-specified times rather than as it is sensed. Periodic transmission of the data decreases the energy used both by the data logger and remote radio modem which is important because both pieces of equipment are powered by batteries.



Data Logger



Radio Modem

Sensors



Leaf Wetness Sensor



Rain Sensor



Light Intensity Sensor



Soil Moisture Sensor



Electrical Current Sensor



Camera



Pressure Sensor

Sensors are used to measure conditions and record activities at the remote locations. Cables are used to connect the sensors to the data logger. Commercial companies market electronic sensors to measure most activities and conditions related to farm operations. Companies are often interested in working with individuals to develop new sensors for unique applications so if a sensor is not commercially available for a specific application there is likely opportunities to work with these companies to develop the needed sensor.

Software is used in a computer to display data collected from the remote locations. Existing spreadsheet or basic word processing software can be used to summarize and view data; however graphical displays of the data require specialized software available from the same vendors who market the wireless hardware.

What are the Maximum Distances for Wireless Applications?

Wireless networks function within a few hundred feet indoors and several miles outdoors. The type of equipment and the building construction materials influence wireless technology operation within buildings. The maximum working distance outdoors is affected by the type and quality of the wireless equipment, terrain, weather conditions and interference from other wireless technologies. Wireless networks using common whip antennas function effectively up to two miles. Distances can be increased up to several miles using directional antennas. The effective operating distance of 802.11 wireless networks is unique to each site so it is important to try equipment to determine actual distances onsite.

John Nowatzki, Extension Ag Machine Systems Specialist
Ag & Biosystems Engineering Department
North Dakota State University
Fargo, ND 58105

John.Nowatzki@ndsu.edu
Telephone 701-231-8213

August 22, 2006