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White Spaces Primer
Shure Overview

In the United States, the private or commercial use of radio frequency spectrum is managed by the Federal Communications Commission (FCC). Wireless microphones, wireless personal monitors, and similar professional wireless devices are permitted to operate in several different parts of the spectrum; the largest of these is the UHF TV band, whose primary occupants are television broadcast stations. The UHF TV band happens to be in the middle of the most desirable frequency range for consumer and commercial wireless devices: 300 MHz to 3 GHz. This range is the crème de la crème of radio spectrum, because signals in this range propagate well over distances, through walls, and around corners, yet only require a small antenna that can be concealed within a handheld device.

As a result of the transition from analog to digital television (DTV), television stations in the U.S. can be spaced closer together in the spectrum – even on adjacent channels. This allowed the DTV stations to fit into a smaller section of spectrum without causing interference. After the DTV transition was officially completed on June 12, 2009, the spectrum allocated to the UHF TV band was condensed from 470-806 MHz to 470-698 MHz.

The remaining spectrum (698-806 MHz, also known as the "700 MHz Band") was reallocated for other wireless services. Some sections were reserved for use by public safety agencies, and other sections were licensed to commercial wireless service providers through a series of auctions conducted by the FCC. Carriers now offer services such as "4G" or "LTE" that use the 700 MHz band in hundreds of cities, and public safety agencies have begun to create networks that allow emergency responders to communicate with each other more easily. Wireless microphones and other professional wireless systems were prohibited from operating in the 700 MHz band after June 12, 2010. If you're still using wireless mics in the 700 MHz band, you may be interfering with licensed users (including emergency responders), and you could receive a fine that far exceeds the cost of new wireless gear.

There simply isn't enough spectrum for every type of device or service to have its own frequency range, so different types of devices have to share the same spectrum without disrupting each other. This has actually been going on for many years in the TV band, which the TV stations have been sharing with wireless microphones, in-ear monitors, and intercom systems (known as "low power auxiliary stations" in FCC parlance); some two-way radio users; wireless heart monitors and other medical telemetry

equipment; radio telescopes that analyze signals from deep space; and even telephone links to oil rigs in the Gulf of Mexico.

Even after the DTV transition, some TV channels in each city remain unassigned to TV stations, and are known as "white spaces". After years of study, the FCC decided to allow these unassigned TV channels to be opened to a new class of products: "TV band devices". These will use the white spaces as a "Super Wi-Fi" that will provide additional wireless broadband capacity for next-generation smartphones and computers in urban areas and bring cost-effective internet access to rural areas, where dialup or expensive satellite internet may be the only options available. Some TV band devices will be "fixed" (e.g. mounted on a rooftop or tower) while others will be portable handheld types.

Wireless microphones and other wireless audio gear may operate on any VHF or UHF TV channel (2-51, except 37) that is not assigned to a TV station or one of the other licensed services listed above. The TV band devices will be allowed to use most, but not all, of those channels, depending on their type and power output. The new TV band devices are expected to reach the market in 2012, and it's possible that they could cause occasional interference if they're close to your facility and your wireless mics are set to a frequency in a TV channel that they are permitted to use.

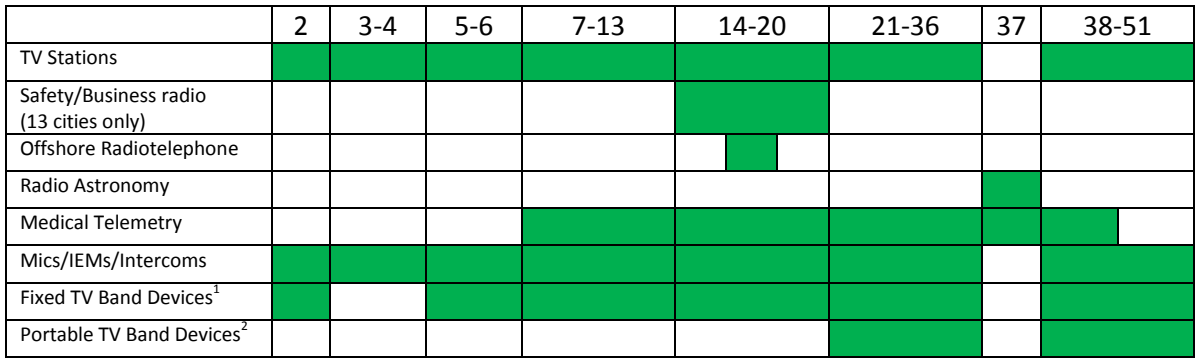

Figure 1. Wireless devices that share the TV band. (1) Fixed TV band devices may not use a channel that is adjacent to one occupied by a TV station. (2) Portable TV band devices must reduce their power when on a channel adjacent to one occupied by a TV station.

How Wireless Mic Users Can Avoid Interference From TVBD's

Wireless audio has become an essential part of not only major news, sports, and entertainment productions, but also business meetings, cultural events, and worship services. In some of these situations an occasional dropout is tolerable, while in others it's a show-stopper -- literally. The FCC has therefore created two distinct ways that wireless mic users can eliminate any chance of interference from new TV band devices.

First, the FCC has set aside designated TV channels for wireless microphones which are off-limits to TV band devices. These TV channels will be in two areas of the UHF TV band: around channel 37, and between channels 14 and 20. In every city, the first channels above and below TV channel 37 that are not assigned to a local TV station will be reserved for wireless microphone use. (If none of the channels above 37 are open, then the first two open channels below 37 will be reserved; if none of the channels below 37 are open, then the first two open channels above 37 will be reserved.) In many (but not all)

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cities, a few additional TV channels between 14 and 20 will also be off-limits to TV band devices, bringing the total to five in some cases. Since multiple wireless microphones can operate in a single 6 MHz TV channel, just a few reserved channels should accommodate enough wireless gear for a small to medium-sized wireless microphone user.

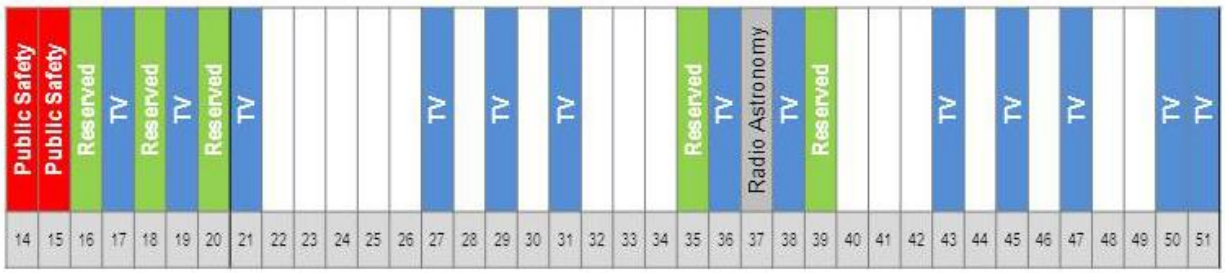

Figure 2. Typical layout of TV channels reserved for wireless microphone use, which are off-limits to TV band devices.

The TV channels that are assigned to TV stations or other services vary from one city to another, so in one city the reserved channels might be 17, 36, and 38, but in another city they might be 18, 35, and 40. The reserved channels could even vary in different parts of the same metropolitan area depending on how TV station coverage patterns overlap at a particular spot. Since TV station channel assignments can change, or a station can move its transmitting antenna to a new location, it's worth checking the FCC website periodically or subscribing to the *FCC Daily Digest*, which includes these updates.

TV Bands Device Database

How will you know which TV channels are reserved for wireless microphone use at your location? There will be an app for that – several of them, probably. The FCC has mandated the creation of a "geo-location database" containing the exact location and TV channel of every user that a TV band device must avoid. They've designated 10 potential database administrators, including Google and Microsoft. Each database will contain the same information and will be synchronized at least daily, and perhaps as often as every 15 minutes.

Before transmitting in the TV band, a device must contact one of the databases to obtain a list of TV channels that are available to use at its specific location (defined as latitude and longitude). A wireless mic user can also query any one of the databases to find out which TV channels are reserved for wireless microphones and therefore the best choice for avoiding interference. Spectrum Bridge, the first database administrator approved by the FCC, has already published an iPhone app for finding open channels for wireless mics.

To determine channel availability, the database will calculate the signal coverage patterns of all of the TV stations that serve your location, as well as public safety/commercial radio users and any other licensed service that operates in the TV band in your area. This means that "your location" must be more precise than just a zip code; you'll need to enter your exact street address or latitude and longitude.

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Extra Protection for Users of Large Numbers of Wireless Microphones

The reserved TV channels in each city will accommodate the needs of most typical wireless microphone users. But what if you have more wireless mics, in-ear monitors, and intercoms than will fit into the reserved channels? You can register in the database to create a temporary "exclusion zone" around your facility during an event that requires additional protected TV channels. That will prevent TV band devices from transmitting on the additional TV channels you're using if they're within a certain radius (400 meters for portable devices, 1 kilometer for fixed devices). You'll enter the date, time, location, and duration of the event, and the TV channels (but not specific frequencies) that you'll be using in any one of the databases, and the information will automatically be synchronized with all the others. If you have an FCC license for your wireless mics, you can register just a day or so before the event; otherwise, you'll need to send a request to the FCC at least 30 days in advance. Before granting your request, the FCC will want to know that you're already making full use of the reserved TV channels available at your location, which means that you have at least 6 wireless mics, monitors, or intercoms operating in each of those channels.

The FCC recognizes that many events – like worship services and theater performances – occur on a regular schedule. When you register in the database, you can specify the start and end dates for a recurring event up to one year in advance. If the TV channels that you're using change (because a local TV station changes their channel assignment, for example), you'll be able to update the database to reflect that.

When registering in the database, you also need to provide the name of a responsible person at your facility who is familiar with the operating frequencies for all of your wireless gear. This means that you should have one or more people at your facility who are well-versed in your wireless systems and database procedures.

When Will TV Band Devices Reach The Market?

The first TV Bands Device (a fixed device designed to provide local wireless broadband) and the first TV Bands Device Database (operated by Spectrum Bridge) will become operational on January 26, 2012. Initial operation will be limited to the city of Wilmington, North Carolina and New Hanover County, North Carolina, and will expand nationwide pending completion of the FCC's procedure for processing database registration requests from unlicensed wireless microphone users. Until the FCC registration system is operational, parties seeking to obtain protection for events where large numbers of unlicensed wireless microphones will be used must submit registration requests directly to the FCC Office of Engineering Technology at TVWSinfo@fcc.gov. The "subject" line in the messages for such requests must begin with the phrase: "[Wireless Microphone Registration]," followed by the entity's full name. For example: [Wireless Microphone Registration] Widget Corporation. If the FCC approves the registration, it will direct Spectrum Bridge to provide the registrant with a registration number so that they can enter the protected TV channel information in the database.

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White Spaces: What Happens Next?

The FCC is under intense pressure to reallocate even more spectrum for broadband – preferably in a single large block instead of a patchwork of TV channels that vary from place to place. The FCC and major wireless carriers have been aggressively promoting the approach that appeared in the National Broadband Plan published in 2010: have TV stations change or share channels so that they can fit into an even smaller piece of spectrum, allowing the FCC to auction the remainder to wireless carriers. Some of the auction proceeds would be shared with the TV stations that change channels. The FCC cannot conduct such an "incentive auction" without Congressional approval, however. The authorization has been included in several House and Senate bills, but none have been passed so far.

Why the holdup? Congress has told the FCC that they will not grant permission to conduct the auctions until the FCC publishes an estimate of how many TV stations would need to change channels, how many would need to share a channel, and how many would likely go off the air entirely under various auction scenarios. The FCC has told Congress that it will not reveal this until Congress grants permission to conduct the auctions, resulting in a stalemate.

The major wireless carriers support the "repack and auction" scenario, and are lobbying hard in favor of it. But the tech industry at large is generally against it, and Congress isn't so sure. Why? Because an auction would put this valuable spectrum under the control of just two or three large companies that can afford to buy it, which means that it would support only the devices and services that they decide to market. On the other hand, unlicensed access to the white spaces would be free and open to any company. Proponents believe that this would stimulate investment in all kinds of new products and services by companies of all sizes, just as the allocation of the 2.4 GHz band for Wi-Fi and Bluetooth did. So, while parties such as CTIA-The Wireless Association® have gone on record supporting incentive auctions, others like the Wi-Fi Alliance, Google, and Microsoft have gone on record supporting maintaining TV white space for unlicensed use. The National Association of Broadcasters remains vigilant and vocal in its position that it has already given up over 100 MHz of spectrum during the 700 MHz reallocation, and that the search for dedicated broadband spectrum should be focused on other bands.

Managing the growing need for spectrum is a challenge being faced by countries around the world. Input from wireless microphone users in a wide variety of disciplines has been fundamental in helping regulators like the FCC, Industry Canada, and Ofcom in the U.K. to clearly understand the importance of wireless audio. That input directly contributed to the extensive protections for wireless microphones that are now in place in the U.S., and the careful deliberation by agencies in other countries where spectrum reforms are still progressing.

One thing is clear: the wireless landscape will continue to change. Wireless microphones, like every other wireless device, will need to evolve to keep up with changes in transmission technology, spectrum availability, and regulations. As with other technologies, users may need to learn and invest along the way.

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For specific inquiries on the White Spaces initiative, you are invited to contact Shure at whitespacesinfo@shure.com.