WIRELESS MESH GAS DETECTION FOR OIL AND GAS EXPLORATION

Workers operating in the oil and gas exploration industries are at risk for exposure to sour gas—gas containing H_2S (hydrogen sulfide) at potentially toxic levels. Operations located in densely populated areas pose additional threats of exposure to the general public. The danger can develop over time, even if the gas source was initially "sweet" (low in H_2S). Local and national regulations define acceptable exposure levels for workers and the public. Over the years, industry has adopted low-level H_2S detection, and continues to look for improved technology to ensure the safety of its workers and the community while meeting regulation requirements.

Safety managers need the ability to remotely view sensor readings in real-time to make quick safety decisions and to contain the threat. With technological advancements in wireless communication, more and more companies are looking to wide-area wireless gas detection systems to meet their detection needs, because these systems are much faster and cheaper to deploy than traditional wired solutions. They eliminate the need to transport heavy and expensive cables, plus they remove the need to dig trenches or install extensive wire networks.

This application note provides an overview of the following:

- Conventional wireless gas detection methods used within the oil and gas industry, with highlights on their limitations associated with interference, complexity, and security.
- Newer technologies available today, including the use of Mesh radios, which speed up deployment and provide stable communications.
- Why Mesh wireless technology should be considered as the backbone for remote gas detection in oil and gas exploration and transportation.

Fixed-Frequency Narrowband Transmission

Initial wireless gas detection systems deployed in the oil and gas industry utilized fixed-frequency narrowband transmission modems. Figure 1 illustrates what a traditional narrow-band signal might look like on an ordinary spectrum analyzer. These modems transmit gas concentration readings from one sensor to a controller.

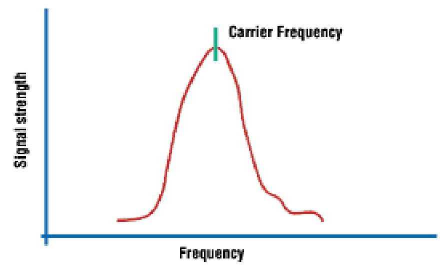

Figure 1. Narrowband fixed-frequency signal

Any obstacles between the sensor and controller cause signal loss. In addition, any "noise" from other wireless sources can easily interfere with the system's operation. This type of co-channel interference occurs when two modems broadcast on the same frequency. As more and more devices using these types of modems were deployed, interference issues became a bigger concern. Because reliable, uninterrupted data transfer from sensors to controllers cannot be compromised, many companies have started to look for alternative wireless solutions that do not have these inherent limitations.

Newer Wireless Technologies

Wider acceptance and application of wireless technology in many industries has accelerated the advancement of digital data processing and communication. Manufacturers of wireless gas detection systems have started to incorporate these technologies into their systems to addresss shortcomings of earlier offerings.

In order to accommodate multiple transmissions within the same frequency band, the narrowband signal can be spread out. The two most common methods for spreading the signal are frequency-hopping spread-spectrum (FHSS) and direct sequence spread-spectrum (DSSS). In an FHSS system, the tranmission frequency is randomly varied with time. At any particular moment, the system essentially operates using narrowband transmission, but because the modems are continuously jumping to different frequencies (up to 1,600 times per second), co-channel interference issues are greatly reduced.

RAE Systems Inc.
3775 N. First St., San Jose, CA 95134-1708 USA
Phone: +1.888.723.8823
Email: raesales@raesystems.com

In a DSSS system (Figure 2), the signal is spread over several frequencies and tranmitted at the same time. By injecting a spreading code into the data, the resultant narrowband signal is broadened. The additional bits are not random, but rather are configured in an exact sequence that allows multiple transmissions to reside in the same spectral band simultaneously. The ordering also provides a method of correcting for various errors that may crop up during the wireless transmission. Finally, the spreading of the signal results in increased security because the signal appears much like noise.

These types of signal-spreading technologies offer

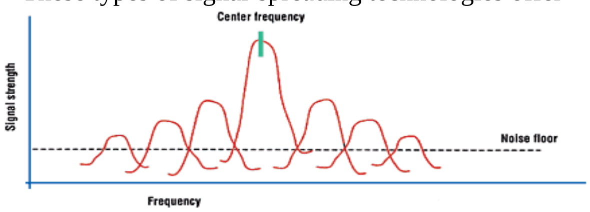

Figure 2. Direct Sequence Spread-Spectrum signal.

solutions for co-channel interference, but they do not address the issue of bypassing obstacles. In addition, the high operating power requirements of these modems limit their use for wireless gas detection within the oil and gas industry. The need exists to combine these capabilities with other technologies to make systems practical for applications such as air monitoring on an oil-drilling rig or onboard a petrochemical shipping vessel.

Mesh Modems: A Better Wireless Solution

Mesh modems have the ability to automatically route the wireless signal to other nearby modems allowing them to easily bypass obstacles and increase the transmission distance. They can run for long periods of time because they require very little power to operate. Mesh networks require minimal programming because the modems locate the best path back to a controller and connect automatically. Any loss of signal is detected, and the network will identify the best method to re-route the signal and heal itself.

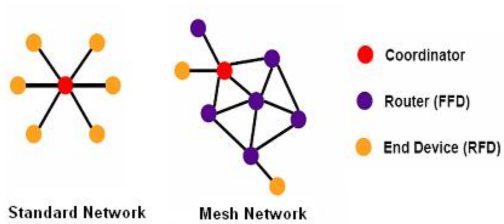

Figure 3. Standard and Mesh network configurations.

Benefits Of A Mesh System

Reliability of wireless signal. Integrated routing function and self-healing of the network ensures delivery of data.

Deployment time. Automatic network configuration means you are up and running in minutes.

Cost. Acquisition costs are typcially a fraction of traditional wireless systems.

Safety. Inherent redundancy of mesh system results in increased safety.

Productivity. Reduced engineering design and system reconfiguration time.

RAE Systems MeshGuard Family

RAE Systems offers intrinsically safe wireless gas detection networks based on 902.15.4 2.4G DSSS mesh technology. Embedded mesh functionality ensures a very stable wireless signal, and self configuration of the network simplifies deployment. Designed for use in oil and gas exploration applications such as drilling rigs, the 2.4GHz modems integrated in these solutions means the same system can be deployed worldwide.

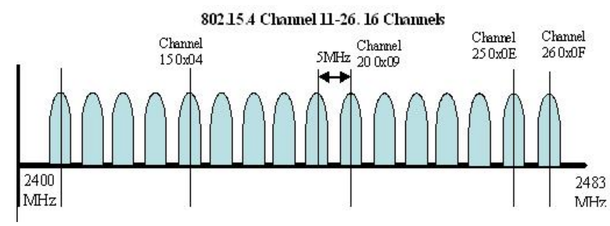

Figure 4. 802.15.4 frequency channels.

Potential interference with other wireless equipment already deployed is limited by the use of multiple channels and very low output power. The frequency band has 16 different channels to choose from, so in case of very high background noise, the system can switch to a “friendlier” channel.

FMC-2000 Wireless Multi-Channel Controller

- Built-in mesh radio wireless modem for MeshGuard family
- Manage up to 24 channels
- 4 programmable SPDT relay outputs
- Built-in backup battery for up to 14 hours of operation
- Stainless-steel enclosure

MeshGuard Battery-Operated Wireless Gas Detector

- Built-in mesh radio wireless modem
- Up to six months run time on disposable battery
- Continuous display of gas concentration in ppm
- Loud audio and bright visual alarms
- Highly resistant to RFI and EMI
- Small and lightweight
- IP-65 rated weather resistant