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# Radio Interoperability

A White Paper  
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CTO

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## **Radio Interoperability**

The events of 9/11 revealed major limitations in systems supporting emergency communications between public safety agencies during a crisis. Those events have added new catchphrases to our daily lives, including “Homeland Security” and “Radio Interoperability”.

If you ask five people to define Radio Interoperability, you will likely receive five different answers. At Voiceboard, we propose the following definition:

***The ability of any commercial, public-safety or military radio user to initiate and receive calls at any time without the assistance of an operator. Radio Interoperability allows calls to be made to any other radio, packet-switched IP network, or circuit-switched telephone network connected user, or a combination of these, when the connection is properly authorized by system rules.***

Radio interoperability problems traditionally arise when radios operate on different frequency bands, or in the event of incompatible signaling and packet data protocols. The mobile radio industry has recently defined the P25 standard to address these long standing compatibility problems.

Voiceboard’s radio interoperability solution not only solves radio compatibility issues without requiring the purchase of new radios, it also provides a global radio communications interoperability solution. The Voiceboard radio interoperability solution brings together a broad array of existing and new technologies to interconnect what once were separate and distinct systems, such as radio networks, PBX or public telephone networks and IP network connected workstations with voice capabilities.

The capability to communicate between these various user networks must be controlled by an easily configured set of rules. Connections across different networks and systems must be dynamic, configured one way for the duration of a communication session, then reconfigured with a different set of connections for a subsequent call. These connections must be made instantly by user request or action and the configuration of necessary communications services (such as establishing an ad hoc emergency conference network) must be selectable by the user. Post 9/11, simply plugging everyone together is no longer a viable solution.

In response to this need, Voiceboard has developed the BridgeWay Radio Controller, which integrates radio, switching, telephone and IP communication technologies in one, easy to use product. BridgeWay allows system integrators to quickly develop custom applications that precisely fit the needs of the end user. Alternatively, BridgeWay may be supplied with a pre-configured applications software package that satisfies typical user requirements for public safety, military and commercial applications.

### **RADIO INTEROPERABILITY SYSTEM FEATURES**

Some elements are common to nearly all deployments of a state-of-the-art Radio Interoperability solution.

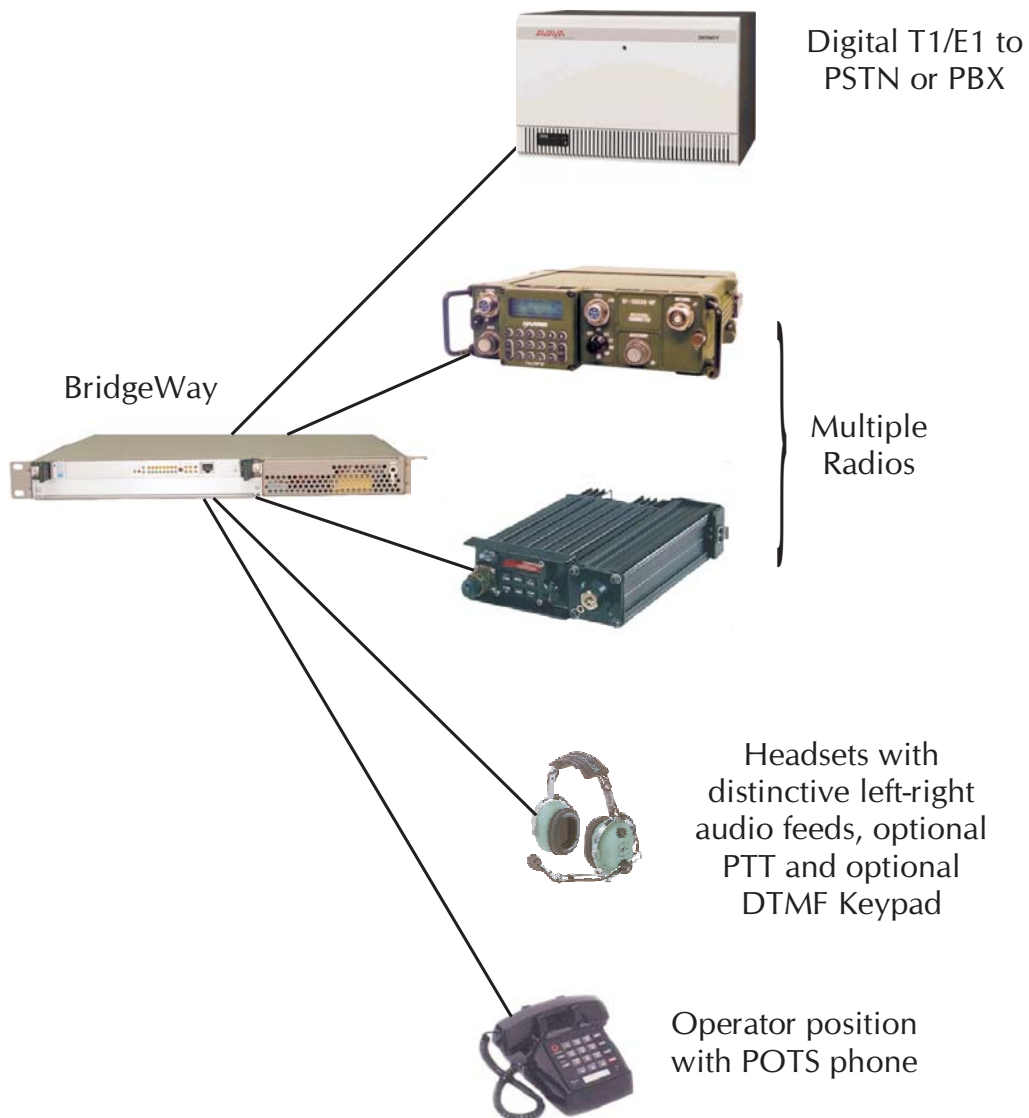
These include:

- **Keypad Radios:** Many radios available for commercial and military use are equipped with a DTMF style keypad. This permits them to initiate calls through a switching (PBX type) system capable of making routing decisions based on DTMF tones.
- **Non-Keypad Radios:** These traditional radios may be configured for primary and backup system operator intercepts, where a default connection is established after the radio user keys transmit and speaks for a configurable time period in order to initiate a call. The operator then transfers the radio user to the desired destination.
- **POTS Phones:** A Radio Interoperability solution typically supports standard (POTS) telephone sets. These phones permit non-radio users to originate and receive calls, and may also serve as system operator positions.
- **Dispatch Stations:** Dispatchers use audio devices to connect to the Radio Interoperability system. These devices include speaker and microphone sets, headsets and stand-alone handsets. A keypad may be added to provide control functions, or these functions may be accommodated by use of a computer workstation or terminal running a system client software application. Transmit control may be achieved by use of a "hard" push-to-talk or workstation control key, or by use of voice activity detection, or VAD.
- **Legacy Switching Systems:** Most of the agencies involved in a communications scenario have existing switched communications systems that must be included in the Radio Interoperability solution. The interface for these systems is frequently a digital T1/E1 circuit with ISDN protocols. The capability to define user messages sent via the ISDN data channel simplifies interoperability issues.
- **Public Switched Network:** The same mechanism used to connect to legacy switching systems may be used to provide access to the public switched telephone network (PSTN). This permits users to go "off net", to access resources to which they would normally not have access.
- **Voice over IP (VoIP):** The addition of Voice over IP to a Radio Interoperability solution offers exciting new capabilities to the radio user. Communications may be provided by Local or Wide Area Network (LAN/WAN), permitting geographically diverse users to participate in the communications network without dedicated wiring.

**BRIDGEWAY RADIO INTEROPERABILITY**

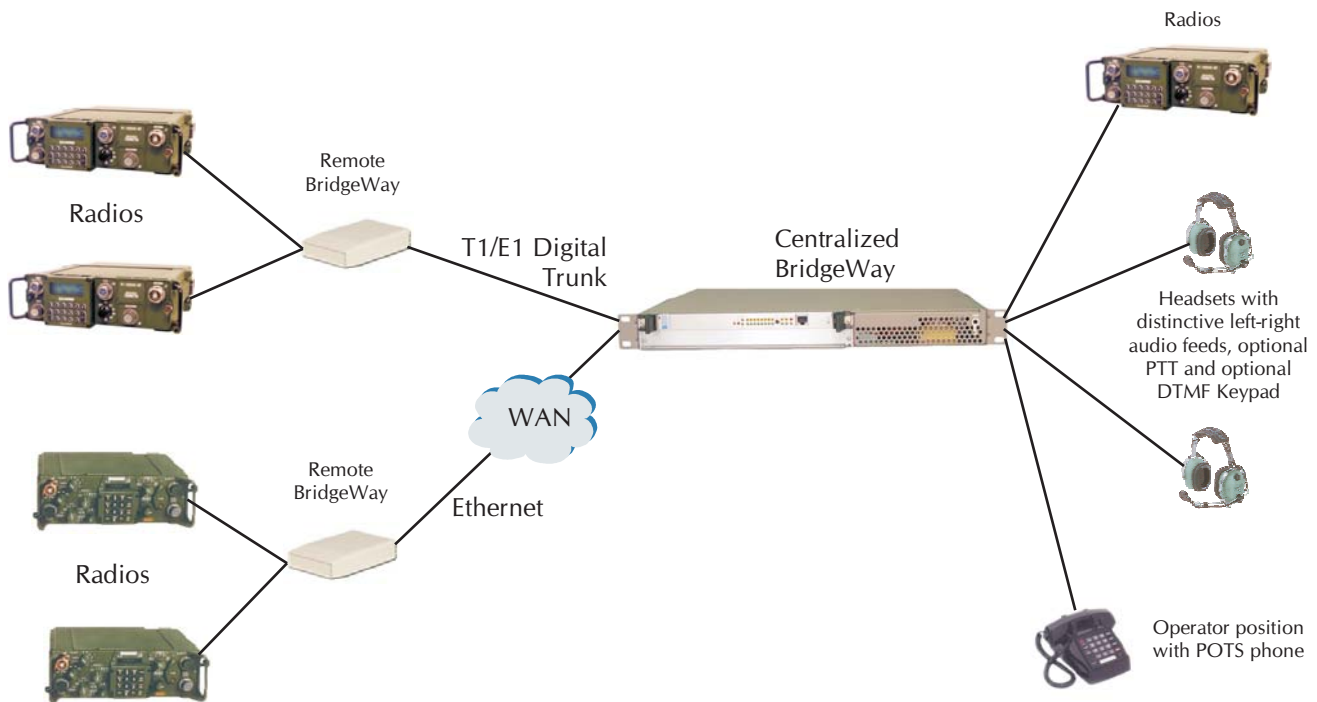
BridgeWay is a versatile product that can be used in a wide variety of applications and configurations.

BridgeWay excels in the radio interoperability arena. It merges a variety of technologies including radio, telephony, intercom, PBX, conferencing and even VoIP into a complete communications solution.



### LOCAL BRIDGEWAY TO REMOTE BRIDGEWAY COMMUNICATIONS

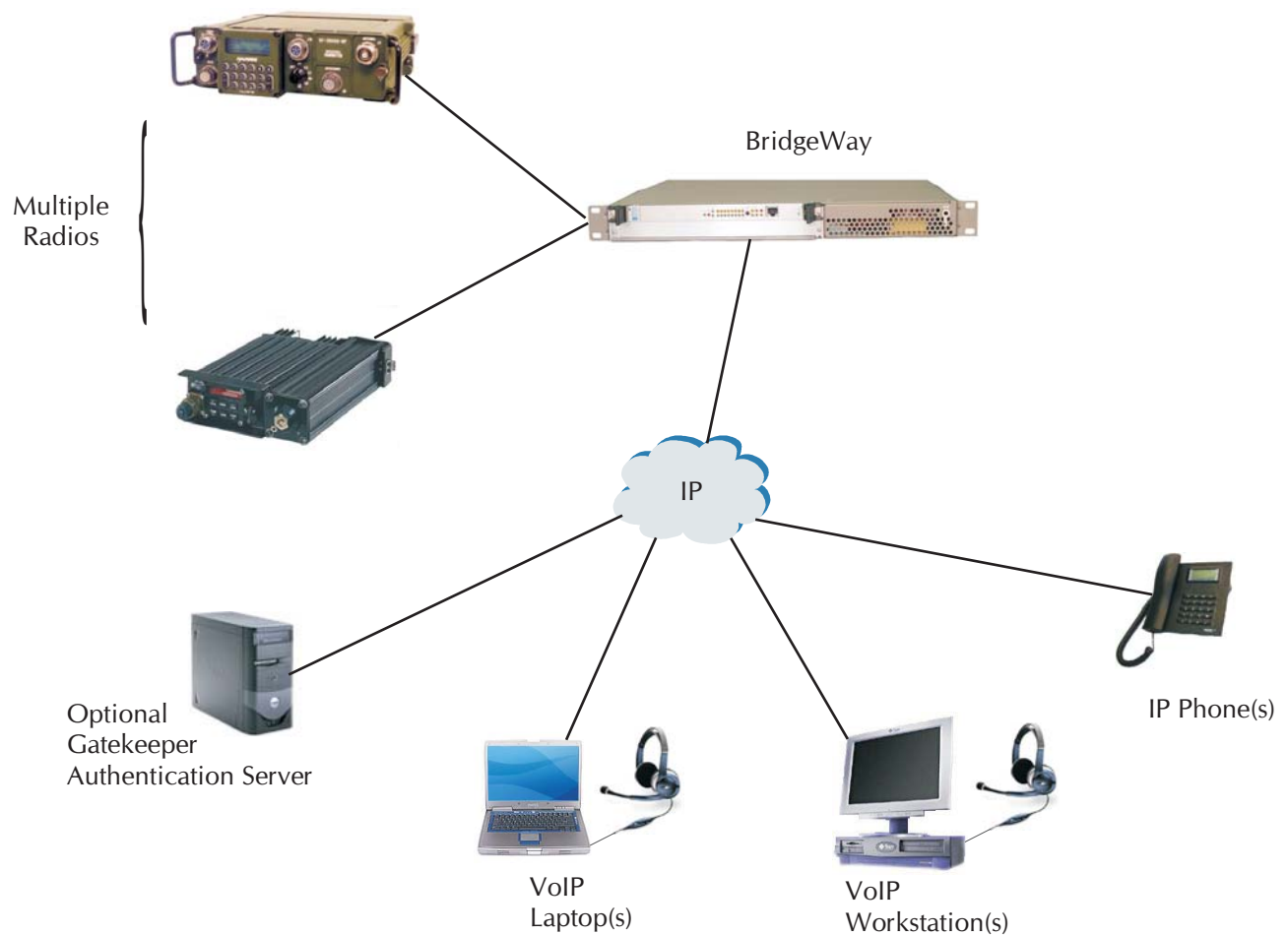
Large radio networks are frequently deployed across wide geographic areas. This makes accessibility from centralized communications points difficult. Fortunately, the BridgeWay product line can be configured for remote operation. Remote BridgeWay types include 12-port BridgeWay cPCI boards, 4-port BridgeWay cPCI boards or a 4-port stand-alone "BridgeWay Lite" box. Remote BridgeWay sites can be tied to each other and/or to a central control and communications point by means of T1/E1 digital trunks or G.711 UDP/RTP packet streaming. Audio conferencing and mixing may be accomplished at the remote or the central site, as required.



**BRIDGEWAY VoIP GATEWAY**

BridgeWay's advanced VoIP capabilities extend into the audio interface, making BridgeWay a true Radio over IP (RoIP) solution. The VoIP software library includes G.726 ADPCM, G.729A/B CS-ACELP, G.723.1 and G.711  $\mu$ /a-law PCM vocoders, conversion of DTMF and Call Progress signals into IP data packets, G.168 Echo Cancellation, AGC, Comfort Noise Generation and Jitter buffering. The Gateway library implements a standalone VoIP Trunking Gateway with the addition of call control, DSP resource management and embedded H.323 or SIP protocols.

VoIP is implemented on BridgeWay with the addition of the PMC41-DSP optional plug-in module. This PMC module may be ordered in 3 different configurations. The maximum capacity configuration supports up to 240 IP terminals, consisting of PCs, IP phones and other IP endpoints. Conferencing and mixing are available on both the IP and switched TDM audio sides.

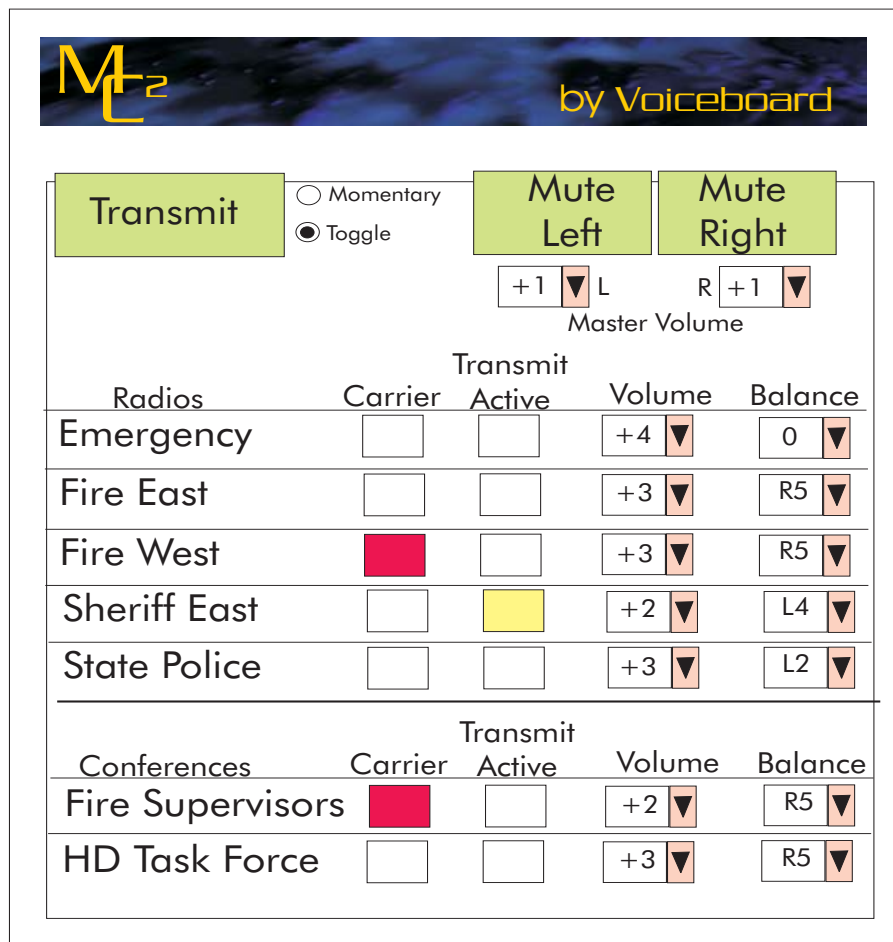


### 3.4 BRIDGEWAY WEB SERVER

BridgeWay Web Server brings new features to Homeland Security, dispatch center, emergency services and tactical military applications.

The BridgeWay operating system includes a fully programmable web server, extending system management and monitoring services to any PC or workstation supporting a standard web browser. This capability, when used in conjunction with VoIP audio services included in PC workstations and laptops, permits desktop control of audio switching, mixing, conferencing, left-right headset audio sources, audio level control and more. Much of the programming to realize this capability can be accomplished in HTML and Java Script, significantly reducing system development time.

Some sample screens developed for Voiceboard customer applications are included below.



Dispatch Console Screen





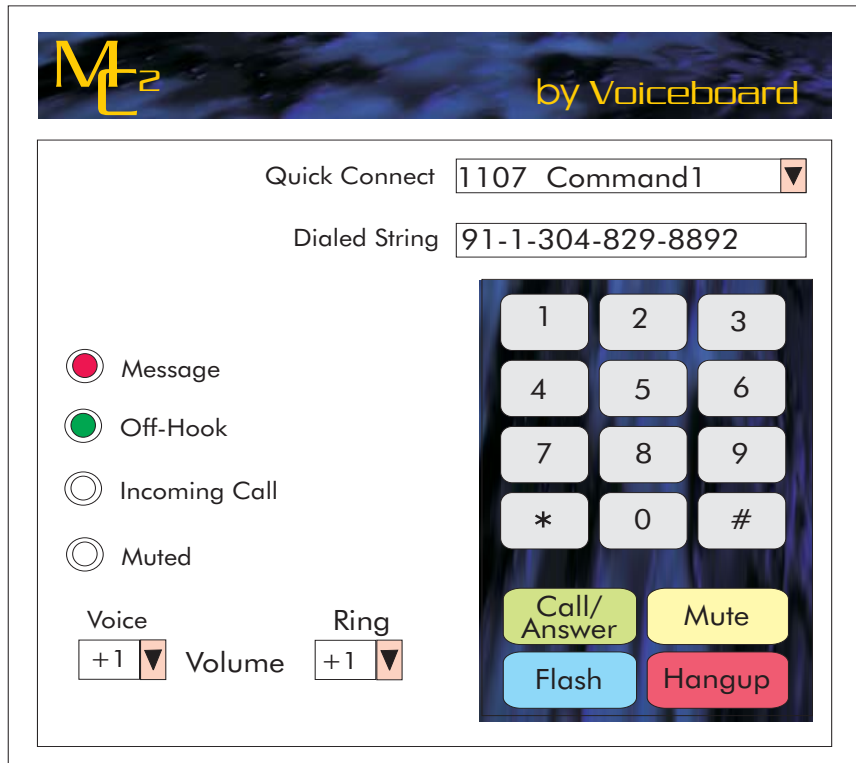
User Administration

Name  Password

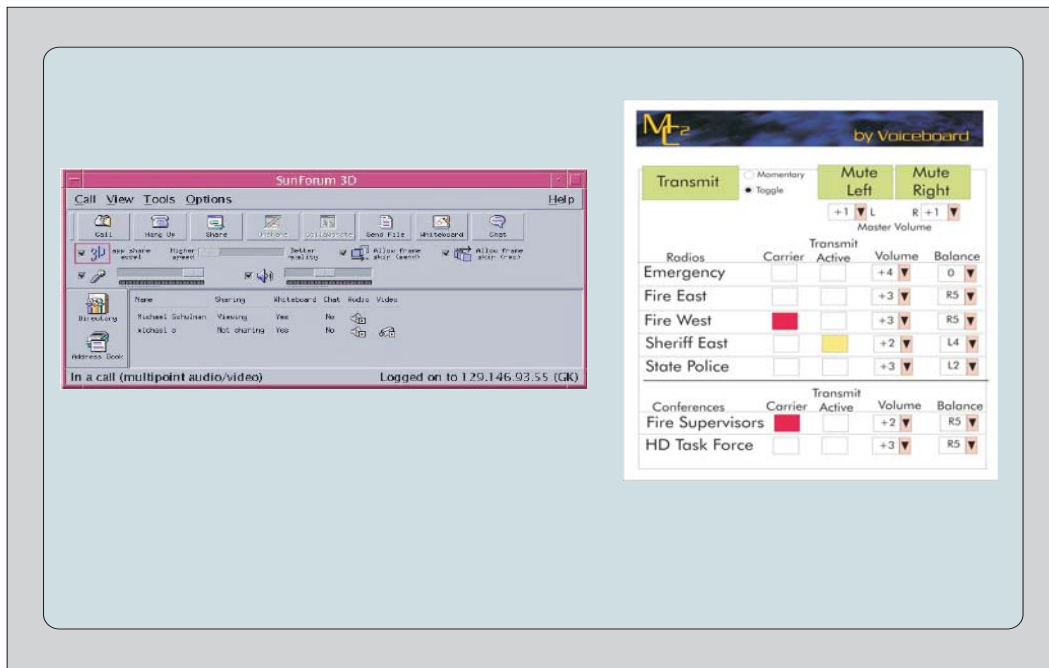
Radios			
Channel	Name	Access	Transmit
<input type="text" value="1"/>	<input type="text" value="Fire East"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="text" value="2"/>	<input type="text" value="Fire West"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="text" value="3"/>	<input type="text" value="Tactical Group A"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text" value="4"/>	<input type="text" value="Tactical Group B"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text" value="5"/>	<input type="text" value="Tactical Group C"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text" value="6"/>	<input type="text" value="Fire Marshall"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="text" value="7"/>	<input type="text" value="Sheriff East"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="text" value="8"/>	<input type="text" value="Sheriff West"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="text" value="9"/>	<input type="text" value="State Police"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="text" value="10"/>	<input type="text" value="Fire Supervisor East"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text" value="11"/>	<input type="text" value="Fire Supervisor West"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text" value="12"/>	<input type="text" value="Fire Supervisor Multi-Alarm"/>	<input type="checkbox"/>	<input type="checkbox"/>

Conferences			
Channel	Name	Access	Transmit
<input type="text" value="1"/>	<input type="text" value="Fire Supervisors"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="text" value="2"/>	<input type="text" value="All Fire"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text" value="3"/>	<input type="text" value="All Tactical"/>	<input type="checkbox"/>	<input type="checkbox"/>

User Administration Screen



Soft Phone Screen



Workstation Display with Collaborative Audio Capabilities

## MC<sup>2</sup>

MediaPro MC<sup>2</sup> Call Control is performance optimized call control application software capable of implementing a wide variety of real time communications applications for military, government, enterprise and commercial carrier services. The primary focus of MC<sup>2</sup> is to integrate software based PBX and IVR functionality with BridgeWay radio interoperability.

MC<sup>2</sup> is compatible with BridgeWay interfaces to the PSTN, radios, POTS telephones, VoIP connected PC's, IP telephones, encrypted communication devices, and PBX and legacy telephone equipment connected via FXO/FXS, T1/E1 spans and E&M tie lines.

MediaPro MC<sup>2</sup> provides the following PBX features. These features are available to all supported interface types, including POTS, FXS, FXO, radio, digital trunks and IP telephone terminals:

- Call Forwarding
- DTMF, MF and Call Progress Tones
- Voice Announcements
- Call Transfer
- POTS Operator console
- IP Operator console
- Individual Line Circuit Class of Service
- Preset and meet me conferencing
- Intercom
- Caller ID
- VoIP
- Priority override
- Hunt group
- Hookflash
- Hold

The MC<sup>2</sup> radio interface is designed to support the demanding requirements of emergency services and tactical military operations, including mobile, shelter, airborne and marine theatres of operation. MC<sup>2</sup> radio interface features include:

- 4-wire audio
- Remote radio control from laptop
- Transformer isolated interface
- Transmit on/off keying control lines
- VOX and squelch
- DTMF keypad signaling
- Multi-channel Radio conferencing
- Universal audio level adaption
- Individual channel gain control
- Multi-channel mixing
- Direct dial

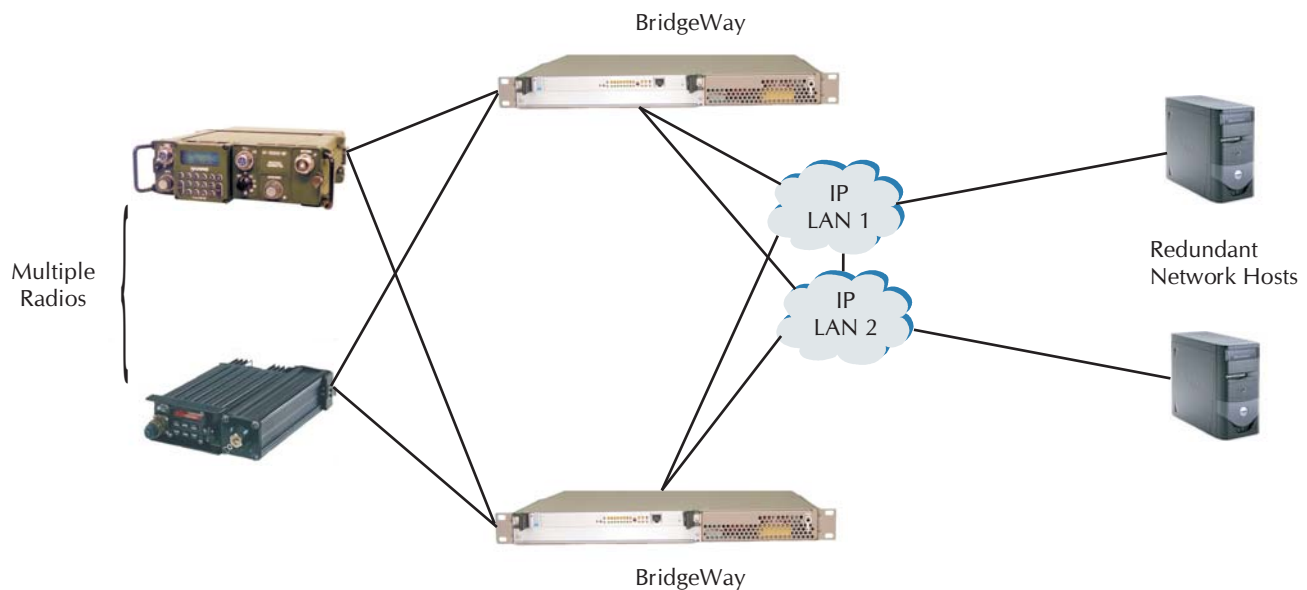
## REDUNDANT BRIDGEWAY CONFIGURATIONS

### Network Redundancy Configuration

BridgeWay may be deployed in a redundant configuration under Ethernet host control to achieve an extremely high (five 9's) system availability. Redundant network hosts communicate BridgeWay port states, negotiate active and standby status and perform automatic switchover in the event of network connectivity or hardware failure.

Key to this capability are BridgeWay's redundant 10/100 base-T Ethernet ports. This feature permits connection to BridgeWay through a dual switching fabric or LAN, effectively eliminating any possible single point of failure.

This degree of high reliability is critical in applications relating to emergency services, military and national security. Historically, high availability has come with a high price tag. With BridgeWay, high availability is now within the reach of commercial users as well.



### 1 + 1 Redundancy Configuration

BridgeWay cards may be paired in an active/standby configuration within a chassis to achieve 1:1 redundancy operation. In this configuration, the standby BridgeWay monitors the active BridgeWay. In the unlikely event of failure in the active BridgeWay, the standby becomes active and seamlessly continues operation.