

APX 7000XE Radio Background Noise Cancelling Field Testing Report 2013-10-11

BACKGROUND

Ambient or background noise from loud environments such as a firefighter PASS alarm, SCBA low air alarm, smoke detector, fire engine pump, and chainsaw, can interfere with intelligible audio being transmitted by a radio. While the first generation of digital radio technology did not account for loud noise environments and posed a great deal of concern for the use of digital channels in the fire service; the latest Motorola APX7000XE radios that were deployed to St Louis County fire agencies in June of 2013 include the latest technology for noise reduction. There are several different audio settings available in the programming which can affect the background noise cancellation and clarity.

PURPOSE

The intent of the testing was to evaluate the difference in audio quality between an analog channel and a digital channel using various audio settings given set scenarios. This evaluation would drive the decision of which setting(s) to use in the next reprogramming.

CONDITIONS

A collection of 5 different audio settings were obtained from Motorola and programmed into the test radios. These settings were then programmed into a couple of test radios and labeled in the radio as Option 1, Option 2, Option 3, Option 4 and Option 5 each for a 700 MHz digital channel and an 800 MHz analog channel. For testing purposes the channels utilized were: '7FIRE64D' and '8TAC94D'.

A scenario/evaluation sheet was produced with following scenarios evaluated:

- Normal (no background noise) with no SCBA mask
- Low air alarm (specifically Scott Vibralert) & Pass alarm with SCBA mask
- K12 saw with SCBA mask

Each scenario was used with each channel and option for a total of 10 transmissions per scenario. The transmitting party read the same script each time, stating "Mayday, Mayday, Mayday, 4835A to Command, I have fallen into the basement and can't find the way out." A base comparison was also performed at the beginning of the test using the old radios on a VHF analog channel with no noise suppression.

ATTENDANCE

Facilitators: James Price and Red Grasso

Receiving audio evaluators: Terry Loehrer, Mark Thorp, DJ Malone, Leo Meyer, Dan Lafata, Greg Brown, Lou Hecht, Marc Ulses, Dan Hogue

Transmitting team: Mike Chellis, Ken Menke, Tim Dorsey, West County EMS & Fire on-duty crew.

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RESULTS

Based on this testing, It is the recommendation of the evaluators that the fire service radios in St Louis County be configured with 'Option 4' settings for all channels on the portable radios and Option 2 for the mobile radio as Option 4 is not available on the mobile.

The digital direct channel was also selected for the 'fallback' channel given the better performance.

Each transmission was evaluated based on an industry excepted standard of Delivered Audio Quality (DAQ) ratings. At the post testing debriefing the evaluators felt that Option 4 offered the best noise reduction for the scenarios that had loud background noise. Option 4 also had little to no impact on audio quality for the scenarios that had little to no background noise. It was revealed in during debrief:

Option 1 was the default radio setting (not fire service specific)

Option 2 was the default for Loud Audio (not fire service specific)

Option 3 was the default for the Xtreme radio

Option 4 was the recommended setting for the Xtreme radio with the XE Remote Speaker Mic

Option 5 was based on a generic noise reduction (not fire service specific)

FURTHER

It is worth noting that this testing did reveal a clear distinction in the background noise suppression between the analog and digital channel. Background noise was present on every analog reception with varying levels of voice on top, while digital was attempting to eliminate the background noise entirely and maintain voice integrity. During several of the tests with the digital channel, the evaluation team was not able to hear any background noise while the transmitting team reported that the background noise was so loud that they had difficulty communicating face to face. The evaluation team even asked the transmitting team to repeat a test as there was doubt that the PASS alarm had been activated. This is the reason the group decisively selected the digital direct channel.

There was some discussion about mic placement when using an SCBA. Motorola's recommendation based on the 'Say It Loud and Clear' best practice video (http://www.motorolasolutions.com/web/Business/landing_pages/US-EN/SayItLoud/SayItLoud.html) is to use the voice port on an SCBA mask and not the voice amplifier. There have been voice amplifiers developed since the production of this video and during a comparison of the two methods; the evaluators felt that the voice amplifier provided a bit more clarity. Microphone placement with regard to voice amplifier or voice port was outside the scope of this testing therefor no specific recommendations is being made at this time. The voice amplifier method was used during this testing.

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TECHNICAL INFORMATION

1. OPTION 1 Equivalent to the standard "Default" radio profile
 - a. Mic AGC Enabled (Output 0 / Total 6)
 - b. Background Noise Reduction Level = Normal (this level is only used when the XE RSM is disconnected from the radio)
 - c. Treble Control = 0
2. OPTION 2 Equivalent to the standard "Loud Audio" radio profile.
 - a. Mic AGC Disabled
 - b. Background Noise Reduction Level = Aggressive
 - c. Internal / External Mic Fixed Gain = -6
 - d. Treble Control = 0
3. OPTION 3 Equivalent to the XE standard "Xtreme" radio profile.
 - a. Mic AGC Disabled
 - b. Background Noise Reduction Level = Xtreme_1_Sided
 - c. Internal / External Mic Fixed Gain = -6
 - d. Treble Control = 6 (added boost that is not part of the "Xtreme" profile but added here to give some variation between OPTION 2 and OPTION 3)
4. OPTION 4 Optimized for the XE RSM using the XE RSM best practices document
 - a. Mic AGC Enabled (Output 0 / Total 6)
 - b. Background Noise Reduction Level = Aggressive (this level is only used when the XE RSM is disconnected from the radio)
 - c. Treble Control = 6 (for all modes)
5. OPTION 5 Optimized for Noise Suppression based on MOL video
 - a. Mic AGC Disabled
 - b. Background Noise Reduction Level = Xtreme_1Sided
 - c. Internal / External Mic Fixed Gain = -3
 - d. Treble Control = -5 for analog and -10 for digital and securenet

Data Collected from evaluators – each evaluators score sheet was compiled into a spreadsheet and the following averages were computed:

Average of all DAQ scores for 700 MHz channel = 4.18

Average of all DAQ scores for 800 MHz channel = 3.76

Average of all DAQ scored for Option 1 settings = 3.88

Average of all DAQ scored for Option 2 settings = 3.98

Average of all DAQ scored for Option 3 settings = 3.86

Average of all DAQ scored for Option 4 settings = 4.18

Average of all DAQ scored for Option 5 settings = 3.93