Networking Basics

- IP Addressing
- Network Classes
- Routers
- Internet Service Provider Requirements
- Dynamic DNS
- VPN
Wireless Networking Basics

• 802.11 Wireless Standard
• Fresnel Zone and Frequencies
• Stations and Access Points
• Standalone Installation
• Farm Network Pivot Hardware Installation
• Farm Network Tower Hardware Installation
• Farm Network Typical Installation
Other Options

• Cellular Modem Installation and Benefits
• FieldView
• FieldView Polling Software
IP Addressing

- Internet Protocol (IP) address is a 32 bit number that uniquely identifies a host such as a computer, printer, or router on a TCP/IP network
- Normally expressed in dotted-decimal format with 4 numbers separated by periods, i.e. 192.168.250.100
- Each 8-bit section is known as an “octet”
- First three octets are known as the “Network Address”, i.e. 192.168.250.100
- Last octet is the “Host Address”, i.e. 192.168.250.100
IP Addressing (Continue)

• In order to communicate with each other, hosts must have the same Network Address, i.e. 192.168.250.100 and 192.168.250.199

• If hosts do not have the same Network Address, their traffic can be passed through a Router to get the packet from the source network to the destination host’s network

• Once the packet is delivered to the destination’s network, the packet is delivered to the host
Subnet Mask

- Subnet Mask is used by the TCP/IP protocol to determine if a host is on the local subnet or on a remote network.
- Used to divide the IP address into two fields, the network prefix and the host identifier.
- If the network prefix of source and destination host are the same, the hosts are on the local subnet.
- If the network prefixes are different, the destination host is on a remote network.
- Traffic is exchanged or “routed” between subnetworks when the network prefixes of the source and destination addresses differ.
- The Router acts as a logical and physical boundary between the two subnets.
Network Classes

- Class C networks use a default subnet mask of 255.255.255.0 and have 192-223 as their first octet, i.e. 192.168.250.100
- Class B networks use a default subnet mask of 255.255.0.0 and have 128-191 as their first octet, i.e. 172.16.3.12
- Class A networks use a default subnet mask of 255.0.0.0 and have 0-127 as their first octet, i.e. 10.25.16.11
- Network class determines how many hosts can be on the same network
  - Class C can have a maximum of 254 hosts per network, i.e. 192.168.250.1 – 192.168.250.254
  - Class B can have a maximum of 65,534 hosts per network
  - Class A can have a maximum of 16,277,214 hosts per network
Why Do I Need to Know This?

- Standard network used for Farm Network installations is a Class B
- Subnet mask used is 255.255.248.0
- IP addresses used are 172.16.0.0 to 172.16.7.254
- Allows up to 2,032 hosts on a single network
- This will allow over 600 pivots to be included on the same network
A router is a networking device that forwards data packets between computer networks. It is connected to two or more data lines from different networks. The router reads the network address in the packet and forwards it on to the proper port for delivery to the destination host. It can be configured as Dynamic Host Configuration Protocol (DHCP) server to automatically assign an IP address to a host connected to the network. Without DHCP, all hosts must specify their own IP address and subnet mask in order to communicate with other hosts.
Router (Continue)

- Can also act as a firewall to control the flow of packets between networks
- Provides security between the Wide Area Network (WAN) and Local Area Network (LAN)
- Can also provide secure connections to the LAN from the WAN via a Virtual Private Network (VPN)
- Allows the user to securely access all devices on the Farm Network via the Internet
Internet Service Provider (ISP) Requirements

• In order to access the Farm Network remotely, a Public Static IP is recommended

• This Static IP is assigned by the ISP and allows remote hosts to connect to the router using the same address every time

• If a Static IP is not available, Dynamic Domain Name System (Dynamic DNS) must be used to associate a Domain Name with the current public IP address of the network
Dynamic DNS

• A method of automatically updating a name server with the current configuration of its hostnames and addresses

• For example, if a customer uses a cellular modem for remote access to a control panel and cannot obtain a static IP from the carrier, DDNS must be used to assign a domain name (such as panel1.noip.com) to the current IP address of the modem

• The modem will send its current IP address to the DDNS server at regular intervals for assignment to the domain name

• When the IP address changes, the modem will still be accessible via panel1.noip.com because the DDNS server has updated its list based on information from the modem
Virtual Private Network (VPN)

• A VPN extends a private network across a public network such as the Internet
• It allows remote hosts to send and receive data across shared networks as if the host were directly connected to the private network
• Establishes a virtual point-to-point connection using dedicated connections, tunneling protocols, or traffic encryption
• When a remote host connects to a VPN server, the server authenticates the host and assigns an IP address on the remote network, allowing secure direct communication with the devices on the remote network
Wireless Networking

• Same networking principles apply to wireless networks, except that instead of passing data over hard wires, data is passed over the air using radio waves
• We use 802.11 compliant devices
• Usually operating in the 2.4GHz or 5GHz frequency bands
802.11 Standard

• Simply put, 802.11 standard is a set of rules for implementing Wireless Local Area Networks in the 2.4, 3.6, 5, and 60 GHz bands
• Standard was released in 1997
• Devices under this standard commonly use the trademarked term “Wi-Fi”
Why use Standard Equipment?

- Any Wi-Fi device operating on the same frequency can connect to the farm network.
- This includes other brands of radios, wireless routers, wireless IP cameras, etc. etc.
- All Wi-Fi enabled devices can connect to the farm network and control the pivots directly, with no proprietary hardware or software requirements (other than a web browser).
Fresnel Zone

• Radio frequency line of sight is defined by Fresnel Zones
• Ellipse shaped areas of RF between any two radios
• For 2.4GHz, the Fresnel Zone radius \( (r) \) is 23.25 feet at a distance of 1 mile
• Shoot for 80% clearance (18.6 feet at 1 mile) to ensure the highest performance of the link
• More than 40% blockage, the signal loss will be significant
Stations and Access Points

• Typically two types of devices on a Wi-Fi network, Stations and Access Points
• Station is a “client” on the network, i.e. a smart phone, laptop, or radio configured as a Station
• Stations connect to Access Points wirelessly, using the 802.11 standard
• Access Point is the wireless gateway to the rest of the network
• In typical installations, Stations can ONLY talk to Access Points
Standalone Installation
Farm Network Pivot Hardware
Farm Network Pivot Hardware (Continue)
Tower Hardware
Typical Installation
Cellular Modem Option

Industrial hardened cellular modem option is available for the Evo Touch panel.

Installs directly in panel and provides remote access via VPN.

Quad Band modem works globally on all CDMA and GSM networks.

Accepts a SIM card.
Cellular Modem Option (Continue)

- Advantage of this option is that the installation of a local wireless network is not required
- Cell coverage at pivot point must be good in order to provide reliable remote access
- Data usage and overages can be a concern, depending on carrier and customer usage
- Monthly fee typically associated with cellular data plan
- Public Static IP is recommended, although DDNS can be used if IP is dynamic
FieldView
FieldView (Continue)

• FieldView is a light version of SCADA developed in-house
• Used to locally and remotely monitor farm using a standard web browser
• Data displayed in browser is from a Linux based Apache web server installed in farm office
• Server polls each pivot on the farm and populates data on screen
• Entire farm can be polled in seconds so data is close to real time
• Direct connection to pivots is also possible for remote reprogramming and control, bypassing FieldView
FieldView (Continue)

- Customers and Dealers can easily maintain FieldView map using the intuitive interface
Panel Class B Radio Programming
Panel Class B Radio Programming (Continue)
Panel Class B Radio Programming (Continue)
Panel Class B Radio Programming (Continue)
Pivot Class B Access Point Programming
Pivot Class B Access Point Programming (Continue)
General Rules of Thumb

- Pico Station at control panel with IP of 172.16.1.xx (xx = machine number) connects to Pico AP radio above collector ring with IP of 172.16.2.xx
- Link between panel radio and AP radio is locked to Channel 1 and Station is locked to MAC of AP radio to prevent network loop or connection to other pivot AP with same SSID
- Bullet Upload/Station radio (172.16.3.xx) is hardwired to LAN port of Pico AP radio above collector ring
General Rules of Thumb (Continue)

• Bullet equipped with higher gain omni-directional antenna for connection to the AP radio on local tower
• Bullet Upload radio is locked to the MAC of the AP radio at the tower and locked on Channel 11
• Channel 6 typically left open for other traffic or when panel antennas are required at tower in large farm installations
• Router in Farm Office will have an IP of 172.16.7.254
• FieldView server IP will be 172.16.7.250
• Panel’s HMI will have an IP of 172.16.0.xx
Hands On Programming
THANK YOU