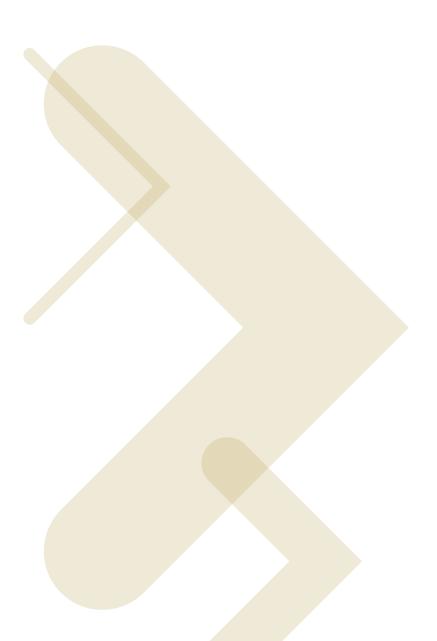# Background Noise and Radio Performance

Best practices help firefighters and other first responders maximize the intelligibility of two-way radio communications in high-noise environments

What users and departments can do today
…and where the industry is heading

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Executive Summary

Background noise is a fact of life on the fireground. However, as anyone who's tried to talk over the noise of a chain saw knows, noise interferes with the ability to hear and understand what people are saying. Some firefighters have reported interference with their radio communications in high noise environments. These concerns prompted the International Association of Fire Chiefs (IAFC) to begin an ongoing investigation. The IAFC has determined that:

- Background noise and personal safety equipment such as self contained breathing apparatus (SCBA) masks can significantly impact the intelligibility of both Analog and Digital radio transmissions.
- Certain best practices when using two-way radios can greatly improve audio intelligibility.
- Agencies, vendors and standards organizations must continue working together to address this industry-wide issue.

Motorola is an active participant in IAFC workgroups that are studying the issue and identifying solutions. We applaud the IAFC's leadership and continue, as always, to focus on answering the needs of firefighters and other first responders who depend on their communications to work under noisy and dangerous conditions.

Concerns about Background Noise and Intelligibility

In late 2006, the IAFC began receiving reports of possible communications problems involving digital two-way portable radios in close proximity to common fireground noise such as self contained breathing apparatus (SCBA) low air alarms, personal alert safety systems (PASS) devices, chain saws, K12 saws, ventilation fans, and pump panels on the fire apparatus.

The IAFC established the Digital Project Working Group, composed of representatives from the fire service, law enforcement, government and industry, to collectively investigate the issue and provide data-driven recommendations. Early testing by the independent National Telecommunications and Information Administration (NTIA) has indicated that noise is problematic for all communications systems, both analog and digital radios, on the fireground.

IAFC Recommendations for Immediate Action

The IAFC Best Practices Task Group has identified two sets of recommendations that users and agencies can take to immediately improve the audio intelligibility of their current digital or analog radio systems. Procedures and technical issues are directed at department leadership and operating considerations for field users. These practices can significantly improve radio performance in any situation, including high-noise environments and use of personal protective equipment.

Best Practices: *Fire Service Leadership*

The IAFC recommends that agencies implement the following practices to promote safe and effective communications:

1. All personnel must be trained to use their radios in conjunction with other protective equipment. Comprehensive and continuing training is critical as communications is a key component of the firefighter's overall safety ensemble.

2. Standards and guidelines need to be developed for scenario-based user training. This training must integrate communications policies and procedures into an agency's overall operations. Relevant standards are needed to define what constitutes effective communications during an incident.

3. Fire departments should be actively involved, from the very beginning, in the design of communications systems. The importance of fire service participation in the development of requirements cannot be overstated.

4. Incident commanders should evaluate background noise as a safety consideration in task assignments. Additional personnel may need to be assigned in a high-noise environment.

5. Agencies should work with their vendors to ensure that radios and accessories are compatible and configured properly. The right configuration settings can significantly improve audio intelligibility. For example, many radios can be programmed so that only the microphone being used is keyed when the radio is transmitting.

6. Consider the use of accessories—such as the CommPort™ Integrated Microphone/Receiver System, remote speaker microphones and in-ear mics—to reduce the impact of background noise. When carefully selected to ensure that they are compatible with masks and other equipment, accessories can dramatically improve intelligibility.

7. Communications equipment integration should be a factor in the design of SCBA, PASS and other systems that contribute to the firefighter's protective envelope. When procuring these systems, agencies must consider how the protective systems will work with their radio equipment.

Best Practices: *Field User*

The IAFC recommends following these practices whenever possible:

1. Use the radio to send a distress call before manually activating a PASS device. The PASS device generates a lot of background noise very close to the radio microphone and can interfere with others' ability to hear and understand what you're saying.

2. Position the microphone 1-2 inches away from your mouth or SCBA voice port and point the mic so you're speaking directly into it, not across it. This can greatly improve the microphone's ability to pick up your voice and not the surrounding noise.

3. Speak with a loud, clear and controlled voice. This dramatically improves radio performance in all situations, especially in a noisy environment.

4. Shield the microphone from noise sources, water and debris. Try turning away, cupping your hand around the mic, or using your helmet brim/visor. Protecting the mic from direct impacts of water/debris can significantly improve audio intelligibility.

5. Use a free hand (if you have one) to muffle a mask-mounted SCBA low-air alarm when transmitting on the radio. Covering this alarm, which emanates very close to the mask voice port, can greatly improve audio intelligibility.

6. Locate your radios and microphones as far as possible from PASS devices and other equipment that generates noise.

Best Practices: *Motorola Equipment*

As with all radio configurations, we encourage the customer to test the settings to assure compatibility with their operational equipment.

Motorola recommends these configuration settings for XTS radios in high-noise environments:

- Analog / Digital AGC Automatic Gain Control: OFF

- Digital / Analog Balance: ON

- Noise Suppression: ON

- Attenuation Level Setting: ADVANCED

We also recommend that users who are wearing SCBA masks should hold the radio mic directly over the SCBA voice port. For those masks which employ in-mask alarm systems, the microphone should not make direct contact to the SCBA voice port to minimize the transfer of the alert sound to the microphone.

We support and commend the IAFC's leadership in emphasizing the importance of best practices, user training and appropriate use of accessories.

Best-in-Class Equipment: *Motorola XTS® Two-Way Radios*

Motorola's rugged XTS Project 25 radios are part of the MOTOA4™ portfolio of mission critical solutions, designed to meet the needs of public safety users in harsh conditions. Knowing that lives may depend on this equipment, Motorola has applied its expertise to optimize XTS performance on the fireground.

Like other equipment that conforms to the Project 25 Phase 1 standard, the XTS radios use IMBE™ vocoder software to translate speech into digital signals. However, the XTS line also uses Motorola's own sophisticated DSP (Digital Signal Processor) audio shaping and noise reduction algorithms. Whether operating in analog or digital mode, the XTS noise suppression software achieves exceptional end-to-end audio intelligibility compared to radios that use the IMBE vocoder alone.

Communication intelligibility is an overall radio architecture requirement. This starts with the mechanics of the radio from the point of audio entering the radio via the microphone port through the inner working of the radio including the DSP algorithms that are used to shape and filter the audio. While the Vocoder plays an important role, it is

Next Steps from Motorola

only one part of the overall radio design.

Motorola is actively working with the IAFC, other manufacturers, and the fire service industry to enhance radio performance on the fireground. We continue to invest in technology that could make a difference, such as noise suppression software and new speaker/microphone designs.

Our technical experts are helping customers select accessories and configure their systems for optimal audio intelligibility. We can assist with integrating radio hardware into other components of the users' personal equipment. And, in the Motorola user groups, such as the Motorola Trunked Users Group and the Motorola Data Users Group, as well as the IAFC work groups, we are listening to the experiences and concerns of customers. Our goal remains, as always, to deliver technologies seamlessly into the hands of first responders: simply, reliably, and without distracting them from their work. Technology That's Second Nature™.

All equipment on the fireground is a system and should be integrated as such. We believe that focusing the entire industry's attention on this issue will lead to new standards, new testing and measurement techniques, improved equipment, and expanded best practices that will, in turn, provide more dependable communications for users in the

For more information and ongoing updates, please visit our website at: motorola.com/government

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Mission Critical Portfolio

Technology That's Second Nature™

XTS Two-Way radios are part of the MOTOA4 Mission Critical Portfolio of products that offer seamless connectivity between first responders. Motorola puts real-time information in the hands of public safety personnel to provide better information that enables better decisions for better outcomes. It's Technology That's Second Nature.

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