Communications Challenges on the Fireground

International Association of Fire Fighters 20th Redmond Symposium on the Occupational Health and Hazards of the Fire Service

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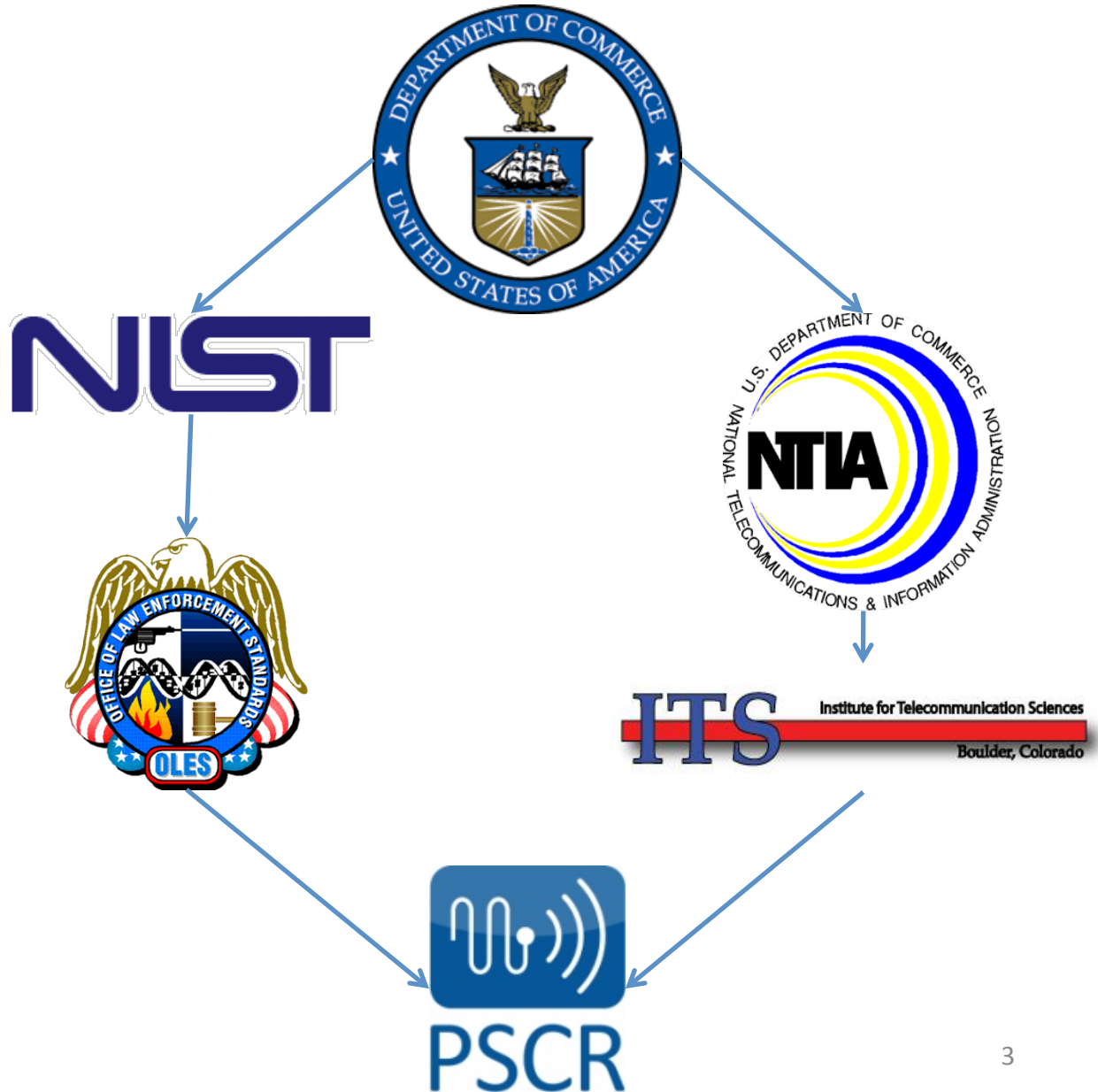
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Outline

- Background
- Summary of work
  - Best Practices Group
  - Testing Group
  - Audio Examples
- Impact/ongoing developments
- What you can do
- How you can help

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Public Safety Communications Research Program

Located at the Department of Commerce Boulder Labs in Colorado

The PSCR program is a joint partnership between:

NIST's Office of Law Enforcement Standards (OLES) and NTIA's Institute for Telecommunication Sciences (ITS)

PSCR Program Sponsors

Homeland Security

Office for **I**nteroperability and **C**ompatibility

COPS

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Background

- In the fall of 2006 some fire departments discovered that voice audio from digital radios in the presence of background noise (common to fire operations) may cause distortion to the degree of becoming unintelligible.

Boise, ID Fire	Fairfax, VA Fire
Littleton, CO Fire	Phoenix, AZ Fire
Plainfield, IN Fire	

- May 2007 the IAFC created the Digital Project Working Group to perform scientific testing and develop best practices
  - Best Practices Group
    - Focus on shorter term solutions through behavior and operational procedures
  - Testing Group
    - Quantify the nature of the problem
    - Focus on long term solutions to the problem

- http://www.iafc.org/digitalproject

Best Practices Group

- In July 2007 the Best Practices Group finalized their report:
    - Includes operational procedures
    - Training issues
    - Equipment familiarization

- Developed a PowerPoint presentation for educational and outreach purposes
    - available at the IAFC website

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Example Recommendations

- Train all personnel to properly use the assigned radio equipment in conjunction with all components of the protective ensemble.

- Incident commanders should evaluate background noise in the environment as a safety consideration in task assignments. Additional personnel may need to be assigned to a task to ensure communication capability when there are high levels of background noise in the environment.

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Example Recommendations

- Fire departments should be actively involved in the design and development of requirements for any communication-system implementation from the beginning.

- System managers and users should work with their vendors to ensure that their radios and accessories are compatible and configured with the optimal system settings to maximize audio intelligibility in high-noise environments.

Testing Group

- PSCR Audio Lab started testing on November 9, 2007 using an intelligibility test called the Modified Rhyme Test (MRT):

  - 9 Noise conditions:
    - With and without mask
    - Background noise from fire trucks, chain saws, PASS alarms, and low air alarms

  - 4 Types of radio systems used:
    1) 25 kHz analog   2) 12.5 kHz analog
    3) Baseline IMBE vocoder   4) Enhanced IMBE vocoder

  - Firefighters from 10 departments nationwide:
    Boise, ID   Fairfax, VA   Plainfield, IN   Littleton, CO
    Plainfield, IL   Coeur d'Alene, ID   Philadelphia, PA
    Riverside, OH   Englewood, OH   Huber Heights, OH

- Technical Report and Recommendations issued in June 2008:
  - http://www.its.bldrdoc.gov/pub/ntia-rpt/08-453/

Modified Rhyme Test

- Intelligibility, not Mean Opinion Score (MOS)
- Application of NFPA 1981 and ANSI S3.2 standards
- "Please select the word _____."

bed	led	fed
red	wed	shed

- 50 groups of 6 words (or 6 lists of 50 words)
- 300 words total
- 6 talkers

- 300 words x 6 talkers x 30 conditions = 54,000 samples

- HATS = Head and Torso Simulator
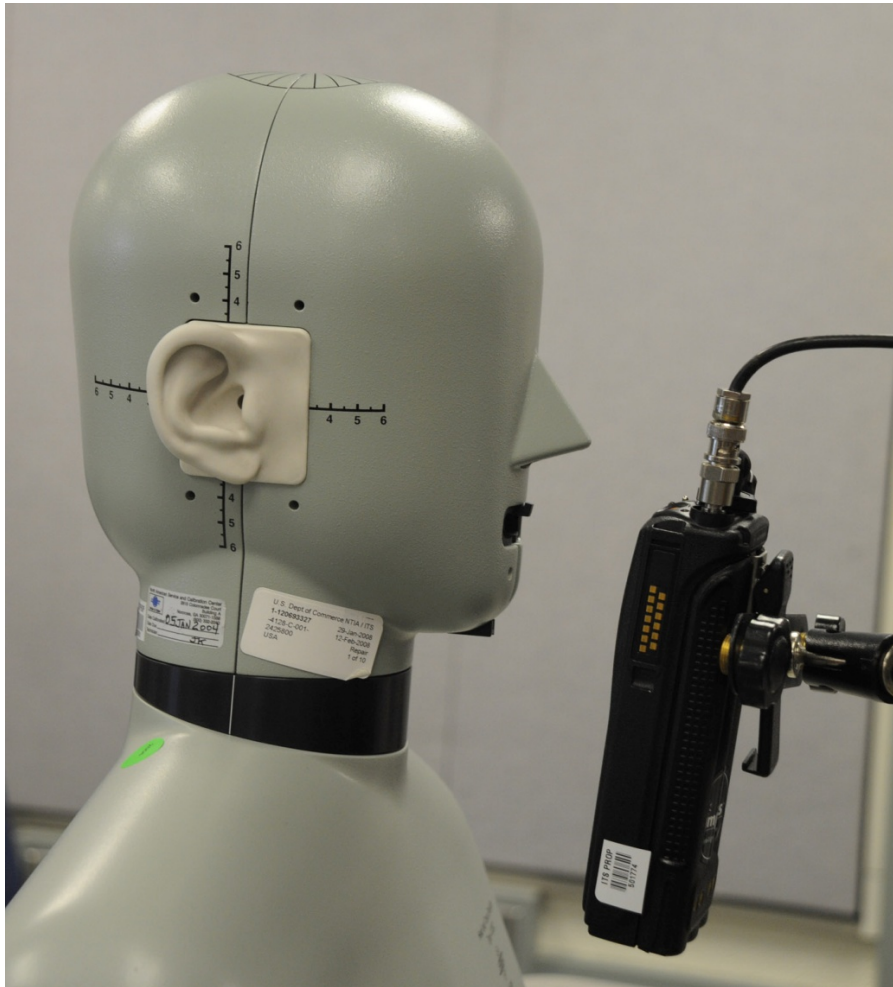
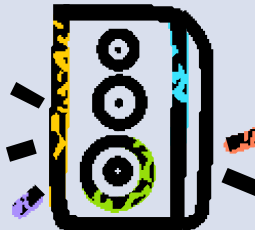Microphone 2 inches from lip reference point (LRP).

Talking HATS with mask

Microphone 1 inch from voice port.*
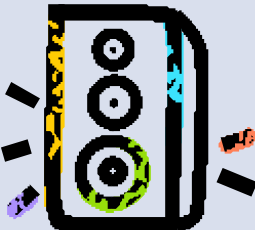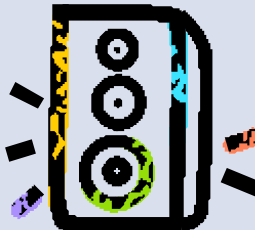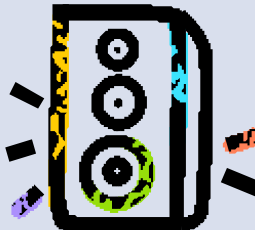
Knob and hose on regulator required careful positioning of the radio to avoid contact.

*IAFC has since changed this recommendation. It now consists of placing the mic directly against the voice port. Future testing will follow the new recommendation.
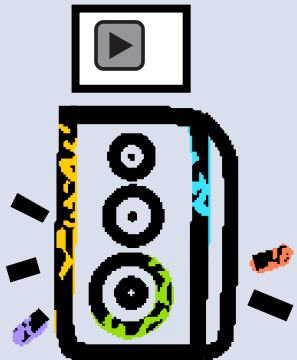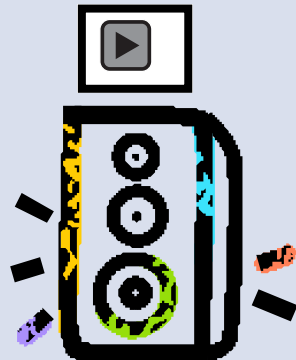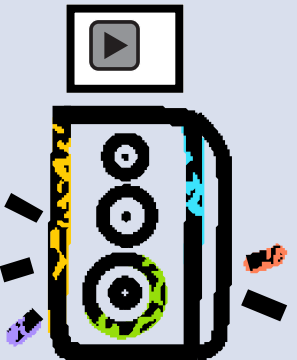
Sample Audio from Test

- No mask with no additional noise

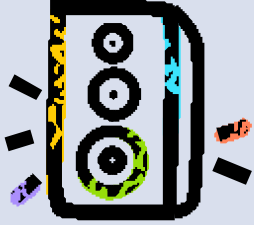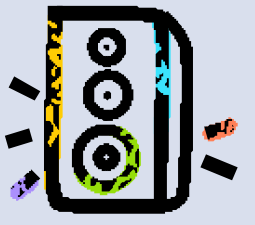| 25 kHz Analog FM	P25 with Baseline Vocoder	P25 with Enhanced Vocoder	12.5 kHz Analog FM
88% Intelligible	83% Intelligible	80% Intelligible	89% Intelligible

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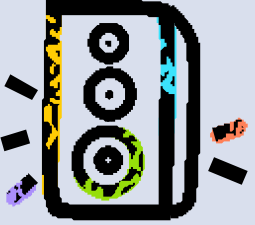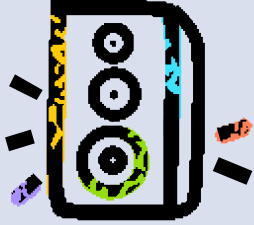
Sample Audio from Test

- No mask, fire truck pump panel

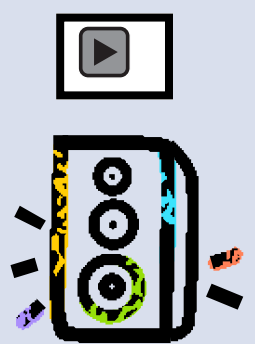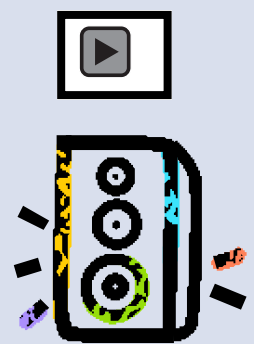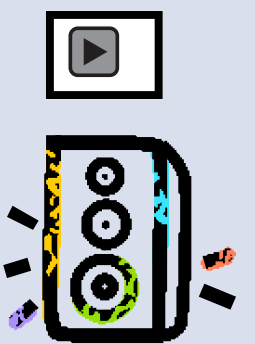| 25 kHz Analog FM	P25 with Baseline Vocoder	P25 with Enhanced Vocoder
44% Intelligible	34% Intelligible	47% Intelligible

Sample Audio from Test

- SCBA mask with no additional noise

25 kHz Analog FM	P25 with Baseline Vocoder	P25 with Enhanced Vocoder	12.5 kHz Analog FM
79% Intelligible	52% Intelligible	59% Intelligible	80% Intelligible

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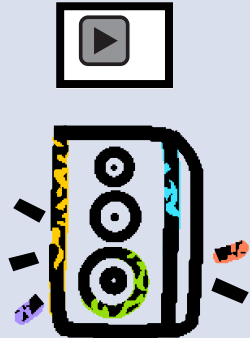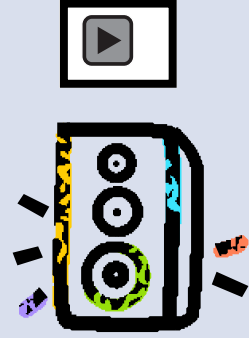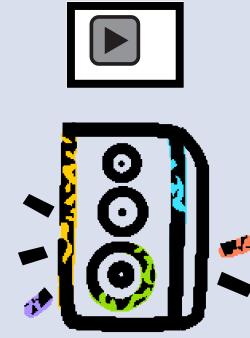
Sample Audio from Test

- SCBA mask with two PASS alarms sounding

25 kHz Analog FM	P25 with Baseline Vocoder	P25 with Enhanced Vocoder
58% Intelligible	15% Intelligible	21% Intelligible
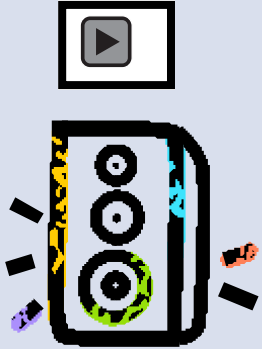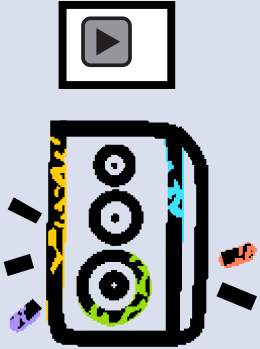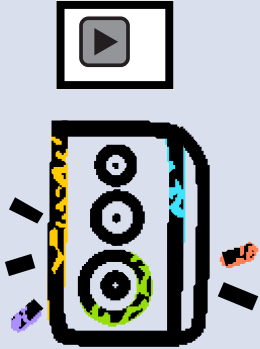
Sample Audio from Test

- SCBA mask with in-mask low air alarm

25 kHz Analog FM	P25 with Baseline Vocoder	P25 with Enhanced Vocoder
▶	▶	▶
17% Intelligible	6% Intelligible	12% Intelligible

Sample Audio from Test

- SCBA mask, 2 ½" fog nozzle

25 kHz Analog FM	P25 with Baseline Vocoder	P25 with Enhanced Vocoder
▶	▶	▶
11% Intelligible	7% Intelligible	8% Intelligible

What's Happening Now

- Project 25 created the Audio Performance Working Group (APWG) to:
  - Determine the full extent of environmental noise conditions that cause problems with the public safety comms systems across all disciplines (Fire/LE/EMS).
  - Recommend methods to measure the performance of a communications system.
  - Develop quantitative user performance requirements (including both audio quality and intelligibility) for communications.
  - Identify and evaluate emerging technologies that can improve the audio quality/intelligibility of a communication system.
  - Develop test procedures, as required, to meet these objectives.

- Manufacturers
  - 2 manufacturers introduced radios with noise cancelling mics
  - DVSI issued new release of their P25 vocoder software with additional enhancements

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What Can You Do?

- Make sure new systems meet your needs
  - Get involved in the procurement process
  - Make sure your work environments are represented in the acceptance testing
  - Participate in the testing yourself
- Give the best training possible to your users

How Can You Help?

- **Participate in formal PSCR testing**
  - Requires 2-3 day commitment for testing
  - Travel expenses to Boulder, CO covered
  - Labor not covered
  - Upcoming test cycle in January/February 2010
- **Participate in standards creation process**
  - Requires 3-4 day commitment 4 times/year
  - Travel to Project 25 quarterly meetings covered
  - Labor not covered
  - Next meetings in Mesa, AZ January 2010

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Thank You

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