Information Sheet on

Wireless Wide Area Networks (WWAN) Technologies

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What is a Wide Area Network (WAN)?

Wide area networking (WAN) is about linking networks to allow wider file sharing or connectivity. Within organisations, this refers to linking multiple internal sites (typically geographically distributed), whilst, externally, the most common use is to allow connection to the Internet via an internet service provider (ISP).

Why Wireless?

As technologies, wireless solutions both complement and compete with traditional cabled solutions. There are some situations where wireless is the only choice, some where it is the most cost effective, others where it is the most convenient, and further cases where it is inappropriate. The following issues need to be considered when planning for a wireless network:

Connectivity models

Wireless connectivity can be installed based on one of two models: where the receiver is fixed in position, or where the receiver is mobile. Within these models there are different solutions and options that can be applied. Wireless WAN connections use radio connection to deliver data, and through technical variations, deliver at different speeds, ranges and frequencies. Some solutions will require licensing, while others do not. In the UK, radio frequency allocation and licensing is administered by the Radiocommunications Agency (RA).

Fixed wireless

Fixed wireless links involve fixed antennae that use different parts of the radio spectrum to deliver data services. Equipment of this nature requires actual or *near* 'line-of-sight' and can operate, at ranges of about 50 km in the 2.4 GHz frequency band. Depending on the required data rate, the higher bandwidth required, the shorter range is possible. Equipment operating on different frequency bands may offer different bandwidth and range combinations. The range can also be affected by the choice of antenna, as this can be optimised for 'spread' to cover a wide area or 'distance' to cover a longer range.

Equipment itself will work in either *point to point* or *point to multi-point*. In point to point solutions, the wireless link is only between two locations, whereas in point to multi-point, the point can handle wireless links that are incoming from different locations and then concentrate the connections together for onward connectivity.

Mobile wireless

Mobile wireless links can cover different scenarios where the receiving equipment is not fixed in position. In some cases, the receiving unit must still be appropriately configured for its location, but in other cases it can be used in a similar way to a wireless local area network, so that you can move about freely within the coverage area of the system.

The two key solutions are the use of satellite and mobile phone technology. Satellite technology is portable, though it requires an element of configuration at each site to point the dish at the satellite. Satellite wireless links often work downstream only, from the satellite to the receiver, rather than downstream and upstream. In some cases, the upstream connection is achieved with a normal telephone line or mobile phone connection.

Mobile telephony currently suffers from bandwidth problems, and the basic services only offer data speeds of 9.6 kbps. There are enhancements to make the technology acceptable to individual computers but, realistically, only the next generation mobile phone networks will offer enough capacity to be used to connect from one network to another – eg, the Internet.

Planning Issues

When considering a wireless implementation, or any telecommunications solution, planning is very important. Solutions that initially appear cheap or practical may become expensive or problematic after physical and radio surveys have been conducted. It is best to approach situations from a functional rather than technological point of view, set out what you wish to achieve, and then choose the appropriate technology. This is apparent in wireless planning, where important issues such as 'line of sight' should be addressed at an early stage. Rural areas can benefit from wireless solutions as an alternative to long and expensive cable or fibre laying, where no existing cable is present.

Self-implemented solutions

Self-implemented, or 'build and manage your own', fixed wireless solutions, are attractive due to the cost structure. Most implementers of wireless own their own equipment, which has a high initial capital purchase, but ongoing costs are low. Important considerations for this approach include support and maintenance, licensing and equipment lifetime / replacement planning.

Rented solutions

Fixed wireless solutions are being offered on the cabled price model as an alternative to digital subscriber line (DSL), where a monthly charge is paid for a service. The only difference between this wireless solution and traditional cabled solutions is the technology: data is delivered to a wireless receiver rather than to a junction box.

Mobile solutions offer flexibility for location, operating over the network of a telecommunications company, so predictable annual expenditure is common and often supplemented by call or download charges. These solutions can work well in outreach projects, where the IT is taken into the community rather than the community coming to the IT. Mobile phone solutions work without any reconfiguration, and portable satellite equipment can be set up correctly in minutes rather than hours.

Wired solutions are rented from a telecommunications company, which owns the cable, the equipment and provides a service with support. This brings consistent and predictable, but often expensive, annual costs.

Capacity Issues

Most fixed wireless connectivity options, like some cabled solutions such as DSL, suffer reduction in capacity as range increases. The ability of specified solutions to meet functional requirements is another strong reason to conduct a survey at an early stage. Bandwidth over fixed wireless solutions is usually the same for upload and download.

Mobile services can vary. Mobile phone based solutions work in a similar way to fixed solutions, as they effectively create circuits of guaranteed capacity.

Satellite based services are often provided as *download only*, which means that to receive data the dish is used, but to send data or requests to the network an alternative has to be found. One solution is to use a standard modem over a telephone line for the upstream. Whilst this is slower, it can be effective as the majority of web usage does involve more downstream than upstream traffic. Upstream, via satellite uplink, is possible but often requires a larger dish and is an expensive service.

Wireless technologies do operate with some kind of overhead, for example on a point-to-point link at 2.4 GHz operating at a theoretical 11 Mbps, the expected ethernet equivalent throughput is likely to be about 8.5 Mbps.

Radio Spectrum Issues

All wireless solutions operate by sending signals in a specific frequency band, known as the spectrum. In the UK, the Radiocommunications Agency regulates the use of spectrum and ensures that available resources are used appropriately. A given product operates on a particular spectrum, but technologies are often similar: for example, you could have fixed wireless access using both the 2.4 GHz band and the 5 GHz band.

Frequency bands are regulated in different ways; some are open for public use without licence, others require a licence, or whole bands are granted on a time-limited exclusive basis. In some cases, use of unlicensed spectrum must still be licensed, depending on the nature of the service.

The use of unlicensed spectrum can become difficult if too many people are using the same spectrum at the same time: there can be congestion, and all users suffer reduced services. Additionally, there is concern about the new Bluetooth systems, which could disrupt signals in the 2.4 GHz band it uses.

These issues are relevant to fixed wireless solutions, as mobile connectivity works within a defined spectrum that is managed by the telecommunications provider.

Safety Issues

The majority of investigation into the safety of wireless communications has been looking at mobile phone use. Results from the research have been inconclusive due primarily to lack of evidence. (See the UK research, The Stewart Report, by the Independent Expert Group on Mobile Phones: [http://www.iegmp.org.uk/index.html].)

Whilst there are some similarities between the technologies used in mobile phones and wireless networking on this scale, the key difference is in the power output, wireless networking devices output significantly less power than mobile phone handsets and transmitters.

Some vendors provide guidelines on use of equipment to minimise any potential risk, and research in these areas is ongoing.

Current Government guidelines on exposure are maintained by the National Radiological Protection Board: [http://www.nrpb.gov.uk/].

Conclusions

Wireless networking is a developing technology that does have a place in the education market with the flexibility and financial models it supports, though the importance of good planning and surveying before implementation cannot be over-emphasised.

As with many technologies, it is best seen as part of a complete solution rather than a standalone approach.

Other Sources of Information

Becta publications
Becta Expert Technology Seminar on Wireless Networking for Education
http://www.becta.org.uk/technology/techseminars/250101/index.html

Locally Managed Internet Connections Information Sheet
Becta June 2000. Free
http://www.becta.org.uk/technology/infosheets/pdf/lmic.pdf
Gives an introduction to connecting a group of computers to the Internet via a locally managed connection. Different options for implementation and an outline of the circumstances in which each option would be suitable/unsuitable are given.

Internet

- **Fixed Wireless**

Equipment Suppliers
Cisco Wireless: http://www.cisco.com/warp/public/44/jump/wireless.shtml
Lucent Wireless: http://www.lucent.com/pss/prodover/01b_gs.html
Breezecom: http://www.breezecom.com/HomePage.asp

Wireless Service Providers
Tele2: http://www.tele2.co.uk

- **Mobile Wireless**

Satellite Systems
Eutelsat: http://www.eutelsat.org/
Bentley Walker: http://www.bentleywalker.com

Mobile Phone based connections
Orange HSCSD: http://www.orange.co.uk/business/about/future/hscsd.html
Nokia Card Phone 2: http://www.nokia.com/phones/cardphone2_0/index.html
3G/UMTS: http://www.umts-forum.org/

- **Safety Issues**

CyberCityCommunincations: http://www.cybercityco.com/

- **Spectrum Management**

Radiocommunications Agency: http://www.radio.gov.uk/

- **Practical Wireless Implementations**

Cleo (supported by Lancaster EdNet): http://www.ednet.lancs.ac.uk/

This sheet can be accessed on the Internet:
- In summary at: *http://www.becta.org.uk/technology/infosheets/html/wan.html*
- In full as a pdf file at: *http://www.becta.org.uk/technology/infosheeets/pdf/wan.pdf*