AWS auctions spawn spectrum shuffle

As the FCC re-allocates microwave backhaul spectrum for 3G advanced wireless services, incumbent carriers needing to relocate will seek out flexible backhaul solutions that can be deployed quickly.

The 2006 auction of advanced wireless services (AWS) spectrum has generated great enthusiasm on the part of commercial mobile phone carriers hoping to deploy third-generation (3G) services. To AWS licensees, the new 1700 and 2100-MHz spectrum represents the additional capacity that is so desperately needed for high-speed wireless data services. However, for those incumbents already using this spectrum for microwave backhaul applications, tough decisions lie ahead.

The spectrum auctioned by the federal communications commission (FCC) comprises the 1710 to 1755-MHz band, currently utilized by federal government organizations, and the 2110 to 2150-MHz band, allocated to non-government organizations such as rail companies, state governments and several commercial carriers. Despite these applications, it is likely that the new AWS licensees will want to utilize the spectrum right away, particularly in key markets. This means incumbents will need to find new backhaul routes – and quickly – in order to vacate the spectrum without disrupting existing services.

It is even anticipated that transitional frequency sharing will be considered by new AWS licensees desperate to utilize the spectrum. Such a scenario will only be approved on a case-by-case basis after detailed interference analysis to ensure no adverse effect on existing services; yet the very fact there will be so much riding on the deployment of new services is bound to put pressure on the incumbents. Whatever the scenario, it is certain that speed of deployment will be a key factor in the choice of new backhaul mechanism.

Backhaul case-by-case

This might all seem like hard luck for the incumbents. However, the cost of the relocation will be borne by the new AWS licensees, and with change can come opportunity. The ability to reassess backhaul options and upgrade to new digital systems should compensate for much of the inconvenience.

Incumbents have a number of backhaul relocation options: lease of existing T1 lines, deployment of fiber networks, utilization of existing microwave backhaul systems in neighboring bands, or relocation of wireless backhaul services to different bands. It will most likely come down to each and all of these options being considered case-by-case. Each link will be assessed in terms of geography, interference, available infrastructure and available capacity.

In the first instance, T1 lines may seem a convenient option because they already exist – especially in major cities – and therefore come unhindered by major capital expenditure. However, there is significant and ongoing operational expenditure in the form of leasing. In fact, taking into account the leasing cost and accompanying interest rates, utilizing T1 infrastructure can be arguably the most expensive backhaul system option in the long term.

Incumbents should also be mindful that T1 networks in rural areas may not be so readily available and quality of service (QoS) may not be so reliable. Remoteness may engender poor response times when maintenance and servicing is required. As a 'tenant', carriers have no

control over the network they are using. Worse, T1 providers may be carriers themselves, meaning that 'tenants' are pumping money directly into the pockets of their competition.

Fiber networks similarly have their own 'pros' and 'cons'. On the plus side, they have very high capacity and costs are diminishing. However, cost is directly proportional to distance and can become prohibitive for long links. Also on the negative side, fiber is difficult to lay across rugged terrain. Moreover, if fibers are broken – which can happen due to natural disasters – it can be some time before services can be restored, especially in more remote locales.

Flexible microwave

Of the options available, microwave radio links remain the most flexible. They can cover great distances without incurring extra cost, can be deployed quickly, and offer payback periods of as little as two years. Offering superior reliability, microwave links are also relatively easy to restore in the event of misalignment due to natural disasters. Furthermore, with microwave backhaul, users have total control of the system.

The frequency bands specified by the FCC for microwave backhaul relocation are illustrated in Figure 1. Federal government incumbents currently using the 1710 to 1755-MHz band can opt to use existing systems in the 1750 to 1850-MHz band, or deploy new systems in the 4 or 7-GHz bands. Similarly, non-government incumbents (2110 to 2150-MHz) can use existing 2450 to 2483-MHz systems, or relocate to the 6, 10, 11 or 18-GHz bands.

Decisions regarding band selection for radio link networks will again be made on a case-by-case basis, taking into account geography and distance to be covered, available infrastructure, interference issues and capacity.

The most expedient radio link solution could, at first glance, appear to be the reuse of existing microwave antenna systems in neighboring bands: 1750 to 1850-MHz for government applications, or 2450 to 2483-MHz for non-government. Yet such a solution would be makeshift at best, since significant modifications to the antenna system would be required to support the new frequencies and provide optimum performance. Moreover, many existing networks comprise aging, analog equipment with limited capacity. In any case, the 2450 to 2483-MHz band is capacity rated to 8DS1 (around 12 Mbps), a substantial limitation.

Digital opportunity

This is, in fact, a huge opportunity to upgrade to new radio link systems utilizing digital microwave technology, where capacity is generally much less of an issue. Nevertheless, in selecting the appropriate band for deploying a new microwave backhaul network, incumbents still need to work within the constraints of FCC capacity regulations, available spectrum and the laws of physics.

Of the bands allocated for backhaul relocation, those at the lower-frequency end (4, 6 and 7-GHz) would naturally be preferred from the point of view of propagation and rain attenuation. These bands are ideal for longer distances.

The government incumbents, allocated the 4 and 7-GHz bands, should have little difficulty in relocating backhaul systems here (approximately 960 links across the country). Both bands are designated by the FCC as high-capacity; plus, being government bands, there should be plenty of spectrum available.

The 6-GHz band, allocated to non-government entities, is divided into two bands: 5.925 to 6.425 GHz (OC3 high-capacity band) and 6.425 to 6.875 GHz (restricted to medium-capacity DS3). Although the lower half of the band is ideal for long-distance microwave backhaul applications, it is quite congested and interference analyses will be imperative if new networks are to be

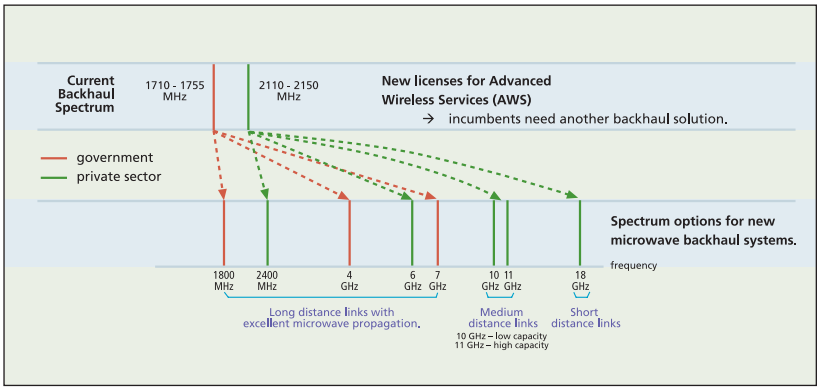

Figure 1 The backhaul relocation scenario caused by the AWS spectrum auctions

added – assuming channels are available. The upper half of the band has a capacity restriction and will only be suited for medium-capacity applications.

This will lead non-government entities, which account for a far larger volume of the backhaul relocation (approximately 5,700 links nationwide), to consider the higher-frequency bands of 10, 11 and 18 GHz.

The 10 and 11-GHz bands both provide a good compromise between rain attenuation, propagation and radio link network congestion (which is low), making them ideal for medium-distance microwave links (10 to 20 miles). Although the 10-GHz band (10.5 to 10.7 GHz) is low-capacity (5-MHz channels restricted to just 16DS1s), the 11-GHz band (10.7 to 11.7 GHz) is rated as a high-capacity band by the FCC, with 40-MHz channels allowing data transfer at 3DS3s or OC3.

11-GHz breakthrough

Until recently, the stringent FCC part 101 Category A requirements for radiation pattern control provided added challenge for adoption of the 10 and 11-GHz bands, leading to their under-utilization. Many carriers, who haven't necessarily required the gain of a four-foot antenna, have been obligated to install one to meet the required radiation patterns (which are easier to achieve with a larger antenna). This has meant added cost and overly complicated site negotiations and permit applications for the larger-than necessary antenna.

Breakthrough antenna designs, however, have yielded three-foot diameter antennas that meet the FCC part 101 Category A requirements. This will facilitate adoption of the high-capacity 11-GHz band in particular. In addition to the positive cost impact, smaller antenna diameters lead to lighter tower loading and streamlined site negotiations.

The final band available for backhaul is the medium-capacity 18-GHz band (17.7 to 19.7 GHz), which is suitable for short and medium links (around 10 miles and under), due to adverse rain impact and overall lower propagation characteristics. Nevertheless, in applications where short distances are practical, this will be a viable option for backhaul relocation.

It is evident that there are a great many options open to those incumbents in the newly allocated AWS bands who will need to relocate backhaul services – whether they choose to stick with the flexibility and performance of microwave radio link networks, or adopt alternative solutions. As with other recent spectrum 'shuffles', each case will be heavily arbitrated.

	Pro	Con
T1 Lines	• Already exist resulting in low CAPEX	• On-going leasing costs are high resulting in high OPEX • Limited in rural areas • Owners have no control over backhaul network
Microwave backhaul	• Cover great distances at no extra cost • Easy to restore after natural disasters • Easy maintenance • Owners have total control over the network	• Spectrum availability is limited • Upfront CAPEX is required • Resistance to new tower infrastructure
Fiber optic backbone	• High capacity	• Cost proportional to distance • Difficult to lay over rugged terrain • Fiber cuts difficult to repair

Incumbents have a number of backhaul relocation options, each with separate 'pros' and 'cons': lease of existing T1 lines, deployment of fiber networks, or microwave radio link networks.

A number of things are certain. Relocation must be achieved with 'near-zero' downtime to incumbent networks, or serious consequences will ensue. Similarly, the replacement backhaul network must operate with the same or better QoS, and the decision regarding backhaul system will be mutually agreed upon by all parties. Despite the initial flurry of activity on the part of new licensees, the reality is that incumbents are expected to have up to three years to relocate.

Clearly there is no single solution and it will be critical for all parties to make informed decisions that encompass both short-term contingencies and long-term strategies. Obtaining expert advice from trusted sources will be essential. The critical issue of fast deployment is likely to favor the adoption of microwave networks, and – although incumbents of the 1700 and 2100-MHz bands are still confronted by a lot of unknowns – these microwave radio link network solutions are ready and available.

RFS microwave backhaul solutions

Radio Frequency Systems designs and delivers complete microwave backhaul solutions for all popular microwave radio bands. These encompass all components of the RF chain from the output of the radio – including elliptical waveguide and accessories, dehydration systems, and a suite of microwave antennas.

RFS's advanced antenna range incorporates multiple antenna sizes, polarizations and four different performance classes: 'standard', 'improved', 'high' and 'ultra-high' performance. In addition, the RFS CompactLine and SlimLine antenna suites provide cost-effective and low-profile solutions that are easy and quick to install while maintaining excellent electrical performance.

RFS offers unsurpassed RF pattern control, meeting all – and exceeding most--global pattern envelope standards. The company is a pioneer in the development of small-diameter antennas that meet the demanding FCC part 101 Category A requirements for various frequency bands, including the 10 and 11-GHz bands.

With complete microwave systems designed and manufactured in Meriden, Connecticut, RFS is committed to fast turnaround on delivery and also offers site installation and training services.

Company background

Radio Frequency Systems is a global designer and manufacturer of cable and antenna systems plus active and passive RF conditioning modules, providing total-package solutions for wireless infrastructure.

RFS serves OEMs, distributors, system integrators, carriers and installers in the broadcast, wireless communications, personal communications service (PCS), land-mobile and microwave market sectors. Its Americas headquarters and manufacturing base is located in Meriden, CT. Backed by a comprehensive 'coast-to-coast' network of sales offices and authorized distributors, RFS is one of North America's most comprehensive wireless technology solutions groups.

As an ISO compliant organization with manufacturing and customer service facilities that span the globe, RFS offers cutting-edge engineering capabilities, superior field support and innovative product design. RFS is a global leader in wireless infrastructure.

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