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Wireless Spectrum Update

By: Mel Lambert

The spectrum incentive auction will dramatically change the 600MHz RF landscape for wireless systems

As the Federal Communications Commission continues to repurpose critical sections of the RF spectrum currently being used by wireless microphones, IEMs, and intercoms, in addition to the UHF TV band, it is becoming obvious that the live entertainment, news, and production communities are in for a dramatic roller-coaster ride during the next several years. Following its auction in 2008 to close out access to the 700MHz band (698MHz — 806MHz)—and hence continuing the congressionally mandated goal of transferring spectrum to mobile services—in early August, the FCC issued further details of the 600MHz band auction, and new rules to address the long-term needs of wireless microphones, as well as expanded access to other RF bands.

Acknowledging that wireless systems continue to play an important role within theatres and music venues, film studios, conventions, corporate events, houses of worship, and other locations, the FCC's recent Report and Orders FCC 15-68, 15-99, and 15-100 prepares the way for late March 2016's planned Spectrum Incentive Auction of the 600MHz spectrum to mobile broadband carriers, and a timetable for the scheduled four-year exit for licensed and unlicensed users of that spectrum space. The FCC's ruling provides additional opportunities for licensed use within remaining TV bands by green-lighting extended use of the high-band VHF channels and co-channel operations under tight limitations, in addition to use by licensed users of a 4MHz portion of the 11MHz duplex gap, new opportunities for licensed wireless mics within the 900MHz band, limited use of sections of the 1.435MHz — 1.525MHz, and sections of the 6.875MHz — 7.125MHz spectrum.

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Lectrosonics' Venue 2 receiver, with iQ filtering, and several wide-tuning transmitters.

Unlike conventional auctions, the FCC's process involves two sequential stages. During the reverse incentive auction, the FCC will determine which broadcasters are willing to relinquish their assigned TV channels, share the channels with other stations, or move to lower channels, and at what price; this process is expected to take several weeks. The forward auction will be a traditional auction that will place the reclaimed spectrum in each market up for sale to the highest bidder. If the former remains below a threshold price set by the FCC's formula, the sale will be complete, with the United States Treasury pocketing the difference; this process also is expected to take a minimum of several weeks, after which the FCC will determine how to repack the spectrum space. In essence, the auction will let a TV broadcaster relinquish or share a current spectrum license on a voluntary basis, in

exchange for a share in the money generated by the auction, which is predicted to cost around $226 million to implement. (Like the 700MHz auction, no financial compensation will be available to replace existing wireless microphone inventory.)

Following the 600MHz auction and repacking process, TV operators electing to stay on the air but currently operating in spectrum to be repurposed will be moved to different TV channels. Some space has also been set aside in the 600MHz band for wireless mics, IEMs, and intercoms in the resulting guard bands, which will be shared with White Space devices and the duplex gap. After the completion of the auction and publication of the FCC's public notice documenting the new spectrum band plans, the repacking and reallocation process is expected to take up to 39 months to complete. If the clock starts in the winter of 2016, current RF users within that spectrum will have until early 2020 to cease using such wireless mics, IEMs, and intercoms, and sooner if the new spectrum owners are up and running with new broadband services. (It should be stated that doubts remain that the planned auction will succeed, with the TV spectrum remaining unchanged for several years or the process being later re-activated.)

If the process runs as expected, the 600MHz landscape after repacking will be very different. The FCC plans to allow unlicensed operators—mics and White Space devices—to operate in guard bands, or buffers, that will separate broadband, TV, and other primary

Audio-Technica's System 10 PRO digital wireless system operates in the 2.4GHz range with a choice of receiver units that operate locally or mounted remotely up to 300' away.

services from each other. These allocations may vary by market and from city to city, and may be subject to interference from out-of-band emissions from the primary services. Likewise, mic operation will be allowed in the duplex gap separating the broadband up/downlink blocks. A 4MHz portion of the duplex gap will be reserved for Part 74 licensed microphone use, with the upper 6MHz of the duplex gap being allocated to unlicensed mics and White Space devices. (Incidentally, the FCC's earlier Report and Order FCC 14-62 stated that "new LPAS licenses [indicating

Low Power Auxiliary Stations, a definition that includes wireless mics, IEMs, and intercoms with a range of around 300'] granted between now and [the end of the spectrum reallocation], including licenses granted to newly eligible licensees, [will] cease operating in the repurposed spectrum no later than that date." Following the post-auction process, such Part 74 licensees will be able to operate only within the remaining bands allocated for TV broadcasting.)

Lectrosonics' IFB system is now available in VHF frequencies.

A crowded RF spectrum

In terms of practical implications, if all goes according to plan, four years from now there will be far less spectrum available for wireless users in both the 500MHz and 600MHz bands. "We need around 200 channels for such events as the Grammy Awards held at the Staples Center," says David Bellamy, of Soundtronics Wireless, the firm that provides RF coordination and system rentals for a number of entertainment events, including the Academy Awards, Emmy Awards, American Music Awards, and BET Awards. "I feel pretty good about the future; we are always adaptable.

"We will need to wait to see what's left [after the auction and repacking process] but we are already looking at the spectrum above 2GHz," advises Bellamy. "And while antenna requirements and coverage will be different for these frequencies, due to reduced propagation compared to the 600MHz range, we can put into place an additional number of our Phoenix antenna arrays, which, within reason, can offer the type of coverage we currently enjoy. For example, during this year's Emmys [at the Microsoft Center in downtown Los Angeles] we deployed a Phoenix 8 antenna system that is capable of eight diversity zones, 16 antenna arrays in all. We only need to use five zones to cover the venue. If we were working at 5GHz, we would need to use all eight zones to give us comparable coverage across the stage, floor, and house. We'll also need to wait and see what manufacturers can offer us in terms of more elaborate hardware" to operate in bands other than 600MHz.

"We have been working in the 900MHz range for some 10 years," Bellamy continues, "and have developed some proprietary solutions for that spectrum. High-band VHF is also attractive, but pretty crowded, dependent upon which city you're working in; everybody seems to be gravitating there! While it's probably

AKG's DMS800 reference digital wireless microphone.

not suitable for wireless mics, because of the higher noise floor, the high-band VHF range is probably safe for PL, IEM, and IFB links. We will likely stay in 900MHz range for our artists' microphones."

As T. Richard Fitzgerald, theatrical sound designer and CEO of New York-based Sound Associates, points out: "We need, on average, around 100 microphones per theatre on Broadway, which, with 10 major venues, means we are using 1,000 channels each day. With careful RF coordination, we're able to share the current spectrum space. But if we lose 600MHz—as happened when 700MHz was closed down—we'll be pushed for bandwidth. But new technologies will come along [from wireless manufacturers] to pack more frequencies into each RF block. Now we can live in TV channels and they don't know we are there; who is going to see our 50mW transmitters in somebody's pocket? After all, we need to keep the power levels low because of adjacent theatres [sharing the same frequencies and to prevent in-band interference].

"It should be no problem, because we have a right to use the frequency band to get the job done," Fitzgerald advises. "Comcast—or whoever else is buying the 600MHz frequencies from the TV broadcaster—will have to kick us out!"

"But there's always the chance the FCC auction could be a bust," com-

ments Henry Cohen, senior RF engineer/designer and FCC liaison with CP Communications. “It’s not yet a slam dunk. Insufficient broadcasters may not want to sell off their channels at a feasible price. However, when talking with clients, I’m advising them that it’s fairly certain the majority of the 600MHz band will be gone within four years, leaving much less usable spectrum.

“The good news is that Part 74 users will have access to the duplex gap and additional bands in the 900MHz spectrum immediately, and the 1.4GHz in the near future, both of which will need to be coordinated, and will be shared with other incumbent users. But the bottom line is relatively simple: We have new opportunities but currently lack equipment to use the space—unlike the cell phone industry, we do not have the economy of scale to develop suitable chipsets quickly and cheaply. What the manufacturers will offer us depends on their return on investment. Part 74 users are looking for high-quality RF systems and will pay more per channel, but the systems will sell in fewer numbers; unlicensed Part 15 users, on the other hand, use systems that sell in great numbers at lower prices, and hence have a better economy of scale from the OEM’s perspective.”

Shure’s ULX-D Digital Wireless System operates in the unlicensed 900MHz — 928MHz bands, in addition to Part 74 licensed regions.

New product developments

Following their in-person representations to the FCC during recent years, a

The Sony DWR-R02DN rackmount receiver offers access to 198MHz of frequency range from 470MHz — 710 MHz (depending on region).

number of wireless manufacturers are innovating new systems that will offer alternatives to current hardware that faces imminent obsolescence, or will at least within four years, according to a reasonable assessment of the spectrum reallocation. As Mark Brunner, senior director of global brand management at Shure, states: "The landscape of the TV band will continue to change during the 39-month period following the incentive auction. It is unknown how many channels will be left after the sale and repacking of the TV band, but it seems certain that we will be losing much of the 600MHz spectrum."

In terms of alternates to 600MHz, Brunner states that, while propagation and antenna requirements are different for each frequency band, "We can innovate as necessary. But not all bands are created equal; we face different design challenges depending on the frequencies of the band and its other users. Our current ULX-D systems now operate in the unlicensed 900MHz — 928MHz bands, in addition to Part 74 licensed regions, which means they can be used in regulated and unregulated areas of spectrum. Our GLX-D systems operate in the 2.4GHz unlicensed band."

"At Lectrosonics, we are also looking at high-band VHF from 174MHz — 216MHz," explains Karl Winkler, the firm's vice president of sales. "For example, our new IFB Systems—available by the end of the year—will allow customers using UHF bands for these systems to migrate to high-band VHF, thus relieving some of the pressure on the critical remaining UHF bands. We have also developed wider tuning solutions coupled with iQ tracking filters for dense channel packing, together with the high audio quality of Digital Hybrid Wireless in our new Venue 2 receiver system.

"We are also following developments within the 941MHz — 960MHz range, for which we already have product, including IFB units, Venue multi-channel receivers, and SM Series transmitters, with expanded applicability for Part 74 users. And although the 7GHz spectrum is wide open, it will need totally different technologies, particularly in terms of antenna design. The 2.4GHz band is not as interesting to us because of limited channel count and other problems, including a crowded spectrum; we do not recom-

mend the band's use for critical applications by professional users."

Joe Ciaudelli, Sennheiser USA's director of spectrum affairs, points out that the portion of 470MHz — 698MHz spectrum that will be retained for TV stations versus the amount that will be repurposed for mobile broadband use will not be known until after the auction. "By mid-2016, following the channel re-assignment, we will know the spectrum that will remain available for wireless mic users. With publication of the channel re-assignment, the

Sennheiser EM3732 receivers operate in the 941MHz — 960MHz band.

Order FCC 15-100] opened portions of 941MHz — 960MHz to all Part 74 users. Previously, the more condensed 944MHz — 952MHz range was restricted to mic use only by broadcasters. Our SK5212 MKII and SKM5200 MKII transmitters and EM3732 receivers can operate in that band. The FCC has also outlined permitted use of 1.435MHz — 1.525MHz band with approved coordination with the primary service. This range has been utilized for mics by power users on special temporary licenses for such

Sennheiser SK5212 MKII and SKM5200 MKII transmitters operate in the 941-960 MHz band.

39-month transition period starts. Wireless microphones will have to vacate repurposed spectrum by the end of the transition period. However, they may need to leave sooner in areas where broadband services are initiated before that final deadline."

Looking to the future, Ciaudelli predicts more entities will apply for a Part 74 license. "The FCC wants to make a clearer distinction between licensed Part 74 and unlicensed mic users; a licensed operator has privileges as well as access to additional bands. For example, its recent ruling [Report and

events as The Super Bowl, using custom-built systems."

The challenge for the unlicensed professional

"The FCC basically drew a line defining a licensed operator as a broadcaster or a venue or sound company that routinely uses 50-plus mics," Ciaudelli continues. "There are plenty of other highly professional users, such as non-profit performing arts centers, that do not qualify. The problem is that the FCC is eliminating the path for these unlicensed professionals to apply for interference protection for their productions. These new rulings hit the unlicensed professional the hardest, so we will continue to work with the commission to address such issues. As we have pointed out to the FCC, an unlicensed user does not necessarily imply an unprofessional user; many of them operate professionally, so let's treat them as such. We have suggested that the commission expand its view of the broad universe of microphone operators beyond simply unlicensed and licensed."

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Winkler concurs. "It may be difficult for the FCC to [instigate] that third category," he says, "but we need to relax the 50-microphone category for Part 74 users. It's worth doing, to raise awareness of our industry."

"That proposed Category #3 offers potential for AV companies, smaller sound companies, and smaller theatrical productions," agrees Cohen. "But we may reach a situation when sound designers and operators will have to say no to a client. For events like the

Super Bowl, we can secure an STA [Special Temporary Authority] for unused spectrum space, or maybe use proprietary equipment, but there can come a limit. It's almost certain we will need to say to clients that, in the near future, it might be impossible to provide several hundred channels, simply because we cannot find the spectrum space, and advise them to use wired microphones in more positions.

"In the end, RF spectrum space is a commodity sold to the highest bidder; if you cannot afford to pay for it, you have to take table scraps."

Balancing optimism against pessimism

"Nothing is happening [in the lead up to next year's spectrum incentive auction] that we were not expecting," considers Jackie Green, VP of R&D/engineering with Audio-Technica US. "It is better to discuss with customers what we can do, and make those systems work as best we can. Once we know the outcome of the two-stage auction, and the effect of the guard bands and duplex bands, then we can make plans to address the resulting spectrum with innovative new hardware, as well as learning more about the FCC's new plans being offered for existing wireless applications.

"In reality, it doesn't matter where you design the new wireless systems to work, since we can pretty much design for those propagation characteristics and spectrum space. The big questions then will be cost and availability. High performance can be offered at any frequency, given our access to suitable development tools.

"But our industry is not a big one; we ride along on the coattails of the mobile phone industry for chipsets and mass-affordable components," Green advises. "Yes, we are innovating new technologies for use in the 2.4GHz band—including our new 10-channel System 10 Pro wireless systems with a choice of frequency, time, and space diversity—in addition to more ultra-wideband products just around the corner."

"We support a broad range of customers, from the professional community all the way to the single owner/operator," states Sony Electronics product manager Andy Munitz, "and will offer advanced technologies to integrate into an ever-challenging RF environment. To that end, at [last year's] IBC Show [in Amsterdam] we introduced our DWX-N series of digital ultra-wideband transmitters and DWR-R02DN rack-mount receivers, which, to add greater flexibility to current frequency-coordination tasks, offers access to 198MHz of frequency range from 470MHz — 710MHz (depending on the region), which translates to more than 7,500 frequencies. In addition to the traditional UHF frequencies, we also have 2.4GHz products, and recently

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Sony's new DWX-N series of ultra-wide-band transmitters.

launched the new DWX Series Digital products for the Japanese domestic market in the GHz range."

"As the consumer ecosystem expands," advises Brunner, "for the foreseeable future the shifting landscape of the RF spectrum will be of major concern for the pro-audio industry. We have been very successful at highlighting the societal significance of these frequencies," for the entertainment, news, and live-performance communities. "Recent [FCC] decisions, while not ideal, have been according to our requests; we are grateful for that."

"I'm confident that the FCC will remain willing to work with our industry so that they can accommodate microphone operators," concludes Ciaudelli.

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