



Multi-Modal Communication

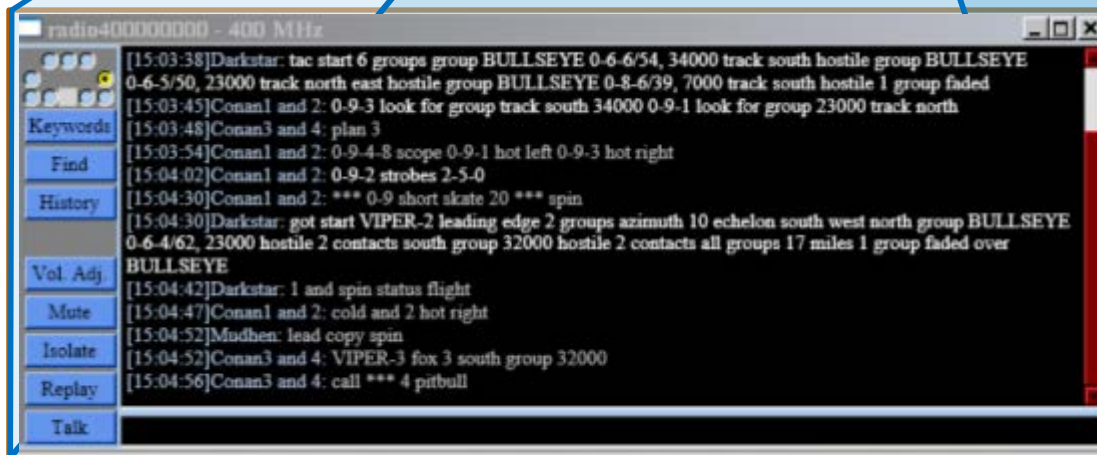
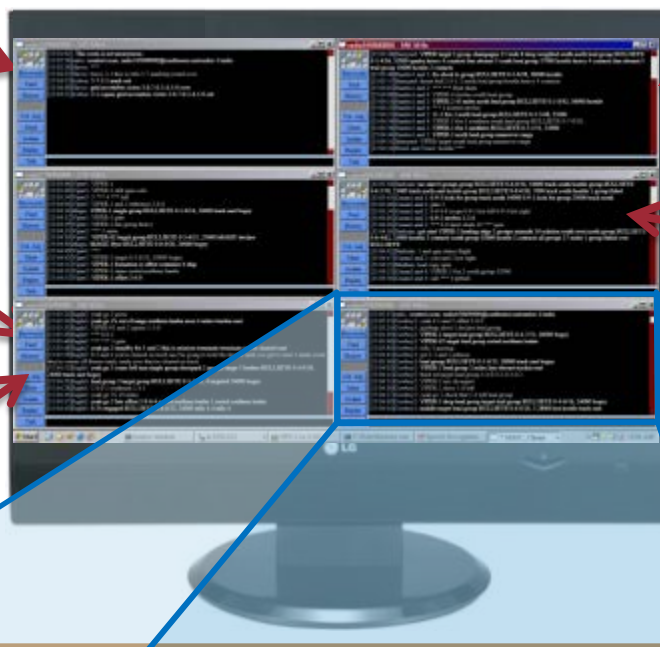
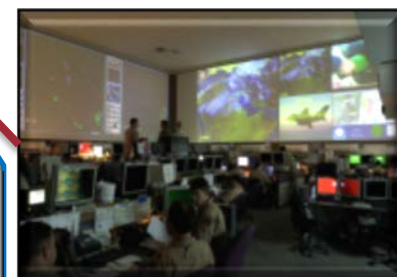
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Multi-Modal Communication





Spatial Audio

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

The diagram illustrates a virtual audio environment. A central character with a face and ears is surrounded by several black speaker icons, representing a spatialized audio field. Below this, a screenshot of a radio communication interface is shown. The interface includes a frequency display at the top, a list of messages with timestamps and call signs, and a control panel on the left with buttons for 'Keywords', 'Find', 'History', 'Vol. Adj.', 'Mute', 'Isolate', 'Replay', and 'Talk'. The messages are as follows:

- [15:02:38]Havoc: [unclear]
- [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



Capture and Display of Radio Messages



- Real-time speech-to-text transcription of radio messages
- Audio files are recorded and linked to transcription
 - Messages can be replayed in faster than real time
- Messages are timestamp

[1] radio450000000 - 450 MHz

Play Stop Revise Annotate Tags: [B] [B] [B] [B] [B] A- A+ R X

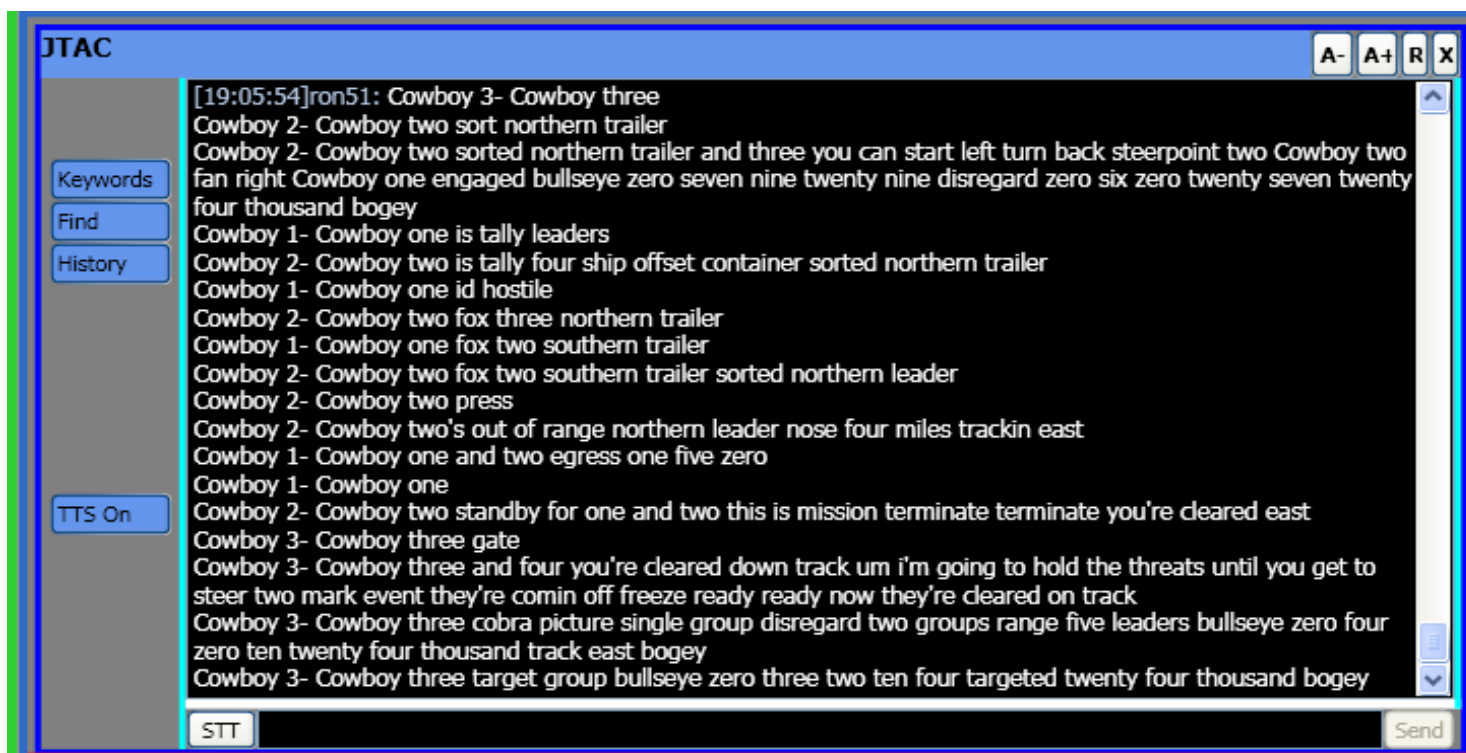
[20:40:54]Cowboy3: cowboy-03 passing
[20:41:00]Cowboy1: cowboy-01 and 2 jettison
[20:41:09]Cowboy1: cleared group BULLSEYE 0- 5- 0 /15 28 ,000 track east bogey
[20:41:16]Cowboy2: cowboy-02 lead group 2 miles line abreast tracking east
[20:41:24]Cowboy3: airedale target lead group 3 and 4 and uh freeze you up and reload you
[20:41:28]Cowboy2: cowboy-02 say 0- aspect
[20:41:33]Cowboy2: cowboy-02 show 1-6 left
[20:41:41]Cowboy1: cowboy-01 check that 1-4 left lead group
[20:41:52]Cowboy2: cowboy-02 drop lead group target trail group BULLSEYE 0- 4- 6 /16 24 ,000 bogey
[20:42:07]Cowboy1: cowboy-02 ID the group BULLSEYE 0- 6- 0 /20 can re-form 88 ,000 HOSS COWBOY track east
[20:42:17]Cowboy2: cowboy-02 targeted trail group BULLSEYE 0- 4- conans out /13 24 ,000 sorted northern trailer
[20:42:18]Cowboy1: cowboy-01
[20:42:27]Cowboy1: cowboy-01's egress 3- 0- 5-0
[20:42:34]Cowboy2: cowboy-02's dropped lead group
[20:42:39]Cowboy1: cowboy-01 that bandsaw right third cowboy-02 fan right too
[20:42:48]Cowboy3: cowboy-03 come left
[20:42:53]Cowboy1: cowboy-01's tally threat



Text-Chat



- Sends and receives Chat messages
- Chat input via typing or speech-to-text (STT)
- Chat messages can be heard with text-to-speech (TTS)





Edit / Annotate Messages



- ASR is not 100% accurate
- Messages can be edited to reflect the correct information
- Text can be formatted to user's preference
- Ability to copy and paste
- Operators can leave notes to themselves for later review or debriefings

The image displays two screenshots of a software interface for editing and annotating messages. The top screenshot shows a message being edited in a text box, with red arrows pointing from the list items to the text box. The bottom screenshot shows a message being annotated with a note in a text box, with a red arrow pointing from the list item to the text box.

radio45000000 - 450 MHz

Play Stop Revise Annotate [P] [P] [P] [P] [A-] [A+] [R] [X]

[17:12:13]Cowboy1: CONAN trail group BULLSEYE 0- 4- 0 /11 can target 0- 5- 0 /12 conan-04 ,000 track east bogey
(R)[17:12:17]Cowboy3: cowboy-01 and 2
[17:12:28]Cowboy2: cowboy-02 say aspect of the lead group track 0- 7- 0-1 and 2-1 conan-03's up and reload ship
(R)[17:12:36]Cowboy3: cowboy-03 drop lead group gimbal airedale target
1. cowboy-02 drop lead group gimbal airedale target
0. cowboy-03 drop lead group gimbal airedale target
[17:12:45]Cowboy3: cowboy-03 target trail group now BULLSEYE 0- 5- 5 /28 4 ,000
cowboy-03 target trail group now BULLSEYE 0- 5- 5 /28 4 ,000

Save Cancel

[17:12:51]Cowboy1: cowboy-01 sorted northern trailer
[17:13:02]Cowboy3: can a all target group BULLSEYE 0- 6- 5 /28 28 ,000
[17:13:18]Cowboy3: cowboy-01 and 2 crackle
[17:13:18]Cowboy1: cowboy-03's 10 miles power hud

TTS On Vol. Adj. Mute Isolate Replay Talk STT Send

radio35000000 - 350 MHz

Play Stop Revise Annotate [P] [P] [P] [P] [A-] [A+] [R] [X]

[17:14:59]: This room is not anonymous.
[17:11:07]Rambo1 and 2: cowboy-01 in-place 90 left reference 2- 5- 5 BARNYARD bogey dope
[17:11:18]Barnyard: CONAN 01 as group BRAA 2- 5- 5 /33 static out of 10 ,000 hostile heavy 4 contacts
[17:11:25]Rambo1 and 2: rambos push
(A)[17:11:27]Barnyard: BARNYARD
[17:11:55]Barnyard: counter are 3- group champagne 15 wide 8 deep weighted south north lead group BULLSEYE 0- 5- 4 /36 32 ,000 spades heavy 4 contacts line abreast 3 cowboy-03 group 27 ,000 hostile heavy 4 contacts line abreast 5 trail group 10 ,000 hostile 2 contacts
[17:12:03]Rambo1 and 2: rambo-02 group BULLSEYE 0- 5- 6 /38 36 ,000 hostile
[17:12:13]Barnyard: cowboy-02 locked north lead group hostile heavy 4 contacts

Save Cancel

[17:12:20]Rambo1 and 2: rambos float skate
[17:12:24]Rambo3 and 4: RAMBO 0- 4- strobes south lead group
[17:12:33]Rambo1 and 2: cowboy-02 45 miles north lead group BULLSEYE 0- 5- 8 /42 36 ,000 hostile
[17:12:41]Rambo1 and 2: rambo-02 fox 2 north lead group BULLSEYE 0- 5- 5 /40 25 ,000

TTS On Vol. Adj. Mute Isolate Replay Talk STT Send



Accessing Information



- 'Find' function allows operators to search for specific words or phrases
- Flag lines of communication for easy retrieval
- 'History' goes to particular times

The screenshot displays two windows of a radio communication interface. The top window is titled "[3] radio300000000 - 300 MHz" and the bottom window is titled "[12] radio450000000 - 450 MHz". Both windows show a list of communication logs with timestamps and call signs. The interface includes a search bar, a list of communication logs, and various control buttons like Play, Stop, Mute, and History. Red arrows point from the text on the left to specific features in the interface: the search bar, a line of communication, and the History button.



Keyword



- User defined keywords are highlighted
- Counts number of messages since channel was last visited

[18] radio300000000 - 300 MHz

Keywords
Find
History

TTS On
Vol. Adj.
Mute
Isolate
Replay
Talk

[20:34:36]Eagle3: eagle-01 and 2 gate
[20:34:45]Eagle2: eagle-02 say aspect of the lead group track 0- 7- 0 want bandsaw 2 untargeted 0 02
[20:34:53]Eagle3: hud eagle-03 drop lead group gimbal cobra uh target
[20:35:03]Eagle3: eagle-03 target trail group now **BULLSEYE** 0- 5- 5 /28 24 ,000
[20:35:06]Eagle1: eagle-01 sorted northern trailer
[20:35:16]Eagle3: cobra targeted lead group **BULLSEYE** 0- 6- 5 /28 28 ,000 track east bogey
[20:35:21]Eagle3: eagle-01 and 2 shackle
[20:35:27]Eagle1: eagle-03's 10 miles power hud 30
[20:35:38]Eagle3: eagle-03's engaged **BULLSEYE** 0- 6- 2 /25 24 ,000 tally 2-4 tally 2
[20:35:41]Eagle1: eagle-01 and 2 cross turn
[20:35:47]Eagle3: eagle-03's ID hostile hostile
[20:35:52]Eagle2: eagle-02 fox-2 northern trailer
[20:35:58]Eagle3: eagle-03 fox southern trailer
[20:36:04]Eagle3: eagle-03's out east below 20
[20:36:12]Eagle3: eagle-03 this is mission terminate you're cleared out east
[20:36:15]Eagle1: eagle-01's ready
[20:36:19]Eagle1: eagle-01 you're cleared on track
[20:36:31]Eagle1: can 01 cobra-03 target 2- groups 0 /10 15 north group **BULLSEYE** 0- 1- 0 /15 22 ,000 track east bogey
[20:36:42]Eagle3: eagle-01 and 2 offset 2- 9- 0 south group **BULLSEYE** 0- 7- 5 /7 28 ,000 track east bogey



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Questions?

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