Marconi and the need for standards

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To commemorate the 100th anniversary of Guglielmo Marconi's historic transmission of a radio signal from Poldhu in Cornwall, England to a receiver at Signal Hill, St. John's in Newfoundland, Canada, the Marconi company asked a team of its radio experts to duplicate the feat. These radio experts determined that it was not possible to duplicate the December 12, 1901 transmission using a replica of Marconi's equipment. The extensive use of the radio spectrum today creates so much 'noise' that the signal would simply have been lost in the 'clutter.'

Background

Modern ports owe much to Marconi's pioneering work. Regular communication with oceangoing vessels depends heavily on radio communications – whether via UHF, VHF or satellite communications. And, as we move into the 21st century, more and more of the radio spectrum will be devoted to communications devices inside port facilities. Radio frequency identification (RFID), wireless local area networks (WLANs) and wireless backhaul will all add to the 'noise' in the radio spectrum. Without international agreement on the use of the radio spectrum for these commercial applications, port operators, like the Marconi team of 2001, will find that communication is simply not possible.

Marconi could not have foreseen the explosive growth of the use of the radio spectrum in the 100 years following his demonstration of the feasibility of communicating long distances via very long radio waves (>1km). At the time, Marconi's radio was limited to transmitting what were essentially bursts of static – a series of spark discharges – suitable only for communication by 'dot' codes, the most universally accepted of which is Morse Code. It would not be until the invention of the vacuum tube that voice and other types of modulated communication would become possible. (Ironically, with the advent of the 'digital age,' many transmissions are again just a series of 'dots' – 1s and 0s.)

However, as early as 1903, the need to regulate and allocate parts of the radio spectrum was recognised by the international community. In that year, an international conference was held in Berlin, Germany to establish allocation, priorities and rights. At the conference, maritime safety was seen as a high priority and agreements were reached on maritime radio protocols and allocation.

The delegates saw the future potential of radio even in this early stage and agreed on rules of interoperation across different systems and allocated the spectrum among government, military and commercial uses.

In the 1920s, Marconi began work with much shorter wavelengths and determined that 'short wave' communication could be more effective than long wave. Governments, however, were not impressed and allocated these 'junk' frequencies to amateur radio operators. Only later, during the 1940s, did this band come into widespread use, primarily for shorter range communications from mobile and handheld devices.

The potential

Therein lies the lesson of radio spectrum allocation. The very promising beginning of international cooperation and agreement on the allocation of frequencies and uses of radio transmission became a more-or-less chaotic jumble of local and national regulations and allocations that, until very recently, prevented the development of globally-acceptable devices that were not 'standard' radios.

In fact, the first international (ISO) standard for the use of radio frequency identification for maritime containers required an RFID tag that was capable of operating on two different frequencies: one for North America and one for Europe. In other parts of the world, neither frequency was legal for use. This made the tag very expensive, not globally acceptable, and, as a result, the system was never widely implemented.

The benefit of having RFID tags that can uniquely and automatically identify containers as they're unloaded should be immediately obvious to port operators. There's an immediate reduction in the labour required to visually identify the container number, particularly when there is more than one number on the container, and then manually enter it into the system.

The use of RFID in ports can go well beyond simple identification.

Using RFID 'signposts' to identify key locations within the yard, readers on tugs or mobile cranes can automatically track the movement and storage location of every container, greatly increasing the efficiency of the system in both storing, and subsequently locating containers for movement out of the yard. GPS systems could also be used for this application but any system depends on being able to accurately record the correct container ID.

Efficient movement of containers through port terminals and staging facilities is also dependent on outside factors such as governmental regulations. With increased concerns about the vulnerability of port facilities to biological and toxicological threats, as well as smuggling of human cargo, governments are becoming more rigorous in their inspection of containers.

Inspections can cause delays that clog yards with containers that miss their scheduled departure. According to the Logistics Institute, if a container is inspected at the point of departure, there is an 80% chance it will miss its shipment schedule by one day and a 10-20% chance it will miss the next departure.

Waiting for inspections of incoming containers also adds days to the time a container just sits in a yard. With an increasing number of inspections by the US government in ports of origin, the implications are clear.

Equally clear, however, is the need to find a way to eliminate the need for these inspections. Containers that are loaded in secure areas (trusted by the US government) and that are secured against tampering or intrusion, can get 'fast tracked' through outgoing as well as incoming inspections.

RFID seals (often called e-seals) and intrusion detection systems using RFID not only identify that an intrusion has taken place and record the exact time of the event but can also, with some systems, even broadcast that an intrusion has occurred to alert port and customs officials to immediately inspect the container.

Using e-seals that can be automatically checked as the container is loaded or unloaded eliminates the need to visually inspect the seal and removes any uncertainty about the integrity of the load. This speeds containers through the inspection process and helps maintain an efficient flow of containers through the facility.

The need for global standards

International standards for most of the major RFID technologies are either in place or nearing final approval. These standards dictate the operation of RFID devices to ensure interoperability. However, national regulations still govern the allowable frequencies, power, bandwidth and use of the RF spectrum.

While the RF regulation landscape has improved greatly over the past several years, with more and more countries approving a common set of frequencies for use by RFID devices, some countries are not yet on board.

And, there are still differences between countries and regions over allowable power, bandwidth, and other technical issues.

Part of the problem is that some RFID systems operate very close to the frequencies used by wireless local area networks (WLANs), cellular and mobile phones, or some countries' emergency or military frequencies. Reallocating or restricting these frequencies is a difficult task at best. Most of all, it takes time.

There are also potential conflicts within facilities with 900 MHz and 2.4 GHz RFID systems, that could conflict with wireless phones and older WLANs. In these situations, an RFID reader could interfere with mobile data terminals mounted in tugs or other vehicles. Conversely, sufficiently strong signals from the WLAN access points could interfere with RFID reader operations.

As important as it is for all importing and exporting countries – and particularly maritime nations – to adopt a consistent set of standards for the use of RFID as well as WLANs and other RF technologies, it's important for port operators to be aware of the existing and emerging standards for RF technologies.

Many older RF systems used proprietary operating parameters and protocols. While these may still be quite adequate for use within the facility, they might also be sources of interference with – or subject to interference by – newer, standards-based systems.

Many of the emerging uses of RFID for container ID and e-seals use active tags. That is, the tags contain a battery to boost signal strength. This signal, particularly at higher frequencies, can be reflected by the metal surface of other containers and travel a considerable distance.

Most wireless phones and WLANS, that operate in the microwave range (2.4 GHz or 5.2 GHz), use spread-spectrum technology to help avoid local sources of interference. That is, they transmit the same message or parts of the message on a range of frequencies – they 'spread' the message across a specific part of the radio spectrum. If one frequency is too 'noisy' for effective communication, the message is also transmitted on another frequency that may not have as much noise. The system will eventually be able to successfully transmit the entire message. However, the greater the local noise, the less efficient the transmission.

Many of the modern UHF and microwave RFID systems also employ spread spectrum technology. The noisier the environment, the less efficient the transmission. While a delay may be measured only in milliseconds, a tug moving past a reader may be in the effective read window of an RFID antenna for only a fraction of a second.

There are also many other sources of electromagnetic interference (EMI), including vehicle engine electrical systems, generators, high power electrical lines, etc.

It's impossible to eliminate all the sources of EMI in any facility but awareness of them, through an RF site survey and understanding of globally-emerging standards, can help terminal operators design the most efficient system for current and future uses of RF technology.

ABOUT THE AUTHOR

Bert Moore is a 20 year veteran of the Automatic Identification and Data Collection (AIDC) industry and is both an educator and consultant on the technologies.

Moore currently serves as the Director of Communications and Media Relations for AIM Global, the worldwide trade association for automatic identification and data collection technologies, services and supplies. He is the editor of AIM Global's 'RFID Connections' and 'AIM Connections' e-newsletters, and a frequent contributor to other publications.

ABOUT THE ORGANISATION

AIM Global is the trade association and worldwide authority on automatic identification technologies in a mobile environment. AIM Global is comprised of providers of components, networks, systems, and services that manage the collection and integration of data with information management systems. Serving more than 900 members in 43 countries, AIM Global is dedicated to accelerating the growth and use of AIDC technologies and services around the world.

AIM Global actively supports the development of AIDC standards through its own Technical Symbology Committee, North American and Global Standards Advisory Groups, and RFID Experts Group (REG), as well as through participation at the industry, national (ANSI) and international (ISO) levels. It is the leading authority on bar code, radio frequency identification (RFID), and magnetic stripe technologies. AIM members are also leading solutions providers of voice systems, magnetic stripe, mobile computing, OCR, and contact memory.AIM has an active educational focus, providing accurate and unbiased information on AIDC technology, standards and applications.

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