

Towards Wireless Web-based Facilities Management

Seán T McAndrew

Research Engineer, BT Exact & Centre for Innovative Construction Engineering (CICE)
Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

Chimay J Anumba

Professor of Construction Engineering & Informatics, Loughborough University, UK

Tarek M Hassan

Lecturer in Construction Management, Loughborough University, UK

Alistair K Duke

Senior Researcher, BT Exact, Adastral Park, Martlesham Heath, Suffolk IP5 3RE, UK

Mark Hughes

General Manager, BT Retail, BT Centre, 81 Newgate Street, London EC1A 7AJ, UK

Abstract

For many years, paper and clipboards were the “mobile” solution for getting critical information out of, and back into, Facilities Management (FM) software systems by the mobile operative. However, with the current frenzied uptake of all things wireless, and the increasing dependency on Internet and intranet-based information submission and retrieval systems, the time is nigh for facilities management to embrace both these technologies. The widespread utilisation of wireless Web-based solutions should not be viewed as another attempt at adopting technology simple for the sake of it. Wireless Web-based solutions could offer achievable benefits to facilities managers over manual, paper-based processes and the technology existing today has matured to such an extent that it is not uncommon for high-speed wireless networks sharing and distributing broadband connections through homes as well as businesses. This paper highlights and discusses the possibilities of wireless Web-based solutions within FM and touches on some of the different wireless standards that exist.

Keywords

Facilities Management, Wireless, WLAN, 802.11, Web-based collaboration

1. Introduction

Employees who manage inventory, conduct inspections and undertake maintenance of critical assets are out wherever those assets may be located. These operatives are not performing work at their desks, but are out at the “point of performance” taking care of critical assets and materials.

Ideally, mobile workers need to interact with FM software at the point of performance, which is typically not in the vicinity of a computer workstation. Organisations rely on paper-based procedures to get

information from FM software, record information on the form and then physically re-enter the information gathered into the system when back at their computer workstation.

However, with manual, paper-based processes several key challenges remained (MRO Software Inc., 2002):

- Higher than necessary amount of non-productive time due to time spent on paperwork and data re-entry.
- Lower asset reliability due to maintenance backlogs and lack of information at the point-of-performance.
- Less than optimal decisions made due to lack of complete, accurate, and timely information.
- Lack of definite accountability of critical equipment and material.
- Inability to track compliance with government, environmental, and safety regulations.

Research into the UK facilities management market (Burgess, 2002) stated:

"The key drivers in the market today remain the search for greater efficiencies and core business focus that lead to increased outsourcing, plus an increasing demand for flexibility. The latter is coming from both organizations and their employees, and is enabled by internet, wireless and broadband technology, such that the nature of FM is changing from a workplace to a people focused activity."

2. Web-based Applications

The aims of using on-line project management tools were summarised as (Seddon *et al*, 2001):

- Facilitating in the transfer of information.
- Making the latest documents/drawings available to everyone.
- Providing a complete record of the project.
- Removing the need to use the same or compatible systems.
- Cost savings.

The use of Web-based collaborative tools in the construction industry is becoming commonplace and is seen as offering recognised business benefits such as the reduction in administrative time and resources and continuity of data from project inception through to the operations and maintenance phase (McAndrew *et al*, 2003).

The basic principles of Web-based collaboration can be applied to FM, and much of the valuable data created during design and construction, such as health & safety files and record drawings, should be readily available in electronic for the Client on completion. It would therefore be sensible to suggest that more providers of Web-based collaborative solutions for construction projects should aim for a similar variant of their offering be available for use by facilities managers and their operatives.

3. Wireless Technologies

Wireless technology is playing an increasing role in the lives of people throughout the world. In addition, ever-larger numbers of people are relying on the technology directly or indirectly. It has been said that (Keane, 2002):

"After 13 years of proprietary products and ineffective standards, the networking industry has finally decided to back one set of standards for wireless networking: the 802.11 series from the Institute of Electrical and Electronics Engineers (IEEE). These emerging standards define wireless Ethernet, or wireless LAN (WLAN)."

Research has indicated that 80 percent of online Europeans had interest in home networking activities (Fogg *et al*, 2003). The avoidance of the need for new cabling is one attraction of wireless LANs (WLANs) that rate highly with home consumers. It could be reasonably assumed that the same could be true for facilities managers who may be restricted or reluctant to implement extensive cable installations in older building or ones with limited leases.

Wireless communication of data is achieved by a number of different technologies such as GSM, GPRS, UMTS (3G), Bluetooth and Wi-Fi to name but a few. By far the most exciting prospect for the imminent future has to be the IEEE 802.11x series, within which Wi-Fi, or 802.11b, sits.

3.1 IEEE 802.11

The IEEE 802.11 series comprises of a number of different specifications, some complete and some still under development and without approvals. One of the key benefits 802.11 has over some of the other technologies is that rather than being subject to operator tariffs of GSM/GPRS/UMTS networks 802.11 can be rolled out like any other piece of IT hardware and used without incurring additional subscription and download charges. The limitations of distance of transmittal of data mitigate against the relative low cost of implementation and high speed data-rate transfers that can be achieved as well as the unobtrusive method of installation, as mentioned previously.

At present three variants of 802.11, namely 54a, 11b, and most recently 54g, have products in the marketplace and have been ratified by the IEEE.

3.1.1 IEEE 802.11a

An IEEE specification for wireless networking that operates in the 5 GHz frequency range (5.725 GHz to 5.850 GHz) with a maximum 54 Mbits/s data transfer rate. 802.11a was previously known as ‘Wi-Fi5’ however WECA dropped this term in October 2002 due to consumer confusion. It is commonly referred to nowadays as 54a. The 5 GHz frequency band is not as crowded as the 2.4 GHz frequency, because the 802.11a specification offers more radio channels than the 802.11b. These additional channels can help avoid radio and microwave interference. In reality, maximum rates of fewer than 20Mbits/s could hope to be achieved. Whilst this improved transfer rate should prove to be more of a competition to wired networks, whose transfer rates are typically either 10Mbits/s or 100Mbits/s. The 802.11a standard is not backwardly compatible with 802.11b meaning existing users would have to upgrade their entire equipment. The 802.11a standard has also had a harder time gaining accreditation in Europe than its predecessor.

3.1.2 IEEE 802.11b or ‘Wi-Fi®’

International standard for wireless networking that operates in the 2.4 GHz frequency range (2.4 GHz to 2.4835 GHz) and provides a throughput of up to 11 Mbits/s. This is a very commonly used frequency. Microwave ovens, cordless phones, medical and scientific equipment, as well as Bluetooth devices, all work within the 2.4 GHz frequency band. The 802.11b standard uses DSSS (direct sequence spread spectrum). The fact that the 2.4 GHz frequency band is unregulated in the majority of countries has almost certainly aided its success. Early efforts of different manufacturer weren’t always compatible with each other, but the creation of the Wireless Ethernet Compatibility Alliance (WECA) has provided the needed conformance and interoperability testing for products. Companies producing devices for the 802.11b standard aim to be granted the WECA Wi-Fi CERTIFIED™ label of approval.

3.1.3 IEEE 802.11g

Similar to 802.11b, but this standard provides a throughput of up to 54 Mbits/s. It also operates in the 2.4 GHz frequency band but uses a different radio technology in order to boost overall bandwidth. The 802.11g standard, or 54g, quotes possible transmission speeds of 54Mbits/s, which is up to five times the bandwidth of 802.11b, and has a greater range than 54Mbits/s rival 802.11a. More importantly, the

licensing issues associated with 802.11a in the UK are not relevant to 802.11g as it operates in the same 2.4GHz spectrum as Bluetooth and 802.11b. The Radiocommunications Agency (RA) has been quoted as saying, with respect to 802.11g, ‘As long as it conforms with existing interface requirements, it doesn’t need a license.’ In July 2003 the standard was ratified by the IEEE.

Table 1: Common varieties of IEEE 802.11

IEEE standard	Maximum Link Rate	Frequency Band	Notes
802.11	1 Mbits/s 2 Mbits/s	2.4 GHz	First standard (1997). Featured both frequency-hopping and direct-sequence modulation techniques.
802.11a (Wi-Fi5)	Up to 54 Mbits/s	5 GHz	Second Standard (1999), but products not released until late 2000.
802.11b (Wi-Fi)	5.5 Mbits/s 11 Mbits/s	2.4 GHz	Third standard, but second wave of products. The most common 802.11 equipment at the time of writing.
802.11g	Up to 54 Mbits/s	2.4 GHz 5 GHz	Recently standardised. Has the benefit of backward compatibility with 802.11b.

4. Benefits of Wireless Technology for FM

There are “hard” and “soft” benefits of mobility solutions (Redman, 2003). Improving accuracy and efficiencies are cited, and these hard benefits can be measurable and quantitative. Soft benefits such as responsiveness and employee satisfaction are high value but are not as measurable in terms of hard return. It is estimated that, through 2004, 75 percent of enterprises that implement mobile access to applications will fail to articulate mobility’s quantitative and qualitative benefits, and will be unable to prove a return on investment (ROI) (Redman, 2003).

Slow, labour intensive and error-prone are words that can describe data collection in the ‘traditional’ method of clipboards, datasheets and paper reference drawings (Shelton, 2003).

In the recent past, intermediate solutions using Windows CE run devices still required the user to come back from the point-of-service to their base and physically synchronise on a desktop machine. In this instance, the operative is using two machines in total but not utilising either to full potential. To compound the inefficiency the deskpace left vacated when the user is out on site could be considered “dead” and, more often than not, it would be typical for their desktop to contain proprietary FM software in stand-alone form. The combination of a wireless Web-based solution in this instance should improve efficiency of this process. And remove the inherent risks associated with stand-alone systems.

The utilisation of wireless connections will reduce contention issues where previously workers would not be working with the latest version of any file or piece of information until they physically synchronised, during which period another employee may have made a change. However the stark benefit of using mobile devices that update instantly over a WLAN is the elimination of double-entry data submission which is all too commonplace in FM currently.

A summary of the benefits of utilising a mobile solution include:

- Improved employee productivity by the reduction of double-entry data submission.
- “Real time” data synchronisation.
- Better access to reference material at the point of performance and therefore aiding decision making.
- Provide access to corporate applications, e-mail and intranet.

- Aiding compliance with government, environmental, and health & safety regulations by improved quality control of data inputting.
- Accountability of and control over strategic assets and materials.
- Higher return on FM system and technical hardware investment.

5. Barriers to Adoption

5.1 “Perceived” cost

From initial investigation it appears that the majority of facility managers are reluctant to deploy wireless technologies for FM purposes. The major obstacle identified by the Centre for Facilities Management (CFM) at Salford University is that of cost. Companies too often look at IT investment in terms of how it will generate income and with the nature of FM it is seen as a cost centre rather than a revenue generator. The ROI is far harder to quantify accurately when analysing savings in terms of time saved by integrating IT solutions into FM processes.

To facilitate the core business many companies are considering, and a number have implemented, wireless connectivity solutions for their employees. The management of facilities can be viewed as more a cost centre as opposed to revenue generating, but it is essential to the working of a business nonetheless. Provision for wireless solutions solely for the management of facilities might be difficult to sanction in many companies, whether this is due to tight budgets for new technology provision, decision on IT spend taken outside FM departments or due to a lack of knowledge in the subject. Typically it will be a combination of these factors. Therefore, in many instances it may be applicable for facility managers to identify areas of their work where wireless can play a part and then ‘piggy-back’ on the technology being used by core business. This piggy-back effect would significantly reduce the implementation cost that would be associated with a solely FM specific system, essentially “stealing” relatively small amounts of bandwidth for O&M and facilities tasks.

5.2 Security

The perceived lack of security of transmitting data over WLANs is almost always cited as the primary concern when considering implementation. It could be argued that to address the needs of facilities operatives the data being transferred would not hold the same allure as say that of company accounts or personal details of customers. Roaming hackers would less likely be interested in report data pertaining to the inability of a WC being able to flush than they would other sorts of data from other areas of the business, it could be argued. More developed variants of 802.11 such as 54a have improved security over that of 11b and 54g.

5.3 Loss of signal strength

IEEE 802.11b, speed decreases the further one moves from the access point. For example, when you are close to the access point, full 11 Mbits/s data rates should be achievable on the device. Move further away, and depending on environment, the data rate will drop to 5.5 Mbits/s. Move even further, and the data rate will drop to 2 Mbits/s, and finally to 1 Mbits/s. But getting just 1 Mbits/s throughput could be considered an acceptable performance level. 1 Mbits/s is faster than most ADSL and cable connections, typically 512 kbits/s, which means it is still a satisfactory high-speed transmission if you're sending and receiving e-mail, browsing the Internet or performing data entry tasks from a mobile device.

5.4 Interoperability

Concerns have been raised regarding the actual interoperability of different manufacturer’s devices within the recently ratified 802.11g standard. In theory, the most common 11b products should work with the newer, and faster, 54g products making it backwards compatible. Something the 54a version lacks.

However, it appears that hardware manufacturers of 802.11g devices have offered features outside of the standard and this has led to reports of incompatibility between 11b and 54g products.

5. Conclusions

Early adopters of wireless technology in facilities management should be aware of the licensing restrictions of some of the protocols; in particular the higher speed 802.11a where up until February 2003 needed licenses to operate in the UK and was restricted to indoor use only. Since February the UK Government has offered to relax the regulations regarding 54a to encourage operators to deliver new broadband services.

At present the 802.11b standard is the most popular and best represented product-wise in the market at the moment, and is the standard used by Intel® in their recently released Centrino™ range. Home consumers have readily taken to the good value that the products represent whereas businesses are still sceptical of the WEP based security. With increased transmission speeds, and the possible compatibility with 11b, the 54g standard is rapidly gaining acceptance in the wireless marketplace and should topple 11b's position. Strategists suggest that 802.11g will be largely an enterprise play over the next several years, due to battery and cost constraints. 802.11b will remain the standard of choice in the notebook PC segment until at least 2005 (Mawston *et al*, 2003).

Web-based applications supported by WLAN driven devices offers exciting opportunities for the management of facilities. Elimination of double-entry data submission can be achieved through a change in working processes and this will undoubtedly realise tangible reductions of non-productive time of mobile operatives. Quality of data, both which is drawn at the point of performance as reference material, and that which is fed back into FM systems will improve as a result of the removal of the extra layer of administration that the current method of paper and clipboard offers. Cost of implementation need not be a limiting factor in the implementation of WLANs. Many mobile devices currently being used by mobile operatives can, with relatively cheap medication and upgrades, be wireless-enabled to utilise the recognised benefits of WLAN technology. "Piggy-backing" on existing office WLANs can reduce these costs further.

6. References

- Burgess, B. (2002). Research of UK market —the third edition of the UK Facilities Management Market Audit report, published by the Workplacelaw Network in association with Masons solicitors.
- Fogg, I. *et al* (2003) Home Wi-Fi: Immediate Wireless Home Network Opportunities, *Jupiter Research*, September 2003.
- Intel Centrino, <http://www.intel.com/products/mobiletechnology/>
- Keane, I. (2002). The ABCs of 802.11 standards, ZDNet Tech Update, Published March 2002
- Mawston, N., Ambrosio, C., and Kerr, D. (2003). Wireless Connectivity Options Beyond Cellular: WLAN & Notebook PCs. *Strategy Analytics Industry Report*, July 2003.
- McAndrew, S. T., Anumba, C. J., and Hassan, T. M. (2003). Overview of Application Service Providers for the UK AEC Industry. *World IT in Construction Conference* (Accepted submission), 18-21 February 2004, Langkawi, Malaysia.
- MRO Software Inc. (2002). Mobilize Your Enterprise. *MAXIMO Mobile Suite White Paper*, December 2002.
- Redman, P. (2003). How to Understand the Benefits of Mobility, *Gartner Monthly Research Review*, October 2003.
- Seddon, C., McMillan, F., Fell, J. (2001), E-business: On-line Project Collaboration. Masons Solicitors Presentation from the Conference 'E-Business in the global construction industry'.
- Shelton, C. (2003). Get Enabled. *Premises and Facilities Management Journal*, September 2003, pp 69-71.