How to Restore Analog Radio Coverage Stolen by Narrowbanding

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Heard Around the Country

Communications managers in Public Safety Answering Points (PSAPs) have had to deal with user complaints ever since 2013, when their analog LMR systems were narrow-banded from 25 kHz down to 12.5 kHz. Many areas that had been marginal are now "dead," leaving portables completely unable to talk back or sometimes, even hear dispatch.

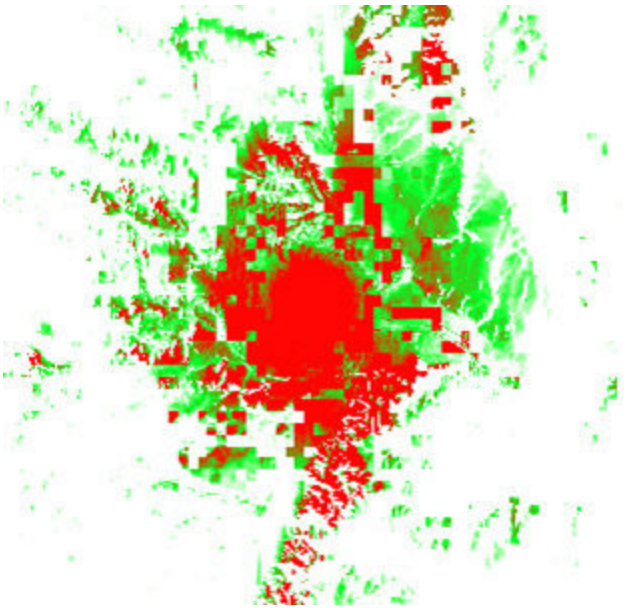
Narrow-banding created significant talk-in problems for anyone dealing with one of these situations:

- Analog systems in the VHF-Hi and UHF bands that had already experienced marginal coverage areas for their wideband portables. This was particularly prevalent if sites were originally selected with wideband mobile coverage in mind (with 50 watts of mobile talkback power, not the 5 watts of a portable).
- Narrow-banding eliminated marginal coverage, and some areas that had previously enjoyed clear communications became marginal and noisy.
- Radio systems with geography that had expanded over time due to consolidation or annexation, which created new outlying areas that had marginal coverage.
- Systems facing more rigorous in-building communications coverage expectations. Cell phones and Wi-Fi provide coverage practically "everywhere," raising expectations of LMR users. Radio users now complain if they can't also enjoy universal coverage. This situation was exacerbated in 2013 by the coverage reduction caused by narrow-banding.

Key Takeaways

Some channels that weren't simulcast or voted may now require it.

Systems that already employed simulcast and voting may now need more sites. In general, an analog channel may need 15-25% more sites after being narrow-banded than was required when it was wideband to simply achieve the same coverage and signal quality as in the past.



Representative coverage difference of an analog system. Before narrow-banding, 25 kHz coverage had been available throughout the two-colored areas. Coverage that remained after narrow-banding to 12.5 kHz is red; "lost" coverage is shown in green.

A Solution to Improving Talk-In: Receiver Voting

Lost talk-in coverage can be restored, and marginal coverage improved, by implementing a receiver voting system. If the radio system already has receiver voting, additional receive sites can be installed to cover newly marginal areas as well as those that completely lack talk-in capability now.

In contrast to a single repeater radio system, a voted system makes use of multiple voting receivers strategically placed throughout the desired coverage area. Whenever a field transmission is made, the voter gets receive audio from every voting receiver that picks up the transmission. The voter continuously selects the best of these signals, which it passes on to the repeater and/or dispatcher. This expands the talk-in coverage area to wherever a portable can reach one of the voting receivers.

A typical Receiver Voter, the JPS SNV-12 is shown below:

SNV-12 Analog Receiver Voter.

An Elegant Solution to Improving Talk-Out: Simulcast

Talk-Out can be dramatically improved by upgrading the transmitters to simulcast operation. Simulcast Control keeps RF carriers exactly on frequency (precise to 0.1 Hz at the transmit frequency), and typically uses a GPS on-time point at each site to sync the audio so that it launches from all sites "at the same time."

In the analog world, the common simulcast audio control devices are: Harris-Tait AS-IP using TB9400 base stations, Motorola Solutions' MLC-8000 with GTR-8000 bases, and GatesAir SynchroCast IP multiplexers, in conjunction with any simulcast capable analog base station.

Tait AS-IP TB9400 needs 10MHz, 1PPS and NTP to "simulcast" base stations connected over an IP Network or IP microwave. The only Tait-approved GPS Master Oscillator is an Orolia SecureSync®. A entry-level SecureSync can drive a handful of radios at a site. Redundancy can be achieved with 2 SecureSyncs and a signal selector. In addition, a SecureSync is the only time server approved by the Defense Information Systems Agency (DISA) for maximum cybersecurity.

A composite 5MPPS/1PPS signal is needed to "sync" Motorola MLC-8000s. In LMR installations, a common source of this signal is an Orolia SecureSync outfitted with a composite output board, which hasfour4 outputs on separate BNCs, each capable of driving multiple MLC-8000s.

GatesAir-based systems need 10MHz, 1PPS, and in many situations, a synchronized CTCSS (Continuous Tone Coded Squelch Signal) to achieve simulcast control. These can be transported over an IP backbone or a legacy T1 backbone. Convex fixed delay modules are used on RF-linked simulcast radio systems. The Orolia SecureSync is the only "public safety grade" GPS Master Oscillator that generates synchronized CTCSS.

Typical Voted-Simulcast Head End Radio Site – showing an Orolia SecureSync, five voters, and other radio accessories.

The Essential Facts

- Narrow-banding from 25 kHz channels down to 12.5 kHz caused at least as much coverage area shrinkage as would a 25 kHz channel experiencing a 3dB power decrease (power cut in half). Plus, remember that this is the best scenario. Actual measured results are often closer to 6 dB.
- After narrow-banding, LMR towers no longer talk out (transmit) as far as they did before. This is minor compared to the fact that narrow-banded portables are no longer able to be heard at all from some areas where 25 kHz portables had at least been marginal.
- Simulcast extends the talk-out range of tower base stations and assists with building penetration.
- A cost-effective option to use analog receiver voting restores lost talk-in coverage and removes the many noisy audio problems.
- Sometime down the road (2030? 2035?), the FCC will mandate a 6.25 kHz channel equivalent for VHF & UHF. The change to 6.25 can only be accomplished by migrating to digital. The FCC has stated that this migration will be mandated only after municipalities realize the "economic value" of the recent migration to 12.5. That's why the next deadline is believed to be far off in the future. Considering the rapid changes in technology, it's prudent to retain and improve what you have while we all wait to see what the future will hold.
- Analog radio is not going away anytime soon. Over half of the 25,000+ public safety radio channels in North America remain analog in 2019.

Summing It All Up

Coverage problems were created when analog systems were narrow-banded. Mission critical communications demand the ability of officers in the field to communicate when necessary. Simulcast and receiver voting can improve talk-in with maximum return on your investment – which is far less expensive than a major infrastructure build-out to add channels or a forklift radio change to P25 or DMR.

About the Author

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Ed O'Connor has spent the last three decades in the land mobile radio simulcast field and has equipment installed in over 7000 simulcast sites worldwide. He founded Simulcast Solutions to provide technical guidance and one-stop-shopping to end users, dealer/integrators, and OEMS to help them implement coherent, cost-effective public safety simulcast radio communications. He holds degrees in engineering and business and is the former president of Spectracom (now Orolia). In partnership with Orolia, Simulcast Solutions provides land mobile radio (LMR) narrow-band simulcast and voting solutions to public safety, transit and utilities. Learn more at www.simulcastsolutions.com.

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