



Development and Evaluation of the Multi-Modal Communication Management Suite

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Command and Control Operations





Command and Control Operations



Pros

- **Real-time access to information from distributed operators results in greater situation awareness thus more accurate and faster decisions**

Cons

- **Overload of communication that is perishable or hard to detect**
- **Systems that are redundant and not inter-connected**





Multi-Modal Communication





Spatial Audio



- **Spatializing communication into virtual locations increases intelligibility by 30 – 40% as well as reduces listener's perceived mental workload**

radio24370000 - 243 MHz

[15:02:58]Havoc: 5-7 marking round willie pete at my command request time of flight max ord over

[15:04:32]Havoc: bravo 2-1 this is zulu 5-7 marking round over

[15:04:35]Icebox: 5-7-2-1 mark out

[15:04:48]Havoc: **grid november-victor 3-0-7-0-3-4-5-0 over**

[15:04:51]Icebox: 2-1 copies grid november-victor 3-0-7-0-3-4-5-0 out

[15:05:02]Havoc: 15 round willie pete at my command request time of flight max ord over

[15:05:07]Icebox: 2-1 copies marking round willie pete at my command request time of flight max ord authenticate alpha-bravo over

[15:05:10]Havoc: engage charlie out

[15:06:32]Icebox: zulu 5-7 bravo 2-5 with message to observer

[15:06:41]Havoc: *** ahead ***

[15:06:54]Icebox: bravo 2-5 passes alpha battery immediate suppression in effect target number alpha-foxtrot 1-0-1-0 time of flight 5-9 seconds max ord 7000 feet over

[15:07:11]Havoc: alpha battery immediate suppression in effect target number alpha-foxtrot 1-0-1-0 time of flight 5-9

Keywords: Find History Vol. Adj. Mute Isolate Replay Talk



Capture and display of messages



- Real-time speech-to-text transcription
- Records audio files
- Sends and receives Chat message

radio275000000 - 275 MHz

[15:03:54]Viper3: 3 *** 4 *** left
[15:04:04]Viper1: VIPER-1 and 2 reference 2-6-0
[15:04:10]Magic: VIPER-1 single group BULLSEYE 0-5-0/14, 24000 track east bogey
[15:04:12]Viper1: VIPER-1 gate
[15:04:19]Viper1: VIPER-1 has group heavy
[15:04:23]Viper2: *** 2 same
[15:04:34]Viper1: VIPER-02 target group BULLSEYE 0-5-6/21, 25000 MAGIC declare
[15:04:40]Magic: MAGIC flyer BULLSEYE 0-6-0/20, 24000 bogey
[15:04:40]Viper1: ***
[15:04:43]Viper2: VIPER-2 target 0-5-8/23, 24000 bogey
[15:04:51]Viper1: VIPER-1 formation is offset container 4 ship
[15:04:51]Viper2: VIPER-2 same sorted northern leader
[15:04:55]Viper1: VIPER-1 offset 3-0-0
[15:04:59]Viper3: *** 0-3

Keywords
Find
History
Vol. Adj.
Mute
Isolate
Replay
Talk

Play Stop Revise Annotate Tags: **P** **P** **P** **P**



Accessing Information



- Flag lines of comm for easy retrieval
- 'Find' function allows operators to search for specific comm
- 'History' goes to particular times

The screenshot displays four windows of a radio monitoring application. Each window shows a list of communication logs with a search bar and various control buttons (Play, Stop, Revise, Annotate, Mute, Isolate, Replay, Talk). The windows are titled as follows:

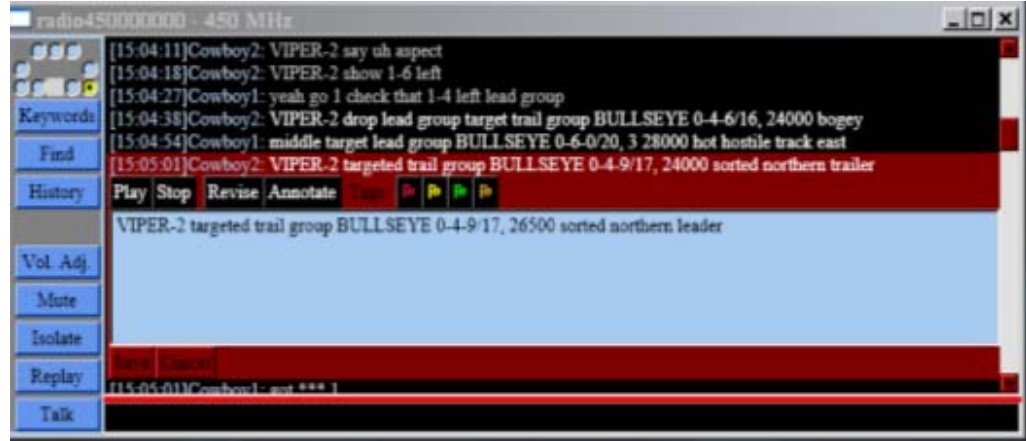
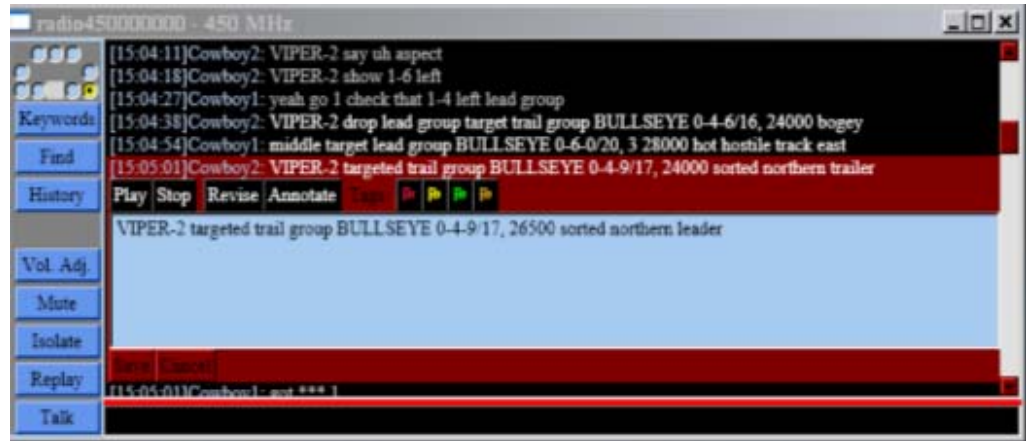
- radio400000000 - 400 MHz:** Shows a search for 'hostile' with results including 'Detected threat' and '0-9-3 threat BRAA 2-0-5/18, 36000 track northeast hostile'.
- radio300000000 - 300 MHz:** Shows a search for 'hostile' with results including 'yeah go 2 fox 3 northern trailer' and 'yeah go 3 ID hostile hostile fox 2 northern trailer fox 2 southern trailer'.
- radio350000000 - 350 MHz:** Shows a search for 'bullseye' with results including 'Barracuda: VIPER target 3 group champagne 15 wide 8 deep weighted south north lead group BULLSEYE 0-5-4/36, 32000 spades heavy 4 contacts line abreast 3 south lead group 27000 hostile heavy 4 contacts line abreast 5 trail group 10000 hostile 2 contacts'.
- radio300000000 - 300 MHz:** Shows a search for 'bullseye' with results including '0-2 target group BULLSEYE 0-4-7/11, 20000 bogey' and 'yeah go 3's radar contact and 2 you're 3-1 and 2 bear 2-3'.

A 'History Criteria' dialog box is open in the bottom right window, showing options for 'Go to Time' (15:11), 'Days ago', and radio buttons for 'Relative Time' and 'Absolute Time'.

Edit / Annotate Messages



- SR is not 100% accurate
- Messages can be edited to reflect the correct information
- Text can be formatted to user's preference
- Operators can leave notes themselves for later view or debriefings



Keyword



- User defined keywords are highlighted

radio400000000 - 400 MHz

[15:16:54]Darkstar: tac start targeted group **BULLSEYE** 0-6-9/51, 7000 hostile

[15:17:03]Conan1 and 2: VIPER-1 spiked notch south

[15:17:09]Conan3 and 4: VIPER-3 fox 3-7000 track 3-3-0

[15:17:14]Conan1 and 2: 0-9-1-8 north

Keywords

- Select Keywords
- Refresh keywords
- Enable highlighting
- Disable highlighting
- Show Keyword List

<input checked="" type="checkbox"/>	braa
<input checked="" type="checkbox"/>	bullseye
<input type="checkbox"/>	fox
<input checked="" type="checkbox"/>	kill
<input checked="" type="checkbox"/>	cleared hot
<input checked="" type="checkbox"/>	tally
<input checked="" type="checkbox"/>	foxtrot
<input checked="" type="checkbox"/>	zsu
<input type="checkbox"/>	hostile

AA 2-3-0/16, 7000 hostile

ed 2-6-0 close

nce 2-7-0

BULLSEYE 0-6-7/55,

BRAA 1-8-0/17, 10000 hostile

is

oup **BULLSEYE** 0-6-6/54, 34000 track south hostile group **BULLSEYE**

group **BULLSEYE** 0-8-6/39, 7000 track south hostile 1 group faded

group track south 34000 0-9-1 look for group 23000 track north

[15:18:39]Conan1

[15:18:42]Conan3

Isolate

Replay

Talk

Evaluation of the Multi-Modal Communication Tool



Initial evaluation of the MMC tool

- Assess the potential utility as a communication management suite as compared to Radio, 3D Radio, and Chat

The combination of comm tools would aid operators to quickly and accurately detect and reply to critical messages independent of information load

10 paid participants monitored six comm channels for 10 minutes for the occurrence of a critical phrase and reply by repeating the message back

Research Design



4 comm devices x 2 signal difficulties within design

- Radio, 3D, Chat, & MMC
- Short & Long
 - Viper 1 ID hostile
 - Vipter 1 hostile north trail group 75 miles
 - **Neutral signals**
- 4 signals per channel per min
 - **Critical signals**
- 1 critical signal per channel per min

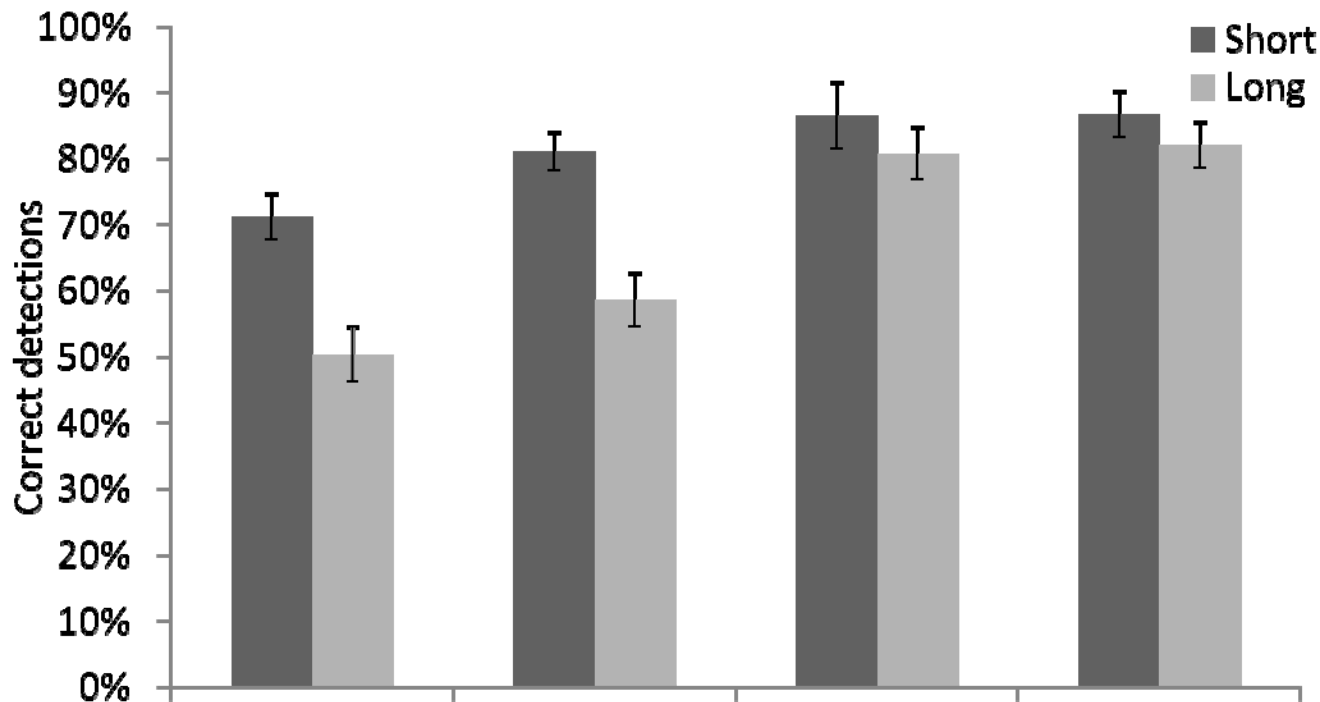
Results - Correct Detections



MMC (84.3) = Chat (83.6) > 3D (69.8) > Radio (60.7)

Short (81.3) > Long (67.9)

Significant Interaction



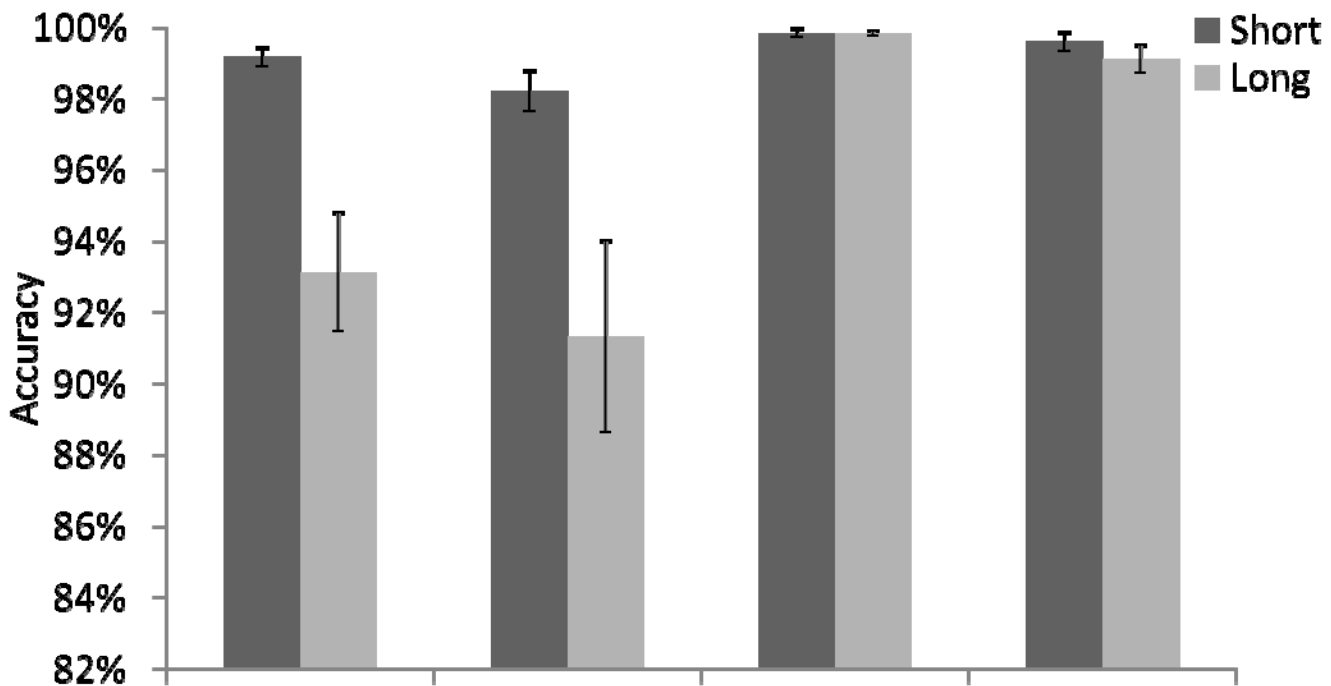
Results - Accuracy



MMC (99.4) = Chat (99.8) > 3D (94.8) = Radio (96.1)

Short (99.2) > Long (95.8)

Significant Interaction

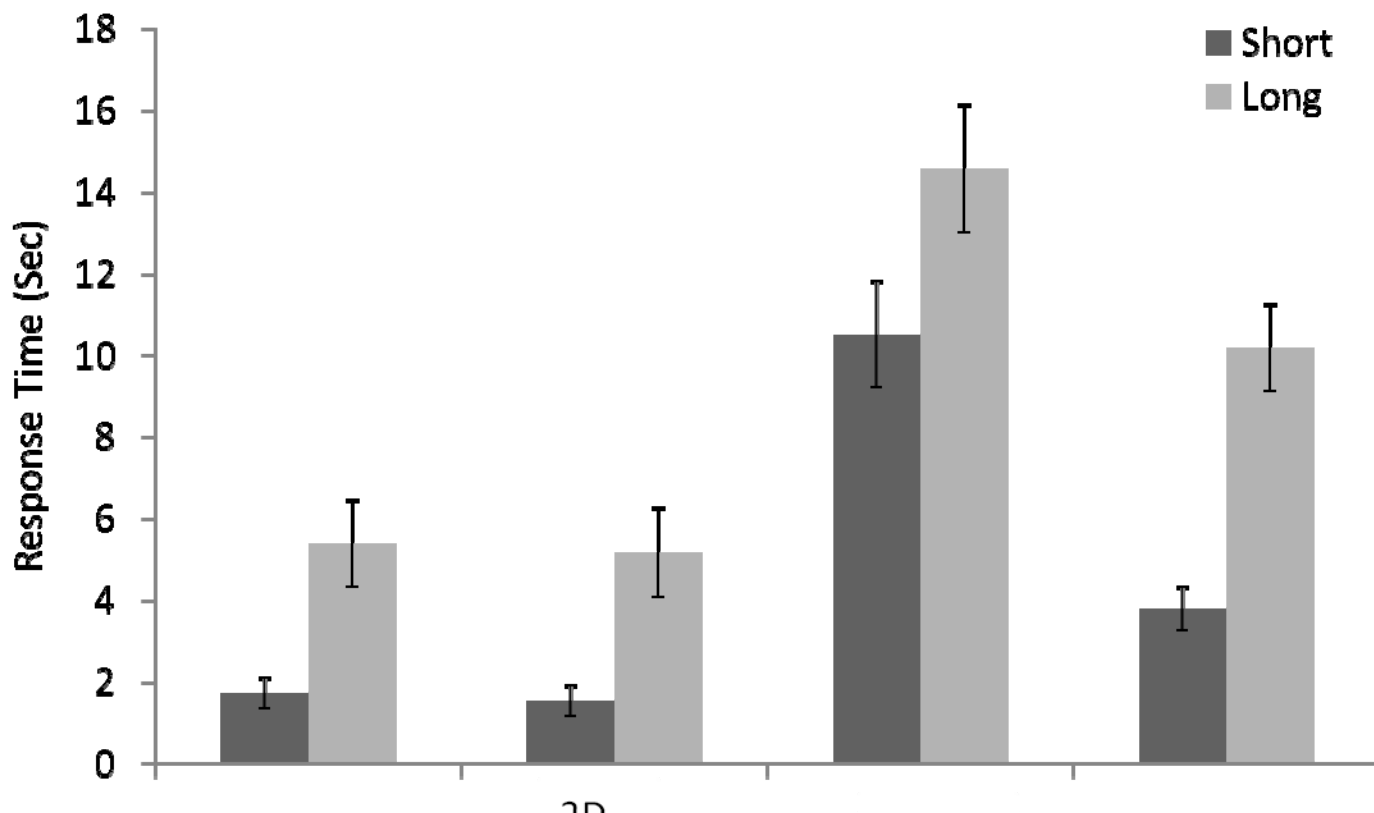


Results – Response Time



Radio (3.51) = 3D (3.35) < MMC (6.98) < Chat (12.54)

Short (4.39) < Long (8.82)



Conclusion



This study examined operator's ability to quickly and accurately reply to detected signals with the use of various communication devices

Radio vs Chat

MMC offers a compromise between the speed of Radio monitoring and the accuracy and logging capabilities afforded from Chat

There was no difference in correct detection and response accuracy between the short and long critical messages for the Chat and MMC conditions

The availability of persistent transcriptions of Radio communication and increased intelligibility of 3D Radio coupled with the ability to retrieve pertinent information could be the difference between mission success or failure

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Questions?

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