The Growth of Wireless Technologies in Process Industries

Part 3

By Steve Mustard

The growing demand for increased monitoring and control of production and distribution assets can no longer be met by conventional methods alone. The cost of installing and maintaining field wiring at any site can be prohibitive, and, in some cases, the solution is not viable.

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An ATEX compliant wireless device is installed in a potentially explosive atmosphere to monitor the site and report incidents.

The average consumer has access to an increasing array of off-the-shelf wireless products, from Bluetooth keyboards and headsets through Generalized Packet Radio Service (GPRS) and Third-Generation (3G)-enabled handsets and laptops, to 802.11 wireless networks in their own homes. With increased adoption, the cost price reduces whilst the reliability and usability increases.

With so many standards and products available, the process engineer's task of selecting the right option to meeting their automation requirements can be a major challenge. No one wants to choose the Betamax of the wireless world, but equally no one wants to miss out on a potential new solution that may solve today's problem.

Whilst the range of standards and products can at first seem bewildering, they can mostly be categorized into three distinct types which suit the needs of the process engineer:

- **Wide Area Network (WAN).** This would cover products that can enable communications from a data center or control room to large process works, typically many kilometers. Data rates in this type of network would need to be high enough to cope with frequent data updates and near-real-time control needs.
- **Local area Network (LAN).** This would cover products for communications around a process works or in the immediate vicinity, typically a few hundreds of meters. Data rates in this type of network would need to be higher than WANs, to allow continuous updates and real-time control.
- **Personal or Plant Area Network (PAN).** The Personal Area definition comes from the typical Bluetooth application of intercommunications of handheld device or peripheral communications. These types of applications typically require very high data rates, but only over a very short range, e.g., a few tens of meters. The Plant Area definition is intended to portray the needs of the process engineer to connect very remote items of plant for monitoring and control needs. Whilst still over a relatively short range, e.g., a few tens of meters, the data rates in this case may be lower than for Personal Area Networks. This allows for the use of products that operate at lower power consumption and, therefore, need less maintenance.

The most common options are listed below:

- **GPRS.** This is an enhancement on Global System for Mobile Communications (GSM) or 2G mobile networks as an interim step towards 3G. Also known as 2.5G (25 km/80 kbps).
- **Enhanced Data rates for GSM Evolution (EDGE).** A further enhancement on GPRS (25 km/236 kbps)
- **Universal Mobile Telecommunications System (UMTS).** 3G mobile network superseding GSM and GPRS (30 km/1–2 Mbps)
- **World Interoperability for Microwave Access (WiMAX).** Defines a standards (802.16) for providing wireless data over long distances (10 km/70 Mbps)
- **WiFi.** Intended to provide local network connectivity similar to wired Ethernet networks. Covered by a range of standards under the 802.11 group (30–50 m/300 Mbps)
- **Bluetooth.** Provides a way to exchange information between devices such as mobile phones, PCs, and the like, over radio frequencies. The Bluetooth Special Interest Group maintains the standards (10–100 m/700 kbps).
- **Zigbee.** Aimed at applications requiring low data rate, long battery life, and secure networking over a wireless connection (10–50 m/40 Kbps).

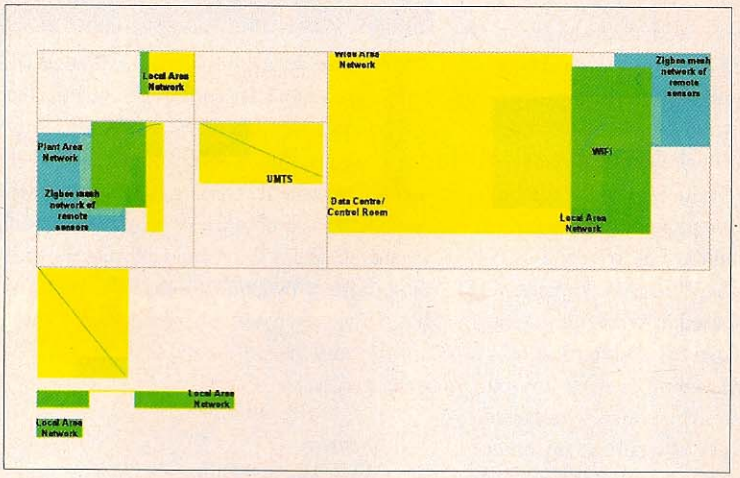
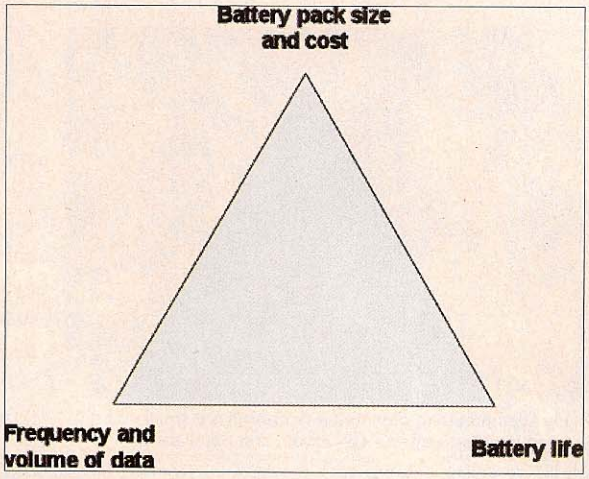


Figure: Network layers



The physical limitations of battery power mean that a choice has to be made as to which of three elements should be compromised.

There are many other options available, including low power radio (under the MPT1 329 definition), UHF radio (MPT141 1), Power Line Carrier (where data is modulated over power lines), and a host of satellite solutions.

The key to creating a future proof and flexible wireless process control network is to recognize that no one wireless standard can solve all needs. Since a multi-communications network is required, this allows some room for flexibility for the future, as the future of any standard is always going to be uncertain. For instance, despite only being available for a few years, the GPRS network will eventually (circa 2012) be superseded by the UMTS network, and all GPRS equipment will need to be upgraded.

In the above figure, the three network layers (WAN, LAN, and PAN) can be seen radiating outwards from the data center/control room. This method allows the process engineer to connect an ever more remote plant into the network for monitoring and control purposes, whilst ensuring the solution is cost-effective. The equipment at the WAN and LAN level will need to cope with higher data rates and be permanently powered.

In addition to the initial capital outlay, the cost of powering the equipment can be expensive and inappropriate for some remote sites. However, using PAN equipment, such as Zigbee, the process engineer can install monitoring and control nodes that operate for many years on battery power.

Wireless in an ATEX Environment

The European Community explosives atmospheres (ATEX) directive exists to define the mandatory requirements for equipment that is to be installed in environments such as those involved in oil and gas production and distribution, petrol stations, and sewers.

Those involved in the running of such environments have a need to monitor and control processes, and in order to do this they will need to ensure that monitoring and control devices comply with the ATEX requirements. This mainly involves ensuring that the devices cannot generate sufficient energy to cause ignition of the explosive atmosphere that they are installed in. With wireless devices, this can be at odds with the requirement to transmit data as far as possible and as quickly as possible.

The ability to provide wireless devices that transmit data as far as possible at reasonable data rates but still comply with ATEX requirements is limited to a few specialist providers, but the demand for such products is significant and growing. Some providers design ATEX compliant products from scratch, and some providers specialize in taking standard products and making them ATEX compliant.

An ATEX compliant wireless device is installed in a potentially explosive atmosphere to monitor the site and report incidents as soon as they happen. Such a device needs to be designed such that it cannot generate sufficient energy to ignite an explosive gas in the atmosphere, but still be capable of transmitting data out of the environment.

It is common for wireless monitoring and control installations to need to operate in the absence of mains power. Just as wireless communications allows lower cost installation in locations where traditional wired communications would be needed, alternatives to mains power reduce installation costs and increase availability of solutions.

Battery power is an obvious choice and indeed many products exist today that can run from a non-rechargeable battery pack for many years. However, users are demanding more data more often, and the end result is either a larger battery pack or a shorter life, even bearing in mind the improvements in electronic design that have greatly reduced power consumption.

As well as non-rechargeable battery solutions, users can elect to use solar, wind, and even water (or potentially multiple sources) to generate energy to recharge batteries, thus increasing serviceable life. However, such options can be expensive to install and can require cumbersome additional equipment and so tend to be less popular.

Many sites that require monitoring or control are small and located in areas such as grass verges, main roads, and pathways.

The choice of power source is crucial to avoid unsightly, expensive, and cumbersome equipment.

One of the most exciting new developments in wireless equipment power supply design is energy harvesting. Here a small device uses the vibration of machinery to generate sufficient energy to charge a small wireless transmitter for long enough to allow it to transfer its data. The potential for such a solution is huge, allowing users to monitor rotating machinery without the need for large devices that require regular battery changes.

With the continuation of both terrorist and hacker threats, it is no surprise that the electronic attack of organizations