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In-building

The genie and the magic

As Ofcom stages its first auction, for a block of GSM spectrum, Richard Lambley roams on to a private, in-building mobile phone system to find how such spectrum might be exploited

Below: Dr Simon Saunders, chief technical officer of Red-M. The company has deployed more than 300 in-building wireless systems, some of them at high-profile locations such as London's Canary Wharf and the Millennium Stadium in Cardiff



Dr Simon Saunders invites me to take my mobile phone out of my pocket. To my surprise, I find that the display is showing not the name of my usual mobile phone network but 'Red-M'.

We're sitting in a meeting room at the Sussex technical centre of Red-M, a company which specializes in indoor wireless networks – and my phone (no doubt because of weak coverage outside) has roamed on to Red-M's private, in-house GSM system. It's an example of what could soon become a common occurrence on company premises and in private buildings all over the UK, following Ofcom's auction at the end of last month of a small block of radio spectrum in the 1800 MHz GSM range.

At the time of writing, the winners have yet to be announced. But Red-M, which has been working on in-building wireless technology for more than ten years, is already excited. "It's great to see Ofcom actually turning to action", Dr Saunders declares. "This is the first of their spectrum awards under the new regime. It means they are serious about applying market mechanisms to radio spectrum.

"It won't be as good a spectator sport as the 3G auctions were – it's a single round, closed-bid auction. But they've put a lot of thought into it. Now what will actually happen is anybody's guess."

Red-M's activities span technologies from PMR and Wi-Fi to 2G and 3G, and the company has been involved in deploying more than 300 in-building projects, developing along the way its own portfolio of tools and techniques. "Most of our activity early on in in-building wireless was for cellular operators in very high-end locations like airports and shopping centres, and particularly corporate environments", continues Dr Saunders. "It's always been a challenge for those operators to produce an appropriate business case for anything other than the biggest buildings. But what's been happening most recently



Roaming to Red-M: the company has accepted this handset as a guest user of its in-house GSM network

is through technologies, through different sorts of infrastructure and increasingly different sorts of operators, that the business case is starting to be much more sensible."

The Ofcom auction, he believes, will give this process a further push. "It promises well", he says. "It illustrates that not all roads lead to Wi-Fi today – there are other technologies to be considered. Wi-Fi has had the great impact. It has let the wireless genie out of the bottle. But that doesn't mean it's the wireless technology for all purposes."

Red-M's in-building GSM system is an illustration of where that genie might lead. "The network is there as a demo and a trial network", Dr Saunders explains. "We've been learning a lot from it over the past period of time and it's very exciting to be potentially just weeks away from as many as 12 new operators."

Low-cost communication

My GSM handset, it turns out, has been silently 'auto-provisioned' on to the network while we've been talking. I've received a welcoming SMS message assigning me a four-digit telephone number, and now I'm enabled for outgoing and incoming calls. All this, of course, is under the control of the network operator – in this case, Red-M itself.

"The network that has just done that is a remarkably low-cost network", says Dr Saunders. "In fact, it cost us less to dimension and build that than it did for the Wi-Fi portion of the network, to provide reasonably equivalent levels of coverage."

The radio unit supplying the GSM service is a compact Base Transceiver Station (BTS) from ip.access, a prominent supplier in this field; but with interest in in-building systems growing, more and more vendors are announcing small base station products, from start-ups to big names such as Lucent and Motorola.

"There had been a perception that Wi-Fi would always be a cheaper way of doing this, because people are used to access point economics", Dr Saunders continues. "But actually there is no reason why a GSM network can't be extraordinarily simple. We have a

simple Linux-based server sitting in an equipment rack downstairs. We've got base stations and a distribution system around that with a complete MSC, BSC and BTS functionality for less than a new PBX would have cost us."

The number of antenna points needed depends on the layout of the building. In Red-M's case, the building is a rambling old manor house with a modern open-plan extension. "Overall we can cover this building to a very good degree with GSM – at the power levels that Ofcom have specified for low-power GSM – with just two antennas", Dr Saunders says. But this does not necessarily mean two base stations, unless they are needed to meet the traffic load, he points out: a single base station fed through a distributed antenna system might be enough. For comparison, the building's Wi-Fi system has no fewer than 12 access points. "You could certainly do with that with less", he adds. "We've got a fairly high-stress network which we've engineered so that you can put it through its paces, so I wouldn't necessarily use that as a standard ratio – but it does show that you can get a lot of coverage within a building from just the 23 dBm that Ofcom have specified."

On the GSM side, it might seem that the new spectrum offered by Ofcom is too little to support a worthwhile service. "Given 12 operators and only 15 channels, that sounds as though it shouldn't fit", he continues. "But it is restricted in power – that's first and foremost the issue – so it's ideal for an in-building environment." And he adds: "The magic of cellular is that you can reuse. If you used all of those 15 channels at reasonable traffic levels, you could serve about 2200 users without reuse. But then once you start to reuse, it's difficult to imagine a user density that couldn't in principle be served with those carriers, if properly managed and deployed."

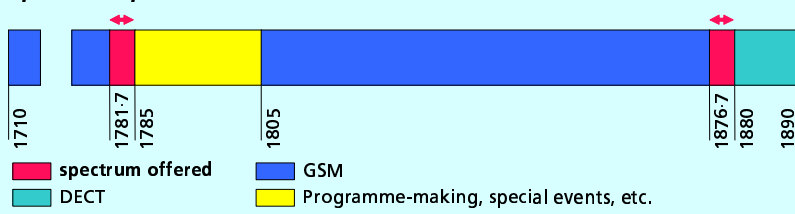
It's the management of the radio environment, then, that largely determines the success of a system – especially an intensively-used system in a busy office building or public space. Red-M is applying this principle on a large scale through a concept it calls Total Airspace Management – a process of forming a wireless strategy and policies informed by audits and technical understanding. One customer using this service is the airport operator BAA, for which Red-M provides radio strategy support at seven UK airports across the range from 9 kHz to 105 GHz.

Wi-Fi – the surprising facts

"With Wi-Fi, we find that people sometimes assume that a licence-exempt piece of spectrum is spectrum that doesn't need management", says Dr Saunders. "We explain that Ofcom say that they won't manage it. *Caveat emptor!* That is sometimes quite a surprise for people who are increasingly running applications which are genuinely business-critical.

"We feel we are at the second phase of Wi-Fi now: we've gone from tactical deployment and experimentation into people recognizing the potential and actually using Wi-Fi as a business-critical application for shelf-stacking, for public access or for voice, and it's a different level of quality of service and resilience that is needed at that point."

Spectrum up for auction: 1781-7–1785.0 and 1876.7–1880.0 MHz



In Ofcom's auction, which closed for bids late last month, spectrum sufficient for just 15 GSM carriers was on offer – far less than a major operator would regard as enough for a wide-area network. Yet Ofcom's plan was to shoehorn as many as 12 licensees into this space. Dr Saunders sees this as an illustration of how market mechanisms can squeeze more from the spectrum. "Now what will actually happen is anybody's guess", he says. "What is certainly interesting is that there is a wide mixture in terms of those expressing an interest in bidding, from very large well-known operators through to tiny start-ups who have got some niche application – which is exactly what you'd hope for"



And now it's GSM's turn – yet Dr Saunders finds there is still no industry-standard process for designing indoor GSM systems. "Macrocellular design became standardized quite a long time ago", he says. "A radio planner could go from a UK operator to an Egyptian operator and, apart from some small differences in the particular design tools, they are doing basically the same thing. They are very transposable." Yet in-building design techniques range from the highly academic to the 'magic finger' approach, where an engineer wanders through the building and chooses sites by instinct. "It's good to have expertise in the process", Dr Saunders observes. "But if you ask ten different engineers to come up with a solution, you'll get ten different answers, costing ten different amounts of money and delivering ten different amounts of service. And that suggests some inefficiencies in the process.

"With in-building particularly, we find that if we don't specify access point and antenna locations to within about 50 cm and make sure that they are deployed in those locations, then the performance can change significantly and it can make the difference between meeting the performance criteria and missing them. It's application-dependent, but we see real examples of that happening."

Should you hang back?

However, GSM is not the end of the matter, and Dr Saunders finds that newer technologies and what he calls the alphabet soup of wireless acronyms can be a source of real anxiety and

confusion among end users – causing them to reach for the brake pedal as they wait to see which ones will win. "We find ourselves breaking it gently to them that that probably won't happen for the foreseeable future", he says. "It isn't a case of WiMAX versus Wi-Fi versus 3G – it's a combination of those, for a whole bunch of reasons of operators and spectrum and software-defined radio and so forth. So what we're trying to help them understand is which of these suit their applications and their businesses – and preferably to find ways in which they can hedge their bets across the technologies.

"Whichever wireless technology you are using, whichever applications, if you apply this airspace management concept, then your airspace becomes a business asset. And if it's not managed, it's a business risk." □

Essential in-building coverage

Property owners and managers are fast recognizing that indoor radio coverage systems have progressed from being an optional add-on to a service that is as essential a part of the building as the computer network or the electricity supply.

"There is a lot already happening", says Dr Simon Saunders, of Red-M. "Even in environments where they say they have no-wireless policy, we generally point out through surveys and talking to them that that's actually not the case.

"It is increasingly not a case of *if* people are deploying applications over wireless, it's *how* they do it, what their policies are and how they are going to manage against those, how they are going to respond. And we see a real sea change in that in the last 12-18 months.

"Formerly, in the community of building owners, for them the only relevance was that they might be talking to an operator about a site on their rooftop. In the context of the total operations of the building, it was not at all critical. But now they've got tenants whose businesses depend totally on Wi-Fi."