Understanding Wireless Radio Communication Options and the Benefits of Hybrid Wireless Networks

Curt Goldman, Business Development Executive
FreeWave Technologies, Inc.
Radio Communication Options

Consists of watt meters, spectrum analyzers, radios, antennas, coaxial cable, jumpers, lightning protection, grounding, path studies, diagnostic tools, power supplies, radio masts and towers, knowledge of radio types and spread spectrum and licensed frequencies and serial and/or Ethernet devices.
Different Topologies, Network Sizes and Data Requirements

- Field size and location – where is data going?
- Topology and vegetation types and challenges
- Feel the need for speed? What are you bringing back to the hose and are you trying to tie into the network from the field?
- Video, IP, PLC’s, Wi-Fi and other Ethernet devices
- Combining different types of data to your SCADA network
- New field challenges and how to get your data back to the host
- Microwave – spread spectrum or licensed radios, ring or self healing link architectures
- Cellular networks – where and why you might use them
- Satellite networks – for those really remote areas…
New Software Options

Some new software programs offer:
• All software applications in one package
• A common set of tools for end-users, resellers and tech support
• For some providers, new software can replace outdated versions
Line of sight is mandatory to enable robust, reliable communications.

Multipath reflectance

Path loss software measures “fade margin”

Bad Path

Good Path
Path Study Basics – Fresnel Zone

Fresnel Zone

- D is the distance between the transmitter and receiver
- B is the radius of the Fresnel Zone

NOTE: Fresnel Zone radius is different with different frequencies
Basic Network Considerations

Detailed Planning

- Frequency of data acquisition
  - On-demand
  - Hourly or daily
  - On exception/change of status

- Data or data packet sizes
  - Large or Small
  - Streaming, polled or report by exception

- Latency requirements

These considerations help identify appropriate (or insufficient and appropriate) technology choices early on.
Know the Market

- Pay attention to what your neighbors and the market are doing
- Make your choices based on your individual needs and goals, not what
- Verify performance and do not blindly trust market buzz or advertising
Considerations

June 13-14, 2011

2011 Appalachian Basin Gas Well Deliquification Seminar

Budget

• Cost
  – CAPEX; upfront investment
  – OPEX; recurring charges
  – Maintenance, repairs, service

• Financing
  – Depreciation (tax write off)

• Benefits
  – Savings
Technology Selection

- Don’t be afraid to learn about technologies, their advantages and limitations
- Be skeptical; one size does not fit all when it comes to communication networks
- Hybrid networks may offer the best technical approach to solving diverse needs and requirements
One Size Doesn’t Always Fit All…

The Hybrid Approach
Combining Different Technologies

- Ethernet
- Cell Phone
- Land Line
- Licensed Radio
- Spread Spectrum
- Satellite
- Microwave
Hybrid Networks

- Hybrid networks combine the use of different technologies in order to achieve an optimized, purpose-built infrastructure design.

- Trunk and Branch Structure
  - MAN (large area, high bandwidth communication)
  - WAN (long distance, high bandwidth communication)
  - LAN (medium distance)
  - PAN (short distance, low bandwidth communication)
Hybrid Systems Often Have Several Radio Technology Types Deployed

This SCADA network has a mix of both licensed and spread spectrum radios from three different radio manufacturers.

This network also combines TCP/IP and serial data into one SCADA host software.
Hybrid Systems with Licensed and Frequency Hopping Spread Spectrum Radios

This SCADA Network has a mix of both licensed and frequency hopping spread spectrum (FHSS) radios and two different radio manufacturers.

This network also combines TCP/IP and Serial Data into one SCADA Host Software.
Hybrid Solution Using Ethernet, Serial and IO Radios
Emerging Technologies

- Ethernet is quickly becoming de facto standard for industrial communications, replacing serial and data bus technologies.

- Why?
  - Ethernet accommodates a wide range of applications
  - Universally supported by communications equipment manufacturers
  - Encapsulates industrial equipment protocols
  - Ease of configuration and low cost of implementation
Purpose

• Given the cost benefits and flexibility of Wireless Ethernet communications, many SCADA professionals are looking to migrate to IP out to the field and convert existing serial communications to Ethernet.
In the world of Well Optimization real time information is critical to performance.

The more data you can see on your performance the more finely you can tune your wells.

Ethernet allows you to see “Near Real time Data”.

Polling 200 wells with serial radios can take hours, with Ethernet it takes seconds.

Major producer in Colorado has 1800 wells, it took them 5 hours to poll the field once with serial radios, with Ethernet it takes 5 minutes.
Frequency of Polling?

- How often should you poll?
- Once an hour?
- Once a day
- 4 times per day?
- 17 seconds per site, times 200 sites = 57 minutes per polling cycle (1 per hour)
- What is best fit Best Fit?
Volume of Data?

- How Much Data per Poll?
- What is Baud Rate?
- How long Will it Take to Poll Each Site
- Quick Equation

Sample Equations

40,000 bytes of data
1200 baud
= 33 seconds per poll

40,000 bytes of data
115.2 Kbaud
= less than 1 second per poll

Can I poll more than one device at a time?
What Do I Gain By Going Wireless

- Better (faster) plunger control at lower cost
- Real time pressure and line status
- Lower cost
  - No trenching
  - No Wiring

- Real time alarms
  - Tank levels
  - Pump shut down
  - Compressor shut down
How Many Inputs Do I Have?

Modbus Application

- 6 Digital Inputs
- 2 Digital Outputs
- 4 Analog inputs
- Controllable sensor power (VSNS)
- Pulse counting DI’s allow detection of 20 msec. pulses and count to 25Hz
- Voltage and temperature monitoring
- Active Modbus data port allows extension by adding external devices
How Do I Deploy it at the Well Head?

- Casing Pressure   AI-1
- Tubing Pressure   AI-2
- Plunger Arrival   DI-1
- Open Valve        DO-1
- Close Valve       DO-2
Complete Well Head Solution in One Kit

• Same Kit does either wire replacement by mirroring Analog or Digital Signals

• Or Converts the analog and digital signals to Modbus registers
Is This Technology Secure?

- **YES, but not all radios are created equal**
- Commonly accepted security features include:
  - AES Encryption
  - Central Radius Authentication
  - MAC Address Filtering
  - Dynamic Key Substitution
  - VLAN Tagging
Is This Technology Reliable?

– A properly designed and installed wireless Ethernet system should be 99.9999% reliable

– Discuss return rates with potential suppliers

– Temperature Range
  • Reliable Operation within industrial temperature ranges (i.e. -40° to +75° C).

– Operation in Hazardous Environments
  • UL certification for Class 1, Division 2 environments permitting radio operation in the presence of flammable or explosive gases, fluids or vapors
Conclusions

• Hybrid networks can have several variations of radio types and frequencies (i.e. licensed or spread spectrum)

• Mixing two or three brands of technology is common – upgrade critical sites when needed and add new technology when needed to get the biggest bang for the buck

• Do your homework – check references, products, features, warranties, get a path study, can you easily get diagnostic and history information?

• Define short and long term goals, network data requirements and plan for future growth and network expansion

• Emerging technologies such as Ethernet are being selected for applications such as optimizing a wireless wellhead for faster control with lower costs
Copyright

Rights to this presentation are owned by the company(ies) and/or author(s) listed on the title page. By submitting this presentation to the Gas Well Deliquification Workshop, they grant to the Workshop, the Artificial Lift Research and Development Council (ALRDC), and the Southwestern Petroleum Short Course (SWPSC), rights to:

- Display the presentation at the Workshop.
- Place it on the www.alrdc.com web site, with access to the site to be as directed by the Workshop Steering Committee.
- Place it on a CD for distribution and/or sale as directed by the Workshop Steering Committee.

Other use of this presentation is prohibited without the expressed written permission of the author(s). The owner company(ies) and/or author(s) may publish this material in other journals or magazines if they refer to the Gas Well Deliquification Workshop where it was first presented.
Disclaimer

The following disclaimer shall be included as the last page of a Technical Presentation or Continuing Education Course. A similar disclaimer is included on the front page of the Gas Well Deliquification Web Site.

The Artificial Lift Research and Development Council and its officers and trustees, and the Gas Well Deliquification Workshop Steering Committee members, and their supporting organizations and companies (here-in-after referred to as the Sponsoring Organizations), and the author(s) of this Technical Presentation or Continuing Education Training Course and their company(ies), provide this presentation and/or training material at the Gas Well Deliquification Workshop "as is" without any warranty of any kind, express or implied, as to the accuracy of the information or the products or services referred to by any presenter (in so far as such warranties may be excluded under any relevant law) and these members and their companies will not be liable for unlawful actions and any losses or damage that may result from use of any presentation as a consequence of any inaccuracies in, or any omission from, the information which therein may be contained.

The views, opinions, and conclusions expressed in these presentations and/or training materials are those of the author and not necessarily those of the Sponsoring Organizations. The author is solely responsible for the content of the materials.

The Sponsoring Organizations cannot and do not warrant the accuracy of these documents beyond the source documents, although we do make every attempt to work from authoritative sources. The Sponsoring Organizations provide these presentations and/or training materials as a service. The Sponsoring Organizations make no representations or warranties, express or implied, with respect to the presentations and/or training materials, or any part thereof, including any warranties of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.