

The Most Important Things to Know about Using Wireless Mics Today

10 Key areas

1. Understand How RF behaves

- It bounces off of metallic objects
 - These reflections cause multi-path drop-outs (sometimes helps though!)
 - In audio we experience reflections as room modes and comb-filtering
- Large metallic objects (set pieces) can cause RF shadows (not usually helpful)
- RF leaks through holes and openings (like windows)
 - Depends on wavelength (which is another way of talking about frequency)
 - Mainly important when in a location with lots of high power TV
 - Can go through walls (depending on construction)
 - Is there a theater next door, or a HOW across the street?
- RF follows the inverse square law (as does audio)
 - Double the distance - level drops 6dB (1/2 the voltage and 1/4 the power!)

2. Know Your RF Environment

- TV channels in each city are different
- Best practice: Use a Spectrum Analyzer or Receiver's built-in scan feature to get a good picture of your venue's RF environment. (Hint: do the scanning during actual times of performances)
- Your venue may be well shielded from the outside world – or maybe not!
- Outdoors is the most challenging – no shielding from broadcast TV

3. Proper System Design

- Use the best possible gear
 - Tight front end filtering and high IP3
- Use low loss coax cable - especially on long runs
- Use active splitters in larger systems (passive splitters are lossy)
- ***** Don't make this common mistake: Powered antennas with preamps should only be used to compensate for cable and splitter losses, if significant. Often performance is seriously degraded if used improperly.

RF Cable Loss Examples

Coaxial cable allows remote positioning of antennas, but it also attenuates the signal.

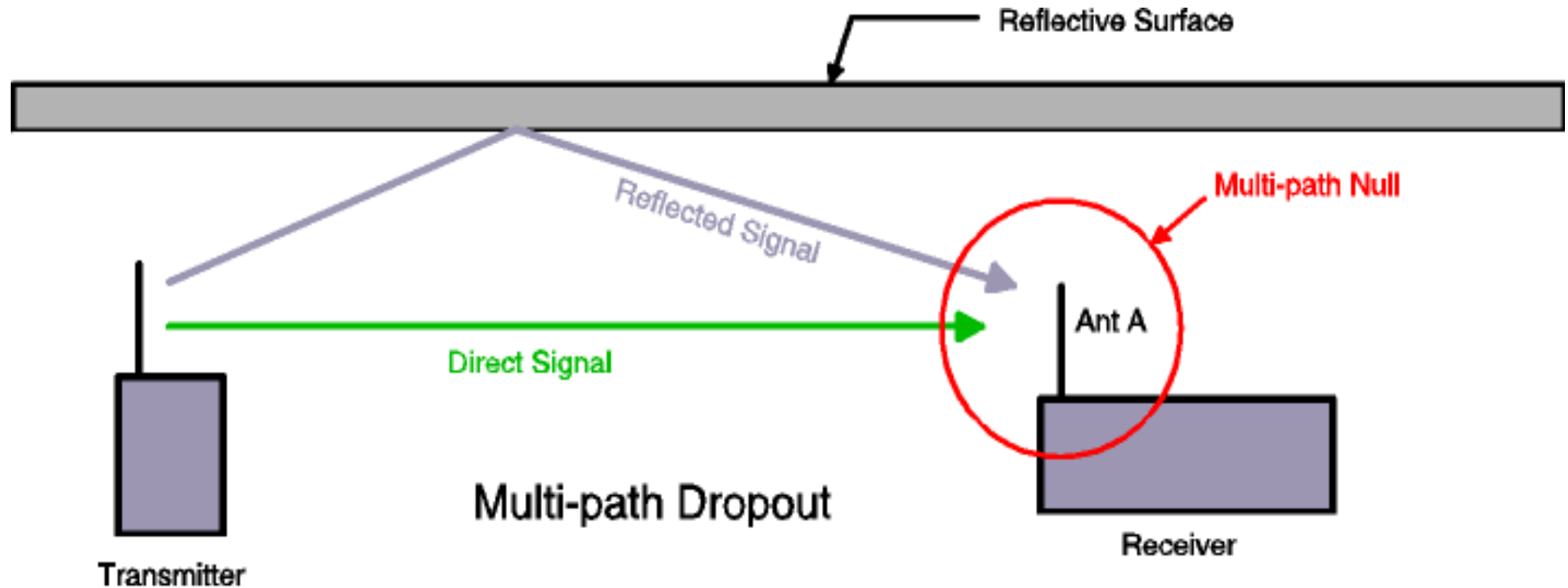
It is imperative to consider cable type and length for a particular application.

<u>Coax Type</u>	<u>Belden #</u>	<u>(Loss at 400 MHz)</u> <u>dB/100ft.</u>	
RG-174/U	8216	19	
RG-58A/U	8240	8.4	
RG-8A/U	8214	3.9	
RG-8A/U	9913F7	3.0	
RG-8	LMR400	2.5	(Times-Microwave)

4. Optimize Receiver Antennas

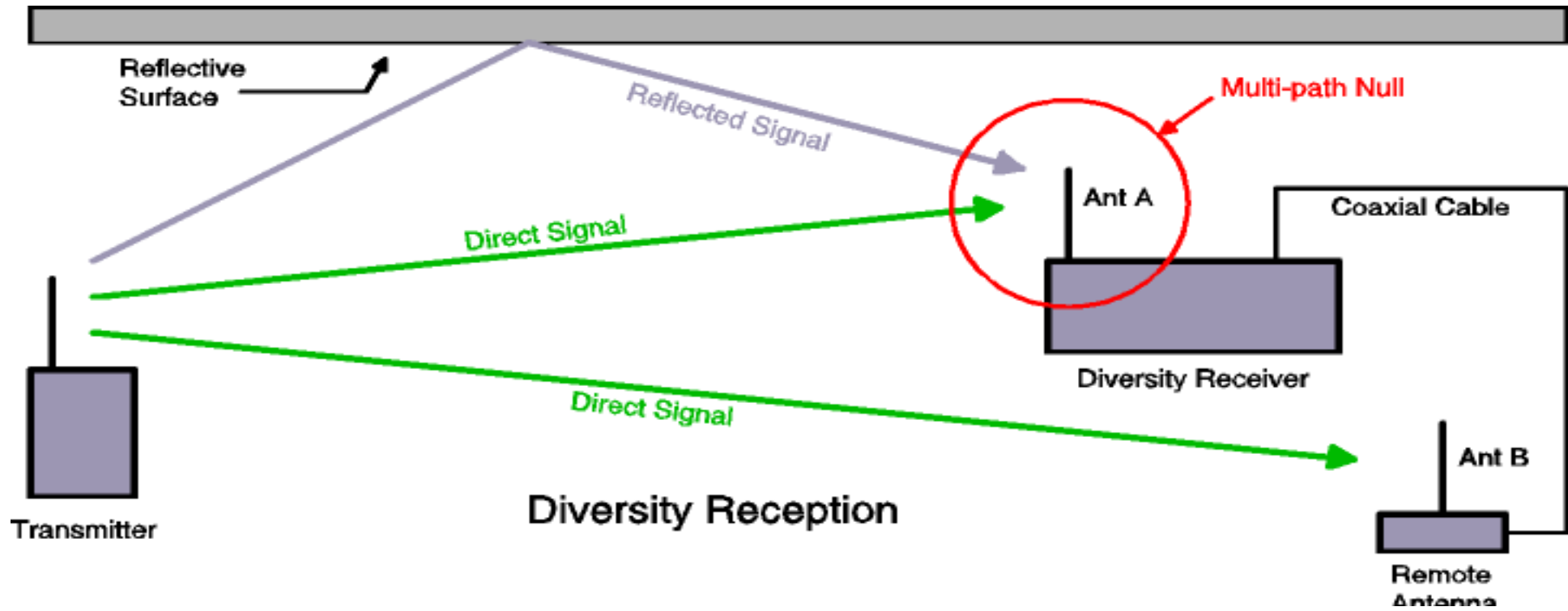
- There are many types of antennas, each with particular patterns and gain – choose wisely
 - Whip/Dipole/LPDA/Helical/Circular Polarized (CP)
- Get antennas as close as practical to the stage
- Clear line of sight shot at the performance area
 - Avoid blocking by audience, lighting grids, scenery, etc.
- Multi Path causes dropouts
 - Solution: Diversity reception – 2 antennas spaced several wavelengths apart
- **Don't put antennas inside of a metal rack!**

- Dropouts due to multi-path nulls



Diversity Reception

- Solution: Pick up the signal in more than one place

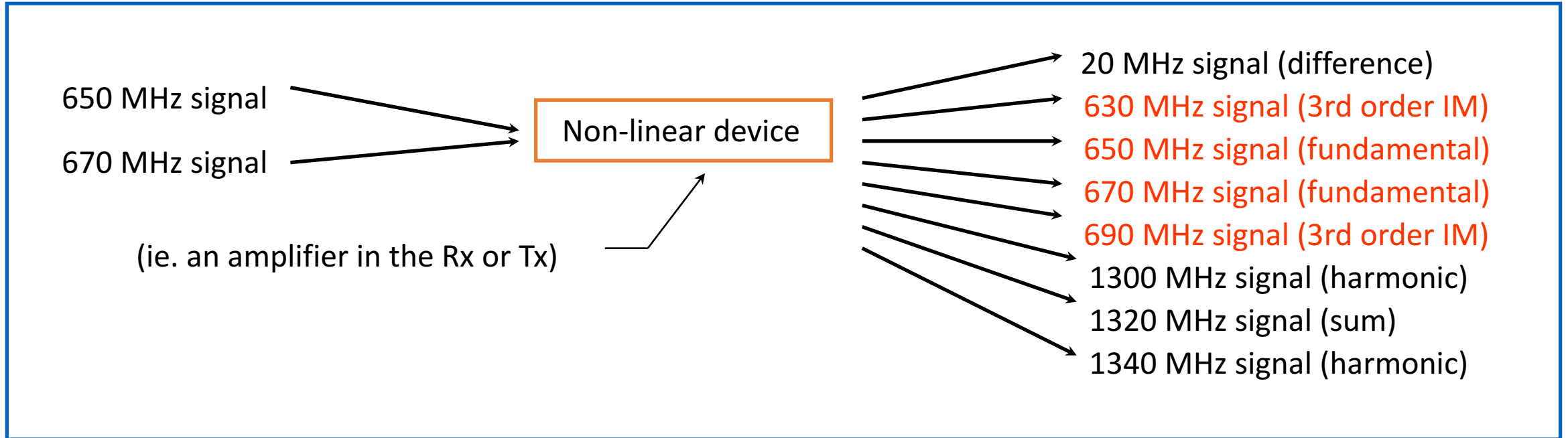


5. Perform a Frequency Coordination

- Frequencies add and subtract to create new signals. It's simple math but gets really messy with many channels. (Technically the problem is called "intermodulation").
- Picking frequencies willy-nilly can work for a few channels (maybe).
- **Once you have more than a few channels you must use software!**
- Some receivers have built-in scanning to help choose frequencies
- Don't forget to include all the other wireless gear, i.e. wireless intercom and in-ear monitors, etc. and broadcast TV, if present.
- The mother of all programs: IAS by Professional Wireless

Frequency Coordination

Fundamentals, 2nd and 3rd order IM **with only two signals:**



These simplified examples include IM generated by the carriers only. Frequency coordination also includes numerous other parameters in transmitters and receivers to accurately predict in-system interference.

6. Place Mics and Packs on Actors Properly

- GBF: (Gain before feedback)
 - Mic on the forehead or over the ear – good compromise for sound vs. hiding
 - Near mouth with a boom – great sound close to mouth but very visible
- Active Audio Mixing is critical to avoid comb filtering and to maximize GBF
- Bodies absorb RF
 - Transmitter antenna should not contact skin – or even a damp undergarment (from sweat)
 - Tricks for avoiding problems:
 - Place transmitter in wig? (Requires very small and lightweight transmitters)
 - Place transmitter upside down/antenna facing down and away from the body
 - Try to separate antenna from skin with foam pad or plastic tube over antenna
- Some transmitters need to be protected from sweating out
 - Condom or plastic glove

7. Set Audio Gain Correctly

- Critical for both for the Transmitter AND Receiver
 - Set Transmitter gain for full modulation
 - Low levels result in noisy (hissy) audio and can reduce range
 - Set Receiver for Line Output (if available) and connect to Line Input on Mixer
 - Less noisy than going into a mic preamp
 - Optimize for headroom vs. noise floor

8. Choose Batteries Wisely

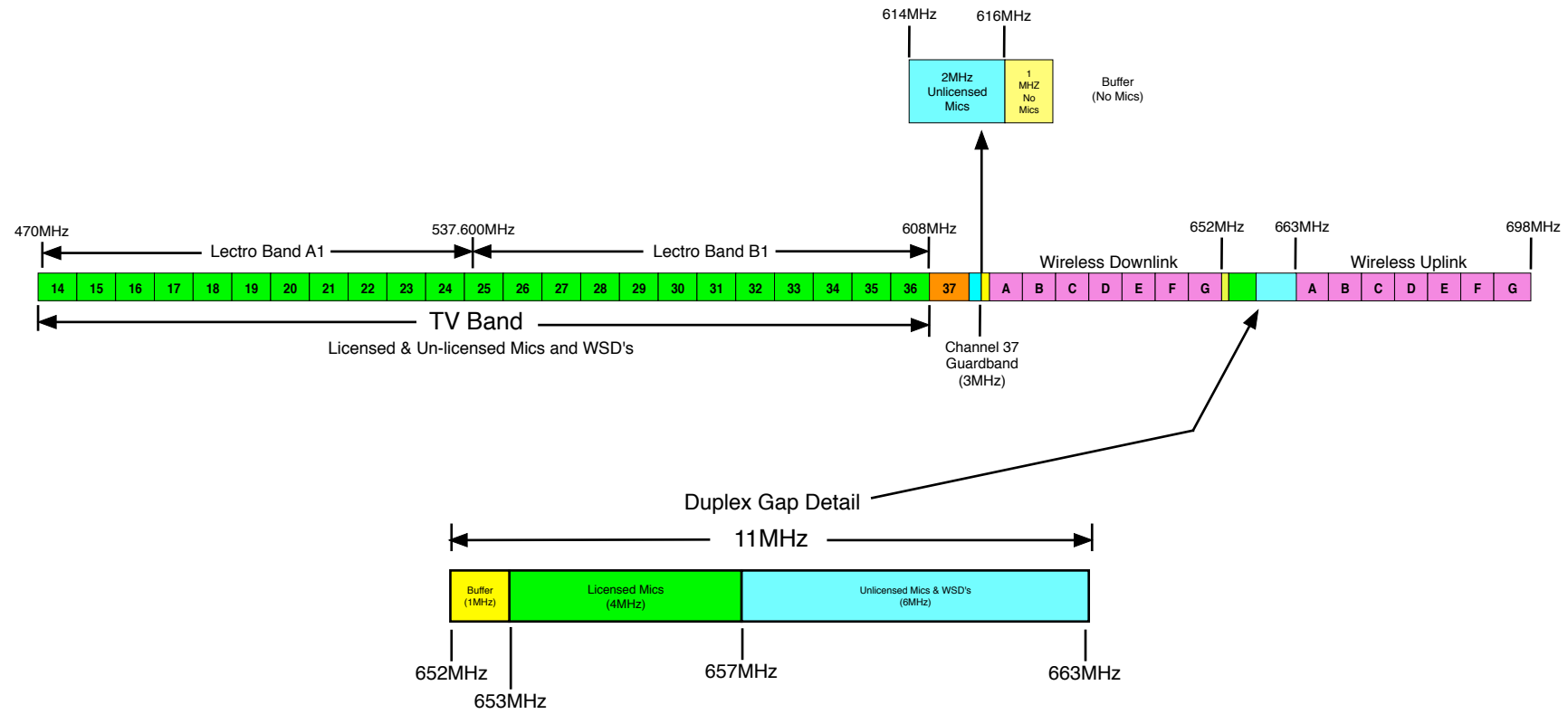
- Alkaline
 - Commonly used and least expensive
 - Duracell Quantum - worth checking out
- NiMH is a good choice
 - Rechargeable and longer run-time than Alkaline (in many cases)
- Lithium Ion – very long run-time but expensive
- Watch out for imposters!
 - Ebay and Amazon have been caught selling Chinese knock-offs that don't work well at all

9. Test before the show!

- Keep transmitters separated during testing – they can create intermods in each other if too close.
 - Keep this in mind when placing on actors as well
 - Do particular actors hug or get very close?
- Turn them all on and walk test
 - Test with all wireless gear turned on – IEM's, Wireless Intercom, etc.
- Test mounted on someone – not held out in free air
- Turn them off one at a time and observe that their corresponding receivers show RF level drop to near zero
 - If not there is likely an intermod or a TV station on that frequency

10. Understand The Impact of the Auction

- Round 4 has succeeded
- We will be left with TV channels 14-36 (470-608 MHz)
- Much less lost than originally anticipated by the FCC!
- 39 months until we must vacate the upper 600MHz spectrum
 - Clock starts ticking the day they publish the new channel reallocations
- Consider getting a license if eligible



Post Auction TV-Wireless Band

New Rules and New Neighbors

- White Space Devices will share UHF TV Channels (not really new)
- Licensed vs. Unlicensed – Different rules!
 - Licensed (Broadcasters and users of more than 50 wireless):
 - Can receive protection from WSD's (via WSD Database)
 - Higher power allowed (up to 250mw.)
 - Use of some new frequency bands not available to unlicensed users
 - Unlicensed (smaller venues <50 mics):
 - Sorry - no Protection in WSD Database
 - Must query WS Database before operation
 - Limited power 20-50 mw. (depending on frequency)
- New Gear may be required

Some new frequencies will become available:

- VHF – 174-216 MHz
- Channel 37 guard band and duplex gap
 - 2MHz in channel 37 guard band – unlicensed mics only (no WSD's)
 - 4MHz in Duplex gap for Licensed users
 - 6MHz in Duplex gap of un-licensed users and WSD's
- 1.4 GHz “AFTRAC” band (for licensed users only)
- 7 GHz

Additional Information:

- Manufacturers Websites
 - Lectrosonics
 - Shure
 - Sennheiser
 - Audio-Technica
- IAS – “The Gold Standard” for frequency coordination
 - <http://www.professionalwireless.com/>
- RF GURU – Stage Research \$79
 - <http://www.stageresearch.com/>
- TV Fool and Rabbit Ears
 - <http://www.tvfool.com>
 - <http://www.rabbitears.info/>
- RF Specialites
 - <http://www.rfvenue.com/>