MERA GB Report B-4
Attachment B-4c

CUSTOMER DESIGN REVIEW

RNI SYSTEM DESCRIPTION

RADIO COMMUNICATIONS SYSTEM AUGUST, 2020

MOTOROLA SOLUTIONS

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Section 2

SECTION 2

SYSTEM DESCRIPTION

2.1 MOTOROLA RADIO NETWORK INFRASTRUCTURE (RNI)

ASTRO® 25 is the most widely used Project 25, Mission-Critical, Integrated Voice and Data (IV&D) communication network for public safety agencies. Installed worldwide, ASTRO 25 solutions meet and exceed IV&D requirements for day-to-day operations, as well as emergency response in the most demanding situations. ASTRO 25 is a wireless platform that combines uncompromising, real-world performance and the legendary reliability of Motorola Solutions, Inc. (Motorola).

Motorola is pleased to implement the Marin Emergency Radio Authority (MERA) a compliant solution in response to the request for a 700 MHz P25 Phase 2 TDMA Trunked Radio System. Motorola's ASTRO 25 Project 25 technology has been deployed in hundreds of systems within the US and hundreds more world-wide. From single-site to nationwide deployments, ASTRO 25 is a flexible, modular network with advanced call processing capabilities designed to meet the needs of public safety. ASTRO 25 has been designed to be adaptable and can accommodate thousands of additional users, increased geographic coverage, enhanced data applications, and connectivity to other networks—all to ensure an efficient and cost-effective mission-critical solution for years to come.

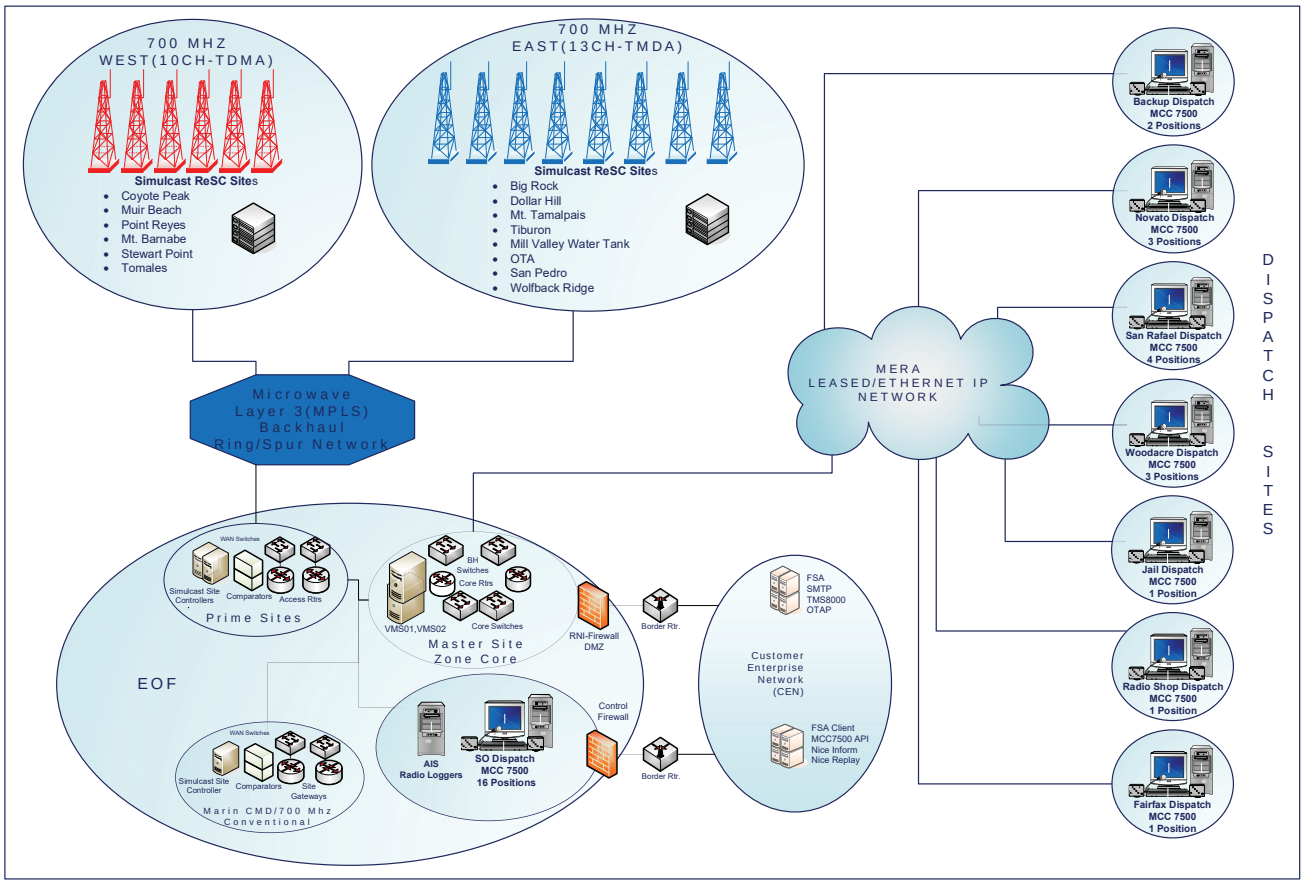


Figure 2-1: System Overview

2.1.1 Solutions Summary

- Redundant ASTRO 25 IV&D M3 master site located at EOF.
- P25 TDMA and FDMA Trunked 7/800 MHz Simulcast subsystems.
  - East Subsystem: 13 - Channels (24 TDMA Talkpaths), 8 RF Sites.
- 6 Channels are equipped with Dynamic Dual Mode
  - West Subsystem: 10 -Channels (18 TDMA Talkpaths), 6 RF Sites
- 5 Channels are equipped with Dynamic Dual Mode
  - Dual RX Diversity Tower Top Amplifiers at each RF Site
  - Microwave Backhaul Subsystem to connect RF Sites to Prime Site
  - DC Power Subsystem for each RF Site as well as for all microwave equipment
  - DC Inverter System at Master site
- Nine MCC 7500 dispatch console locations.
  - EOF Communications Center: 16 Positions (Upgrade VMPs, and Replace Computer Hdw)
  - Marin Backup Center: 2 Positions (new)
  - Novato PD: 3 Positions (new)
  - San Rafael PD : 4 Positions (new)
  - County Fire – Woodacre: 3 Positions (new)
  - Fairfax PD: 1 Position (new)
  - Jail: 1 Position (new)
  - Master Site: 1Positions (new)
  - Radio Shop: 1 Positions (new)
  - Backup control stations included for all console positions (Existing stations at EOF will be reused)
- MPLS L3 Microwave Network
- BDA System for the Jail.
- Critical Spares and Test Equipment
- Relocation /Upgrade Marin Cmd & 700Mhz Simulcast conventional simulcast system.

2.1.2 RF Site Selection

The radio communications system is comprised of 2 simulcast subsystems with 8 RF sites in the East subsystem, and 6 RF sites in the West subsystem, for a total of 14 RF sites. One subsystem provides coverage for the western half of Marin County and the other provides coverage for the eastern half of Marin County. This design provides fully compliant coverage (as detailed in the contract) and consists of the following sites:

Table 2-1: RF Sites

#	East Simulcast Subsystem	#	West Simulcast Subsystem
1	Big Rock	1	Coyote Peak
2	Dollar Hill	2	Muir Beach
3	Mt. Tamalpais	3	Point. Reyes
4	Tiburon	4	Mt. Barnabe
5	Mill Valley	5	Stewart Point.
6	OTA Broadcasting	6	Tomales
7	San Pedro		
8	Wolfback Ridge		

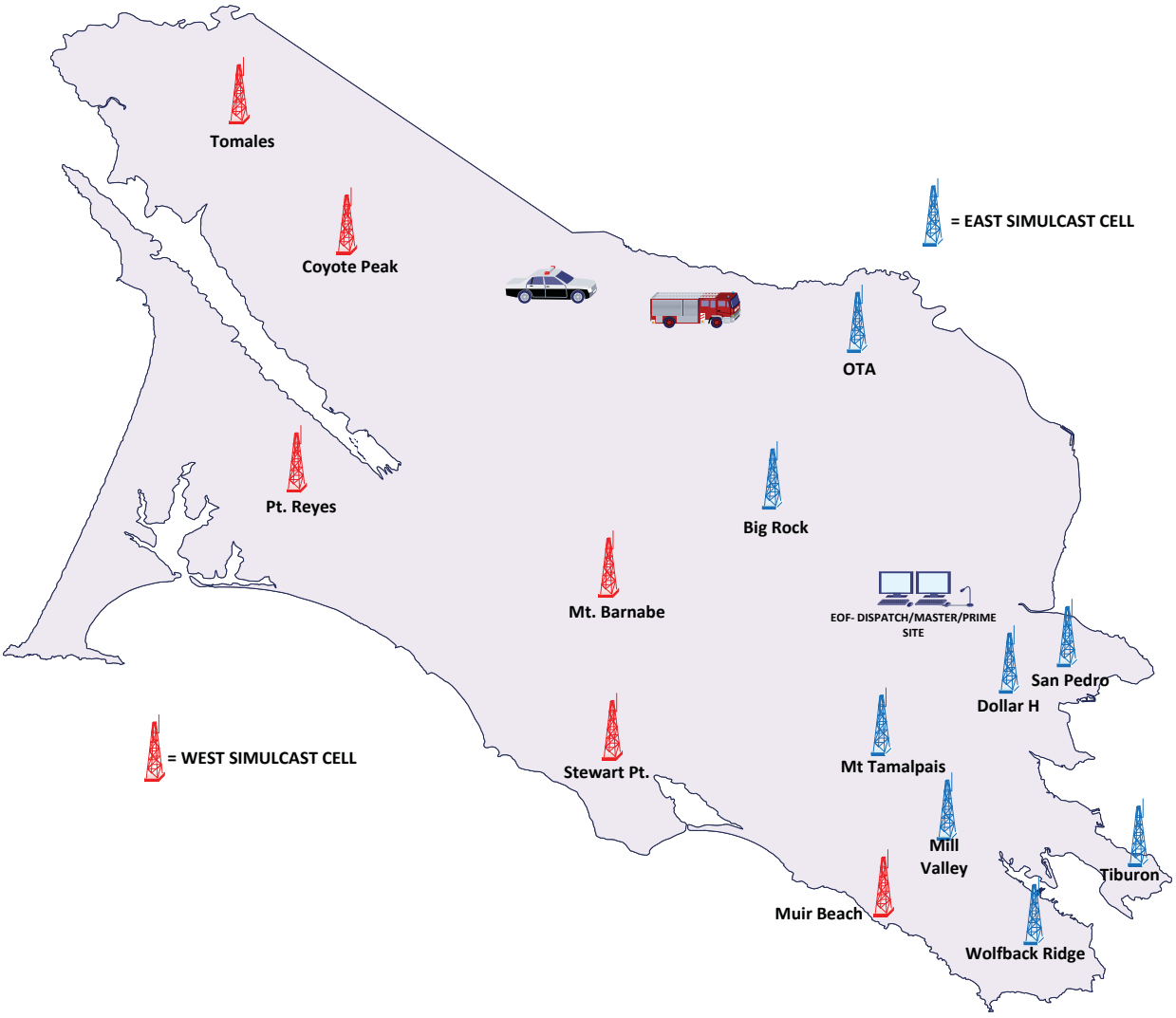


Figure 2-2: Radio Site Overview

Both East and West simulcast prime sites will be located at EOF Radio Room. Motorola will utilize two racks in row two for the prime sites. The microwave backhaul interface to the RF sites will be located in this room and require one additional rack in row two. The Marin CMD/700 Mhz will utilized an additional rack in row three.

The RF sites were selected based on the preferred order of site selection specified in the RFP and an in-depth customer evaluation of coverage and the Region 6 planning approval process.

2.1.3 Traffic Loading Analysis

Per negotiations, the traffic loading was calculated using 2500 active radios accessing the system using the following parameters:

- 1.2 calls per unit per hour
- 12 second transmission duration plus hang time for repeater dekey after end of talkgroup call
- 1% Grade of Service (GOS)

Applying the specified call rate and call duration, as well as a 2 second hang time, results in a total of 12.5 Erlangs of loading. Since the system is made up of two simulcast subsystems, it is important to understand the loading for each subsystem.

- **East Subsystem:** Assuming 100% involvement per negotiations, the result is 12.5 Erlangs, which requires 23 talkpaths in order to provide a 1% GOS.
- **West Subsystem:** Assuming 66.7% involvement per negotiations, the result is 8.33 Erlangs, which requires 17 talkpaths in order to provide a 1% GOS.

In order to satisfy these requirements, the East Subsystem is equipped with a 13-channel GTR 8000 Expandable Site Subsystem that provides 24 P25 TDMA talkpaths and the West Subsystem is equipped with a 10-channel GTR 8000 Expandable Site Subsystem that provides 18 P25 TDMA talkpaths.

2.1.4 Master Site Architecture

The Master Site serves as a primary point for all call processing and traffic management in the system. The Master Site also contains the Network Management (NM) components that manage the overall system configuration and monitors the system for alarms. To best meet the current and future needs of MERA, Motorola Solutions is proposing our scalable single zone Master Site with a redundant call processing configuration for the servers and networking equipment as shown in Figure 2-3. The Master site call processing redundancy ensures that a seamless handoff takes place when maintenance activities and equipment failures require hardware to be taken off line.

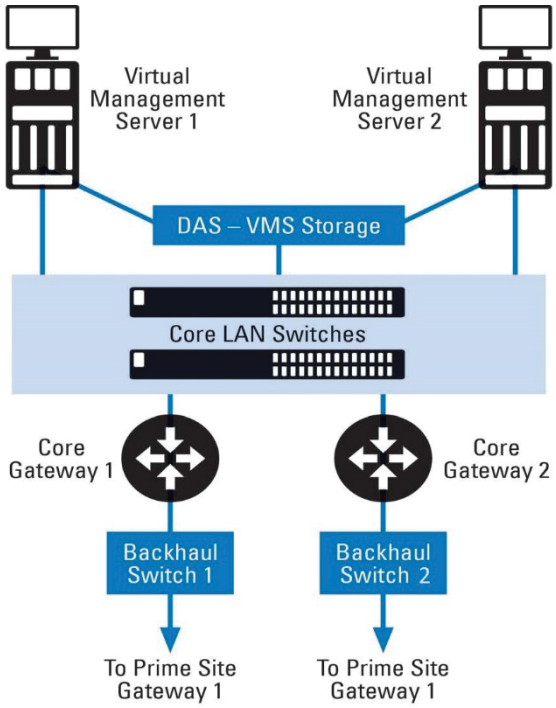


Figure 2-3: Master Site Redundant Core Configuration

The call processing functions are provided by an application known as the Zone Controller. For redundancy purposes the Zone Controller application is duplicated and hosted on both Virtual Management Servers so that in the case of a server failure, the secondary Zone Controller application will take over for the primary. Other NM applications reside on these Virtual Management Servers as

well. These applications comprise the network management components of the system and are used for tasks such as:

- Adding/Deleting subscribers from the system
- Adding/Deleting infrastructure from the system
- Alarm Reporting and Management
- Real-Time Network Monitoring
- Performance Statistics

These NM applications are not considered critical, and therefore reside on either virtual server, but not both. A loss of a virtual server will result in the loss of the functionality of the applications which reside on it, but as discussed previously, voice call processing is automatically switched to the remaining virtual server.

Critical applications (those required for processing voice calls, such as zone control, affiliations, registrations, roaming) are installed on both servers, and non-critical applications are split between the two servers.

The core network structure is comprised of Ethernet switches and routers, which enable the IP traffic to move between the Network Core and the sub-systems (RF and Dispatch sites). In addition, firewalls are included to enable IP traffic out of the radio network to other networks.

The heart of the network core is formed by the core LAN switches and routers. These devices act as the central hub of the system and the central rendezvous points for control and audio within the system. In the design configuration, the core switches and routers are redundant so that the loss of a single core router and/or switch will not interrupt the flow of data within the radio network.

The Motorola radio network is intended to be a closed network between the network core and the sub-systems. However, there are applications where communication to an outside network is required in the system (e.g. remote access, audio logging).

Communication between the radio network core and the sub-systems is accomplished via the core network and the demarcation point between the network core and the sub-systems is the backhaul switch. It is at the backhaul switches where the site links between the simulcast sub-system and dispatch centers will be terminated and where the link demarcation point will be.

2.1.5 Simulcast Architecture

The System contains two simulcast subsystems in order to meet the coverage requirements of MERA. The prime site equipment will be located at EOF.

Prime Sites

Each of the ASTRO 25 Simulcast Prime Sites consists of the following components:

- Two (2) GCP 8000 Site Controllers
- GCM 8000 Comparator Modules for each channel (2 per chassis)
- Two (2) SRX 1500 Site Gateways
- One (1) TRAK 9100 Simulcast Site Reference w/ redundant modules (used for both prime sites)
- Two (2) SRX 1500 Sub-site Access Routers
- Four (4) Prime Site Switches
- Two (2) Backhaul Switches

The fault tolerant prime sites serve as a control and audio center for the simulcast subsystem. Audio from the user radios is received by the GTR 8000 simulcast receivers at the RF sites, packetized, and routed to the prime site. At the prime site, a GCM 8000 voting comparator votes the multiple audio streams from different sites on a frame-by-frame basis. The resulting voted composite signal is better than any one site can provide. This “voted” audio at the prime site is processed by the GCP 8000 Site Controller and forwarded two destinations:

- Audio packets are distributed to each RF site within a simulcast subsystem. The RF sites simultaneously transmit the voted audio to the user radios affiliated to the given talkgroup (since coverage is provided by one simulcast subsystem). This allows all members of the call to receive this optimum audio.
- The prime sites also routes the voted audio to the Marin master site. The master site services the audio to dispatch centers, AIS servers, all wide area RF subsystems, or other devices that require participation in the call.

As shown in Figure 2-4, the prime site is equipped with redundant site controllers and the comparators are distributed between the four LAN switches. Each LAN switch is connected to a site gateway to provide redundant link interfaces to the master site. In addition, each LAN switch is connected to a subsite access router with a backhaul Ethernet switch. This provides the redundant link interfaces to each of the RF sites.

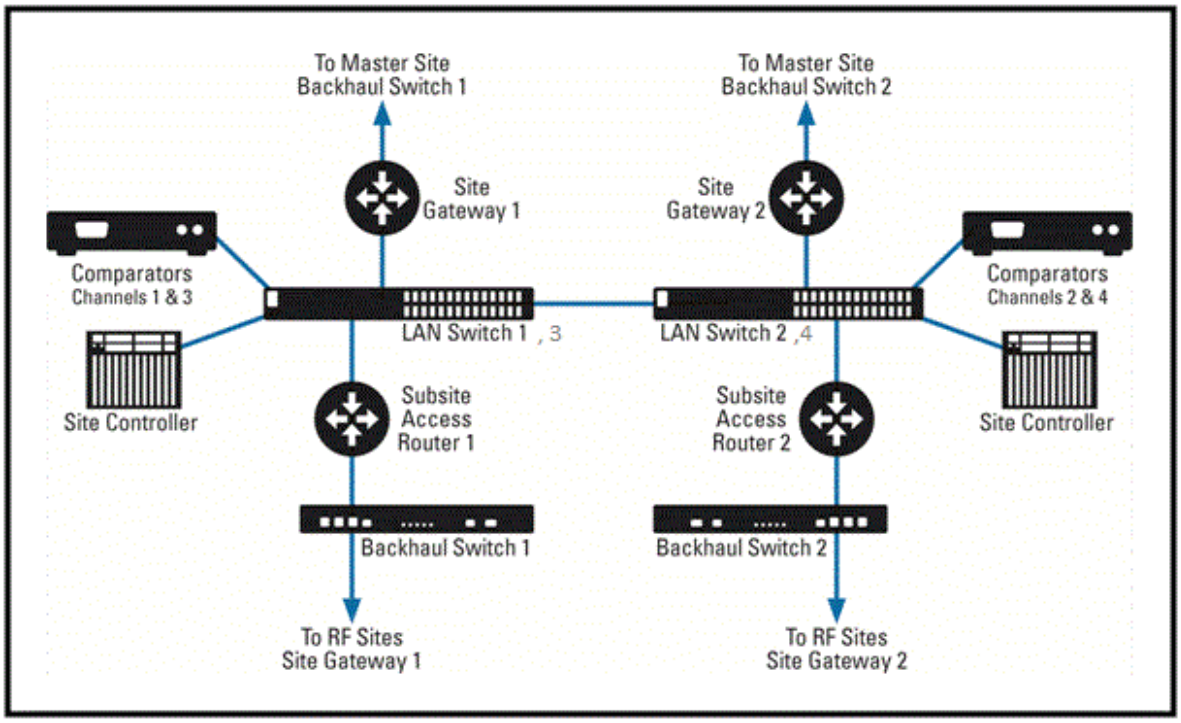


Figure 2-4: Generalized high-level diagram of the P25 trunked simulcast prime site

RF Sites

The East Simulcast Subsystem consists of the following RF sites:

- Big Rock
- OTA Broadcasting
- Mt. Tamalpais

- San Pedro
- Wolfback Ridge
- Dollar Hill
- Tiburon
- Mill Valley Water Tank

Each of the East Subsystem ASTRO 25 Remote Simulcast sites consists of the following components:

- One (1) GTR 8000 Expandable Site Subsystem (ESS) [3 racks]:
  - Thirteen (13) GTR 8000 Base Radios.
  - Two (2) SRX 345 Site Gateways.
  - Two (2) GPB 8000 Reference Distribution Modules.
  - One (1) 12-channel 700 MHz Transmit Combiners with phasing harness.
  - One (1) 6 channel 700 MHz Transmit Combiners with phasing harness.
  - Two (2) 700 MHz Site Receiver Multicouplers (primary rack).
  - Six (6) 700 MHz Cabinet Receiver Multicouplers (2 in each rack).
- Two (2) 700MHz PIP and PIM rated Transmit Antenna.
- One (1) Dual Diversity Tower Top Amplifier System w/ Control Unit.
- Two (2) 700 MHz PIM Rated Receive Antennas.
- One (1) SDM3000 RTU.
- One (1) SRX 345 Site Gateway (conventional interfaces)
- One (1) GGM 8000 Conventional Channel Gate Way (CCGW).

The West Simulcast Subsystem consists of the following RF sites:

- Mt. Barnabe
- Point Reyes
- Stewart Point
- Tomales
- Muir Beach
- Coyote Peak

Each of the West Subsystem ASTRO 25 Simulcast RF Subsites consists of the following components:

- One (1) GTR 8000 Expandable Site Subsystem (ESS) (2 racks):
  - Ten (10) GTR 8000 Base Radios.
  - Two (2) SRX 345 Site Gateways.
  - Two (2) GPB 8000 Reference Distribution Modules.
  - One (1) 12-channel 700 MHz Transmit Combiner with phasing harness.
  - Two (2) 700 MHz Site Receiver Multicouplers (primary rack).
  - Four (4) 700 MHz Cabinet Receiver Multicouplers (2 in each rack).
  -
- One (1) 700MHz PIP and PIM rated Transmit Antenna.
- One (1) Dual Diversity Tower Top Amplifier System w/ Control Unit.
- Two (2) 700 MHz PIM rated Receive Antennas.
- One (1) SDM3000 RTU.
- One (1) SRX 345 Site Gateway (conventional interfaces)
- One (1) GGM 8000 Conventional Channel Gate Way (CCGW).

The simulcast RF sites will utilize GTR 8000 base radios with half of the channels (6 channels in the East Subsystem and 5 channels in the West Subsystem) configured for both P25 Phase 1 FDMA and Phase 2 TDMA operation. Each of these channels can be configured as a control channel or voice channel and is capable of supporting dynamic switching of FDMA and TDMA operation. Up to four channels can automatically assume the control channel role at a given RF site. The architecture of the base radios use the GTR 8000 Expandable Site Subsystem (ESS) platform shown in Figure 2-5, which is an integrated design that provides a small footprint at the sites, minimizes cabling in the field, and provides power supply redundancy as well as redundant LAN switches. The ESS is well suited for future expansion as it is designed to support additional base radios and ESS racks as required.

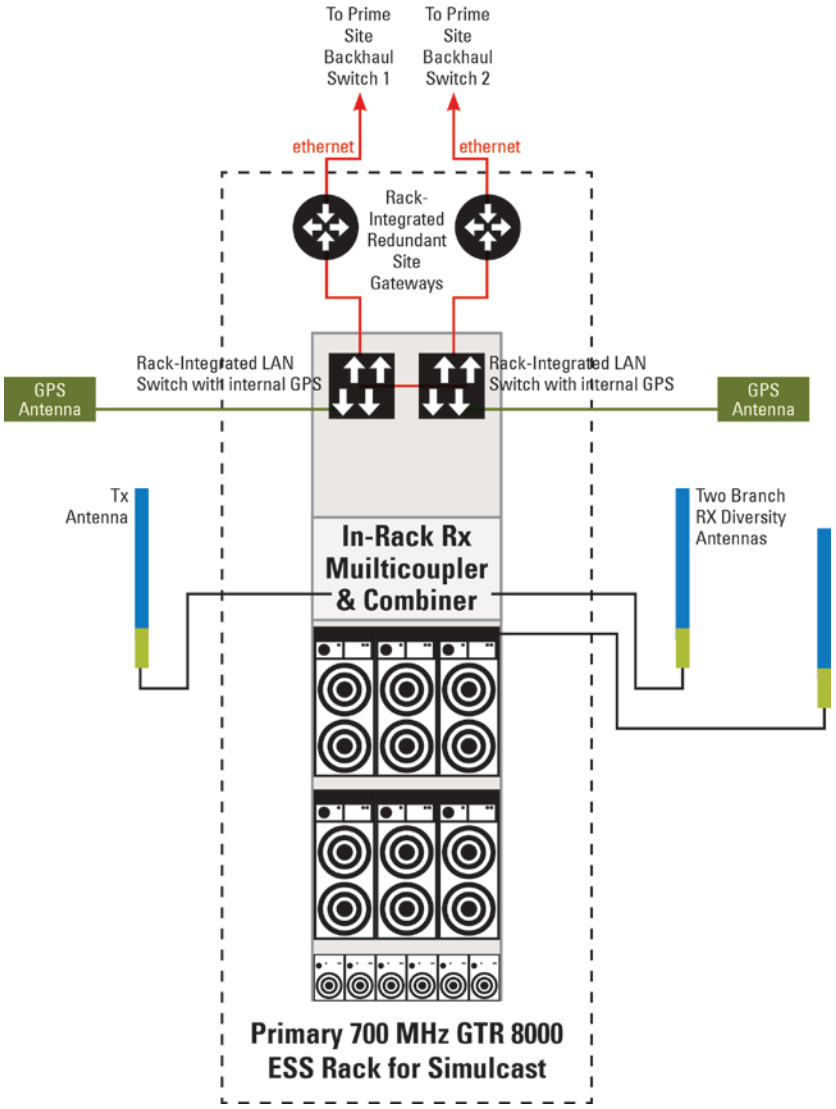


Figure 2-5: High-availability simulcast GTR 8000 ESS layout

The high availability architecture for the simulcast RF sites, providing the RF sites with redundant LAN switches and GPS receivers to eliminate a single point of failure in the switching and timing reference functions. In addition, dual site gateways provide redundant site link interfaces. These devices are powered by the ESS power supplies, one for each station providing redundant power

sources for the GPS and networking components. The power supplies revert to DC plant during AC power failure without interruption to the site's operation.

The proposed TTA's have multiple fallback levels designed into them, including redundant components and parallel RF paths. The ASTRO Network Management System (NMS) will also report and alarm on the status of the TTA's. The TTA unit has a redundant Low Noise Amplifier which is monitored, and automatically switches in the event the active LNA fails.

The RF distribution system (RFDS) utilizes two branch receive diversity integrated into the ESS racks to improve the talk-in component of coverage for Phase 2 TDMA. As shown in Figure 2-6, each receive branch consists of a TTA (tower top amplifier), site preselector and site RMC (receiver multi-coupler) for each site, and a cabinet RMC for each ESS rack. The site RMC allows for future growth as it has four outputs, one that goes to the cabinet RMC situated in ESS rack 1, and one that goes to the cabinet RMC in ESS rack 2 and two that serve as expansion outputs for feeding additional ESS racks.

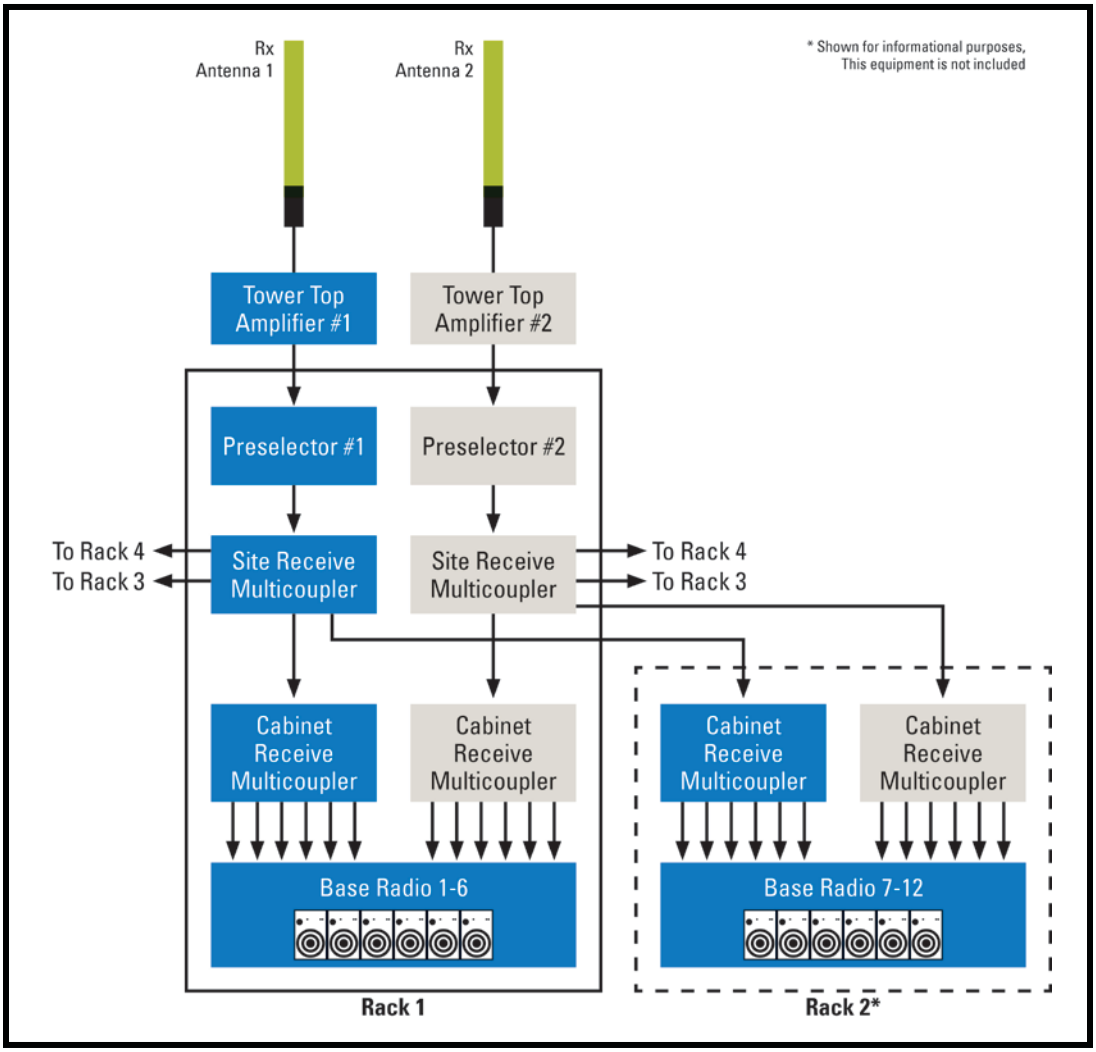


Figure 2-6: Two-branch receive-diversity RFDS

2.1.6 Master Site and Prime Site Power Requirements

The master site equipment will be located in the Radio Room at the EOF Building. The master site equipment will use AC-Power that is backed up by the existing DC plant and building generator. Some components of the Master Site such as the Core Gateways and routers that are -48VDC compatible will be powered by the existing Radio Room DC plant

Due to the space and floor loading limitation, a re-design of the backup power system for the EOF Master site is described below; the Eaton 9170+ 5kW/6kVA UPS system design will be exchanged for a redundant DC/AC inverter power system which will be connected and integrated into the existing DC power system. The power analysis shows that the existing DC system will support the added loading and still meet the 8 hour runtime requirement.

See attachment "Marin County EOF Power Description for details.

2.2 RADIO DISPATCH CONSOLES

Motorola's state-of-the-art, high-tier radio dispatch IP console system, The MCC 7500 operator positions, meets the trunked dispatching needs of MERA with an industry-leading feature set. This advanced feature set, ease of operation, and ability to customize the MCC 7500 dispatch console will improve first responder safety, decrease dispatch operator workload, all while maintaining strict security of voice communications. MCC 7500 operator positions connect directly to the radio system's IP transport network. Audio processing, encryption, and switching intelligence for dispatch are performed within each software-based operator position, without additional centralized electronics.

The MCC 7500 Dispatch IP Consoles and sites consist of the following elements:

- One (1) HP Z2 Mini Workstation PC, keyboard and mouse.
- One (1) 22" Touch-screen LCD monitors.
- One (1)Voice Processing Module (VPM).
  - Two (2) Telephone Headset Port (for radio & telephone on one headset)
- Two (2) Headset Jacks.
- Two (2) Dual Muff Headsets.
- Four (4) Speakers (can be expanded to a total of eight speakers).
- One (1) Dual Pedal Footswitch.
- Network Equipment.
- One (1) Conventional Channel Gateways (CCGW).

These components are connected together and to the rest of the ASTRO 25 system on an IP network via console site gateways and Ethernet switches. The MCC 7500 Dispatch Console functions as an integrated component of the total radio system, fully participating in system level features, such as end-to-end encryption and agency partitioning.

The MCC 7500 Dispatch Console has been robustly engineered to provide 24/7/365 dispatch capabilities with redundant and/or fault-tolerant systems should any failures occur. Every dispatch center has two SRX 345 routers connecting the site and the central controller. If one of the routers fails the other router will automatically take over with no disruption to dispatch or communications. For connectivity to the core, a single site link can be used, but will not provide for dual path redundancy. Motorola is implementing dual site links to provide the highest level of redundancy at console sites, as well as seamless fallback between the routers. If both site links are lost between a dispatch location and the central controller, the console will go into fallback operation. Every

dispatcher at the site experiencing connectivity issues are notified by an indication in the status bar at the bottom of the dispatch GUI that the dispatch console is in fallback operation. Figure 2-7 shows a typical dispatch site configuration with backup control stations and conventional channels connected to the site via Motorola's Conventional Channel Gateways (CCGW). See system drawing for details on specific sites.

Motorola's design assumes re-use of the existing fiber with new terminations to the Motorola routers. If additional fiber is required, Motorola can provide and install through the change order process.

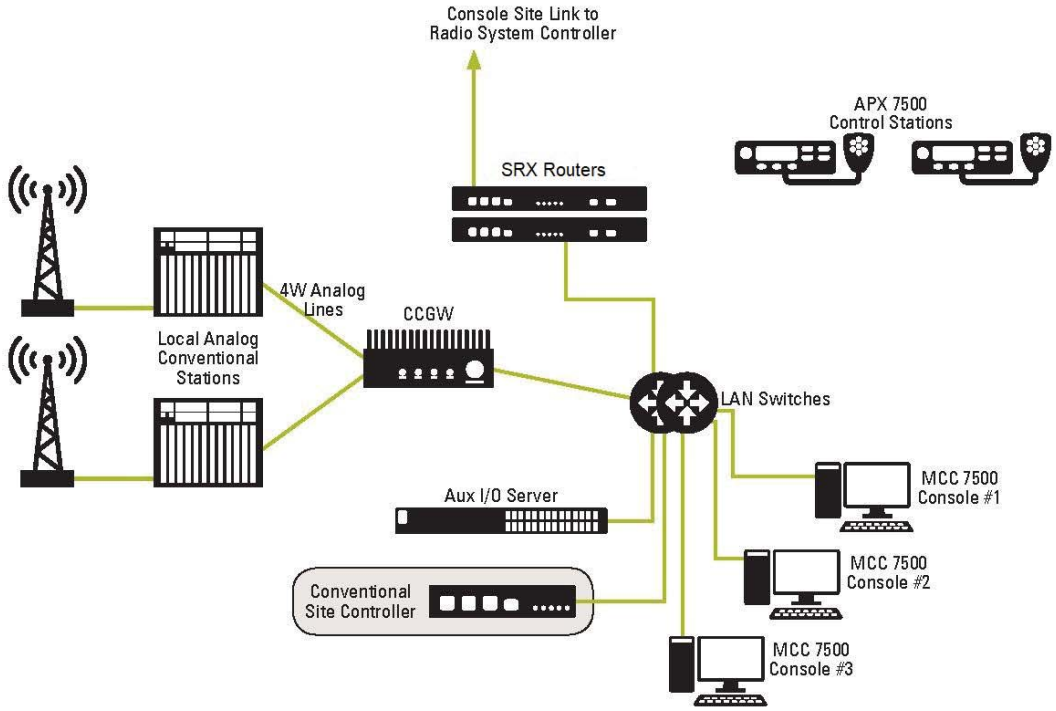


Figure 2-7: Typical Dispatch Console Configuration

The MCC 7500 Dispatch IP Consoles and associated Elite Admin GUI are compliant with the requirements that have been outlined by MERA. The Elite Admin GUI provides a customizable interface to meet Marin's dispatchers' needs. This allows the end-user to determine and utilize a setup with only the features that their dispatchers need. For example, an administrator can select from a comprehensive list of resources, indicators, and controls that their dispatchers will see while interacting with radio resource modules. This gives the end-user the ability to display the information and controls that are specific to their function and avoid an inefficient, cluttered, user interface.

2.2.1 MCC 7500 Position

An MCC 7500 operator position consists of one (1) Microsoft Windows-based computer; one (1) 22" touch screen monitor, Motorola Voice Processing Module (VPM), one select speaker, one unselect speaker, two (2) headset jacks, and one (1) dual pedal footswitch. The operator position also supports a desktop microphone as shown in Figure 2-8. Gooseneck microphones have been included as an optional item in the proposal. Two (2) additional speakers have been included with each dispatch position.

Figure 2-8 is a picture of a typical MCC 7500 Dispatch Position.

Figure 2-8: MCC 7500 Dispatch Position

2.2.2 Voice Processing Module (VPM)

The VPM provides vocoding and audio processing services for the dispatch console. It connects to the console site LAN switch and communicates with the dispatch console PC via Ethernet. Each operator position includes a PC and a dedicated VPM. As shown in Figure 2-9, the VPM also provides connections for analog devices to be connected to the digital console.

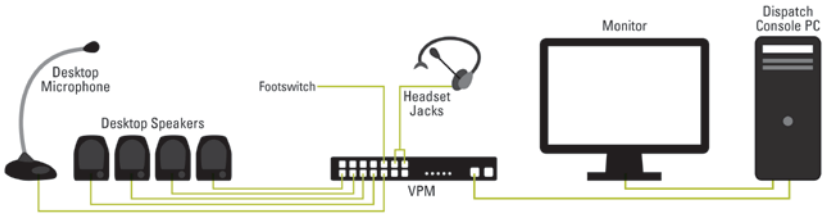


Figure 2-9: VPM Interfaces

The VPM has connectors for the following devices:

- One desktop gooseneck microphone.
- Two headset jacks.
- Four Desktop speakers.
- Logging recorder.
- Radio instant recall recorder.
- Telephone instant recall recorder.
- External telephone set.
- External paging encoder.
- One dual pedal footswitch.
- Generic transmit audio input.

The secure card provides encryption and decryption services for the dispatch console. It is capable of supporting multiple, simultaneous encryption/decryption sessions using multiple algorithms and multiple secure keys. The consoles include DES/OFB and AES encryption.

Headset Jack

Each dispatch console is capable of supporting up to two headset jacks. A headset jack allows a dispatch console user to use a headset while operating the dispatch console. The headset jack supports headsets which use PJ7 (6-wire) connectors (6-wire headsets have a PTT button). Each headset can either be connected to the console for supervisory applications, or to a MCD5000 desk set.

The MCC 7500 headset jack contains two volume controls: one for adjusting the level of received radio audio and one for adjusting the level of received telephone audio. A small dimple is molded into the headset jack housing near the telephone volume control so the dispatch console user can tell them apart without having to look at them.

Desktop Speakers

Each dispatch console is supplied multiple speakers, each of which transmits unique audio—that is, an audio source cannot appear in multiple speakers at a single dispatch console.

Each speaker has individual volume controls, and contains an amplifier that provides a maximum of 2 Watts of power output. Speakers are self-contained units, and can be placed on a desktop, mounted in a rack/furniture, mounted on a wall, or mounted on a computer monitor. A mounting bracket is included with each speaker.

Telephone/Headset Port

The telephone/headset port allows an external telephone set to be connected to the dispatch console. The dispatch console's headset can then be used to communicate on both the radio system and a telephone system (i.e. a 911 system). The instrument must provide the console with telephone network audio and supervisory closures, Off Hook Indicate (active when a line is seized) and Jack Sense (active when the instrument's hand set is removed from the cradle).

When a dispatch operator seizes a line on the telephone instrument without picking up the instrument's handset, the radio audio is directed to the select console speaker and the incoming telephone audio is switched to the headset. The headset microphone audio becomes live and is routed to the telephone instrument, allowing the dispatch console user to communicate hands-free on the telephone set. When the dispatch operator ends their call or the instrument's handset is in use, the headset reverts back to full radio operation.

If the dispatch operator keys up a radio resource, headset microphone is re-routed to the radio channel for the duration of the transmission while the outbound telephone audio is muted. During the transmission, the dispatch operator continues to hear the telephone audio through the headset. Once the transmission is completed, the headset microphone is routed back to the telephone.

When the telephone line is released or the instrument's handset is in use, the console headset is restored normal radio operation.

Touch Screen LCD Monitor

The state-of-the-art 22" LCD touch screen monitor is model DSEV221B from Tech Global. One monitor per dispatch position can handle the functionality needed out of a single position. The supplied monitor does support multi-touch operations, however the use of multi-touch gestures themselves (such as pinch open, pinch close or flick) are not supported on the console's GUI. Only the legacy touch operations are supported.

2.2.2.1 Console System Interfaces

Conventional Station Transmit/Receive

Interoperable communications to the trunked users is provided through a dispatcher-controlled or preconfigured patch to the mutual aid radios. Dispatcher-controlled patching is done using the Elite Dispatch GUI, and preconfigured patch is done using Elite Admin. With Preconfigured patch the resources are preconfigured to be members of a patch group, and become active patch members when Elite dispatch application is started. A preconfigured patch console can be configured to start windows automatically without need to type password and start the configuration file also automatically. If Elite dispatch application is shut down in either case of dispatcher controlled or preconfigured patch the resources will no longer be members of the patch group.

The Motorola Conventional Channel Gateway (CCGW) (Figure 2-10) forms the bridge between the MCC-series dispatch console on the ASTRO 25 trunked radio network and the mutual aid radios. This allows the dispatcher to patch the mutual aid radios and trunked talkgroups on the ASTRO 25 system as situations dictate. Each CCGW can handle eight (8) analog channels, or eight (8) V.24 channels. A total of five (5) GGM 8000 CCGW units can be interfaced a single dispatch or radio site allowing up to 40 conventional resources to be connected.

All dispatch centers will have access to conventional resources from all other (dispatch, RF and conventional only) sites connected to the master site. The limitation of 40 conventional channels refers to 40 local channels (not shared total across the network).

2.2.2.1.1 Conventional Channel Capacity per Site

The Conventional Channel Capacity per site is in Table 2-2.

Table 2-2: Conventional Channel Capacity

Location	Channels Supported
Civic Center 2nd Deck	16
Mt. Barnabe	8
Big Rock	8
Dollar Hill	8
County Jail	8
Mt. Tamalpais	8
EOF Radio Room	8
Point Reyes	8
San Pedro	8
Radio Shop	8
County Fire-Woodacre	8
Stewart Point	8
Tomales	8
OTA Broadcasting	8
Muir Beach	8
Coyote Peak	8

Location	Channels Supported
Wolfback Ridge	8
Mill Valley Water Tank	8
Tiburon	8
San Rafael PD	8
Sonoma Mountain	8

Should Marin need to interface more channels to any sites, additional CCGWs can be added to accommodate those resources.

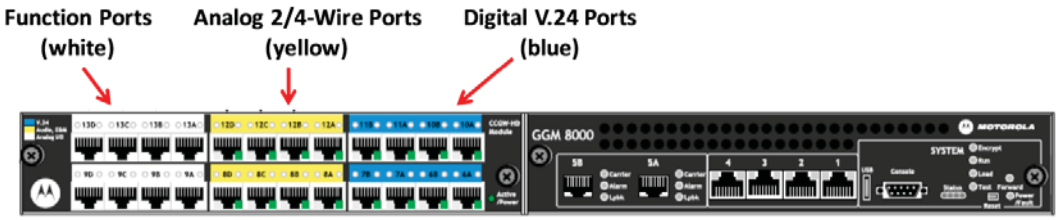


Figure 2-10: Conventional Channel Gateway (CCGW)

2.2.2.1.2 Supported CCGW Interface Protocols

The CCGW supports various methods of controlling conventional resources such as:

- E&M.
- Tone Remote Control. (including custom tone tables)
  - R1.
  - T1R1.
  - T2R2.
  - T4R4.
  - T8R8.
  - T12R12.
  - T14R14.
- Digital Control via V.24 Link.
- Digital Control via IP Link.
- Digital Control via ACIM Link.

The MCC 7500 dispatch console is capable of accessing and controlling all connected conventional resources thru the Master Site within the RNI.

The above types of base stations are referred to as TnRn stations. A TnRn station has one n-frequency transmitter and one n-frequency receiver.

The dispatch console can:

- Process audio received from the station and present it to the dispatch console user via speakers or headsets.
- Key the station's transmitter and provide it with audio to be transmitted over-the-air.
- Control various features such as but not limited to
  - Change resource modes of operation
  - Coded squelch disable
  - Repeater On-Off

– Scan enable

2.2.2.1.3 Identified Conventional Resources

The following are the conventional resources to be interfaced to the CCGW at the indicated sites

Table 2-3: Identified Conventional Resources

Location	Console Alias	Protocol	Modes
2nd DECK CIVIC CENTER	AIR PATROL	ANALOG	T4R4
2nd DECK CIVIC CENTER	CESRS	ANALOG	T4R4
2nd DECK CIVIC CENTER	CHP VIO/BLU	ANALOG	T2R2
2nd DECK CIVIC CENTER	CLERS UHF	ANALOG	T1R1
2nd DECK CIVIC CENTER	COMM/OES	ANALOG	T8R8
2nd DECK CIVIC CENTER	F12 - ALERTING	ANALOG	T1R1
2nd DECK CIVIC CENTER	KNOXBOX	ANALOG	T1R1
2nd DECK CIVIC CENTER	MARIN LOCAL	ANALOG	T8R8
2nd DECK CIVIC CENTER	MED M/A	ANALOG	T8R8
2nd DECK CIVIC CENTER	OES FIRE	ANALOG	T4R4
2nd DECK CIVIC CENTER	UTAC	ANALOG	T4R4
BARNABE	700 BARNABE	DIGITAL	T12R12
BARNABE	8CALL90	ANALOG	T2R2
BARNABE	PRNSS	ANALOG	T4R4
BARNABE	UCALL40	ANALOG	T14R14
BARNABE	UTAC	ANALOG	T4R4
BIG ROCK	700 BIG ROCK	DIGITAL	T12R12
BIG ROCK	CA LAW 1	ANALOG	T1R1
BIG ROCK	UHF MED	ANALOG	T4R4
BIG ROCK	UTAC	ANALOG	T4R4
BIG ROCK	VCALL10	ANALOG	T1R1
DOLLAR HILL	700 DOLLAR	DIGITAL	T12R12
DOLLAR HILL	8CALL90	ANALOG	T2R2
DOLLAR HILL	CALAW 1	ANALOG	T1R1
DOLLAR HILL	CA LAW 4	ANALOG	T4R4
DOLLAR HILL	CDF RADIO #1	ANALOG	T8R8
DOLLAR HILL	CDF RADIO #2	ANALOG	T14R14
DOLLAR HILL	SRFD VHF	ANALOG	T1R1
EOF	7CALL50	DIGITAL	T1R1
EOF	UCALL	DIGITAL	T1R1
EOF	CHP ACU 1	ANALOG	T1R1
EOF	CHP ACU 2	ANALOG	T1R1
COUNTY JAIL	JAIL CONV	DIGITAL	T2R2
MT TAMALPAIS	700 MT TAM	DIGITAL	T12R12
MT TAMALPAIS	UHF MED	ANALOG	T4R4
MT TAMALPAIS	USCG CH 16/22A/11	ANALOG	T14R14

Location	Console Alias	Protocol	Modes
MT TAMALPAIS	USCG CH 22 RX	ANALOG	R1
MT TAMALPAIS	UTAC	ANALOG	T4R4
MUIR BEACH	CHP MON	ANALOG	T1R1
OTA BROADCASTING	CALAW4	ANALOG	T2R2
OTA BROADCASTING	UTAC	ANALOG	T4R4
OTA BROADCASTING	VFIRE 21	ANALOG	T1R1
POINT REYES	700 PT REYES	DIGITAL	T12R12
RADIO SHOP	CA PARKS	ANALOG	T4R4
RADIO SHOP	SHOP BACKUP	ANALOG	T1R1
SAN PEDRO	700 SAN PEDRO	DIGITAL	T12R12
SAN PEDRO	UCALL40	ANALOG	T14R14
SAN PEDRO	VFIRE21	ANALOG	T1R1
SONOMA	700 SONOMA	DIGITAL	T12R12
STEWART POINT	700 STEWART	DIGITAL	T12R12
STEWART POINT	VCALL10	ANALOG	T1R1
TOMALES	700 TOMALES	DIGITAL	T12R12
WOLFBACK RIDGE	CHP MON	ANALOG	T1R1
WOODACRE	CDF INTERCOM	ANALOG	T1R1
CIVIC CENTER EQUIP ROOM	VHF PAGING	ANALOG	T1R1

2.2.2.2 Console Subsystem Rack Space

Motorola is supplying a 7.0ft, 19” rack for each dispatch center except for EOF dispatch. Where there is not enough room for this additional rack in and individual dispatch center, Motorola will relocate the networking equipment to existing racks where feasible. Due to the limited space in most of the existing sites, the rack space requirements are critical during the transition from Gold Elite to the new MCC 7500 dispatch sites.

2.2.2.3 Console Site Power Requirements

Each console position requires three (3) NEMA 5-15 receptacles. UPS is recommended to avoiding outages due to momentary power interruptions.

Table 2-4: UPS Power Requirements of a MCC 7500 Dispatch Position

Equipment	Source Power (VAC)	Amps	Watts
MCC 7500 PC Workstation	120	0.5	60
VPM	120	0.4	48
Monitor	120	1.5	180

It is recommended two independent dedicated NEMA 5-15R circuits feed the network hardware to maintain redundancy should a UPS fails. Two (2) power strips will be used to distribute power to the RNI equipment in the rack.

Table 2-5: UPS Power Requirements for Dispatch Network Equipment

Equipment	Source Power (VAC)	Amps	Watts
SITE GATEWAY 1	120	0.5	60
SITE GATEWAY 1	120	0.5	60
SITE SWITCH 1	120	0.2	24
SITE SWITCH 2	120	0.2	24
CCGW	120	0.4	48
SDM3000	120	0.2	24

Each desk set and consolette require a NEMA 5-15R outlet within 4 feet of the unit or a PoE 802.3af switch or injector.

Table 2-6: UPS Power Requirements for Deskset and Consolette Station

Equipment	Source Power (VAC)	Amps	Watts
MCD 5000 DESKSET	120	0.5	60
SITE GATEWAY 1	120	0.5	60
SITE SWITCH 1	120	0.2	24
SITE SWITCH 2	120	0.2	24
CCGW	120	0.4	48
SDM3000	120	0.2	24

2.2.2.4 Console Backup Desksets

Motorola is providing the MCD5000 desk set for radio control of the backup control stations. These flexible desktop consoles provide digital control by connecting directly to the APX 7500 Consolette Stations via an IP network. The MCD5000 desk set emulates the buttons and display of the connected APX 7500 Consolette radio and performs all the function of the radio control head. A major benefit to the MCD5000 is its IP connectivity, which enables the desk set to reside anywhere an IP network can be accessed.

Additionally, the MCD5000 serves as an intercom system between all parallel MCD5000 desk sets connected to the same radio. This adds another layer of communication between dispatchers and radio users.

Figure 2-11 shows the MCD5000 unit.

Figure 2-11: MCD5000 unit.

2.2.2.5 Console Application Programming Interface for CAD

The implemented solution includes a Console Application Programming Interface (API) for the Marin CAD system. After signing a licensing agreement, Motorola will provide MERA with a Software Development Kit containing all the information necessary for Marin to be able to access and use the API. As an option, Motorola has included our full-feature CAD Interface.

MERA and Intergraph (MERA's CAD supplier) are responsible for developing the interface between Intergraph and the MCC7500 system. Motorola will provide the API documents to Intergraph. Intergraph must write to the API. No cost for this development by Intergraph is included as part of the proposal.

MERA and Intergraph must agree to any cost associated with developing the interface that writes to the MCC7500 API, and is wholly separate from the MCC7500 pricing from Motorola.

The MCC7500 GUI screens are configurable and customizable.

2.2.2.6 Console Alias Management System

A single Console Alias Manager workstation will be installed at the EOF Master site for shared use by the agencies. Agency aliases will be organized by folder. Console Alias Manager can only update aliases and do not have access to system parameters. Access to the console Alias manager can be assigned to dispatch supervisors only and the access is using Internet Explorer from MCC7500 position or a NM Client.

2.3 VOICE LOGGING RECORDER AND INTEGRATION

Based on new requirements provided by MERA during the change order process, Motorola is providing a redundant NICE IP-based logging solution to capture radio traffic from the trunked system and any conventional channels that are tied into the new system via Conventional Channel Gateways (CCGW). The IP logging recorder works in conjunction with a Motorola Archiving Interface Server (AIS) and a NICE INFORM server. The AIS and NICE IP Logger sits inside the Radio Network, and will be located at the EOF Master site and will be part of the console sub site system, while the INFORM server sits on the MERA CEN network. These networks are separated by a firewall.

The AIS is configured to provide radio audio to the NICE IP Logger. The IP Logger stores the audio on to the INFORM server. When users need to recall captured audio, they use a web browser to access the INFORM server.

The current IP NICE Logger design DOES NOT capture telephone audio: If MERA requires the ability to integrate and also capture telephone audio, NICE can provide a NRX product which interfaces to the telephone network through the change order process. The NRX telephony logger sits at each specific agency since phone lines are not consolidated at a central point like the radio system's Master site. The NRX server was is not part of the CDR. The INFORM server can allow users the ability to store and recall telephone and radio audio from a single interface.

The existing Voice Print International logger will remain operational to capture telephone audio as it currently functions. No changes to the VPI logger are required.

NICE equipment is a certified solution for Motorola systems and is part of the Motorola maintenance plan and System Upgrade Agreement (years 1-15).

Table 2-4: Server Hardware

Component	Hardware
Archiving Interface Server	HP Z2 Mini Workstation
IP Logger	HP DL360p G9
Logging Backup Server	HP DL360p G9
Inform Server	HP DL380 G9

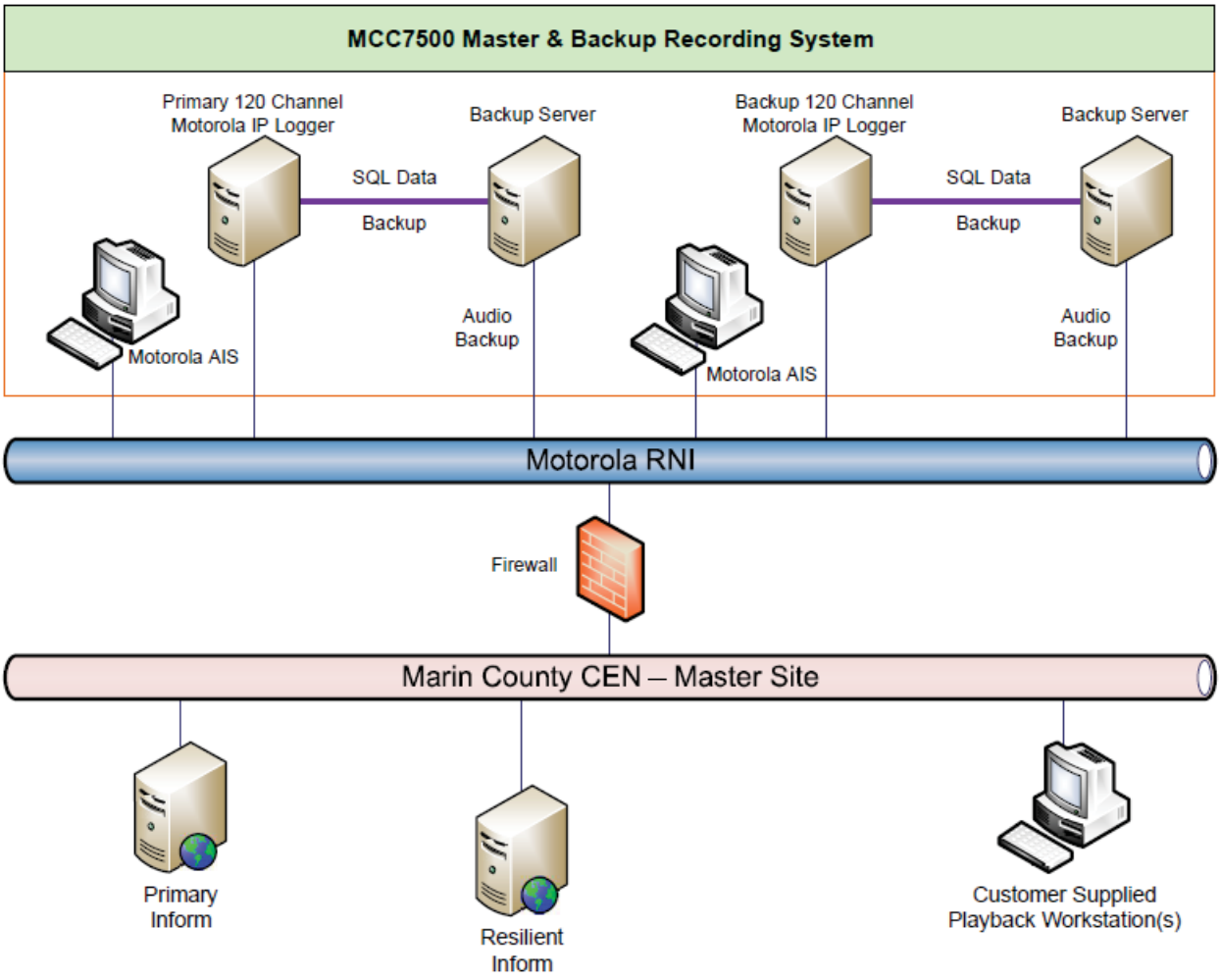


Figure 2-12

The logging recorder system is capable of approximately 150,000 channel hours of storage per IP Logger and 500,000 channel hours of LBS storage. The NICE loggers can record up to 120 simultaneous voice transmissions which will be sufficient for the MERA system, which includes 24 talkpaths and multiple conventional resources. The conventional resources connected to the new P25 system can be recorded through the Motorola IP logging solution and stored on the NICE system.

Record and Replay of Archived Calls

Audio search and playback will be with NICE Inform. Inform server works in conjunction with the NICE loggers to capture call data and store it along with the audio. This data includes:

- Talkgroup and channel information.
- User identification such as unit ID and alias.
- Call type such as Talkgroup Call, Telephone Patch Call, Emergency Call, etc.
- Non-voice events such as Call Alerts, Radio Status Check, Radio Message, etc.

This information is available for display to the user upon playback, and can be searched by the user in order to retrieve the desired call. The logging recorder's capacity is based on the number of radio transmissions it needs to record simultaneously, not on the number of channels that it will record. A call can be saved either as a complete call (audio and any information associated with the call) or as a

simple .wav file. Files saved as complete calls must be played using the Scenario Replay application included with the logging recorder. Files saved as .wav files can be played on any application that supports them. A replay station can access recordings on multiple recorders to provide MERA with a complete view of everything being recorded from a single point.

Motorola has includes 10 concurrent NICE Inform Reconstruction licenses to allow personnel to access the Inform server.

Management of the Logging Recorder Subsystem

Security and fault management for the logging recorder subsystem are configured and managed by a common administration application, residing on either a playback station or a dedicated PC. Administrative personnel can use the management controls of the logging recorder subsystem to configure how calls are recorded. On a global level, administrators can define which calls are recorded by which agency or department; on a more granular level, administrators can define the following recording behavior:

- Which talkgroups and conventional resources are to be recorded
- Whether or not secure calls are recorded
- Which talkgroups and conventional resources are critical and which are not
- Access rights for replay station user accounts
- Configures various operational characteristics of the recorders (watermark limits for the recording media, what to do when the recording media fills up, etc.)

Motorola's design includes 2-wire analog recording ports that have the ability to record transmit and receive audio on the conventional resources tied to the MCC 7500 dispatch consoles. These ports are located on the Conventional Channel Gateway (CCGW's), where the conventional resources tie into the radio network.

These recording ports are built in functionality for the CCGW. All conventional resources will be interfaced in the CCGW and if a conventional resource is to be recorded by NICE it will be recorded IP from the CCGW and does not require use of the white recording ports.

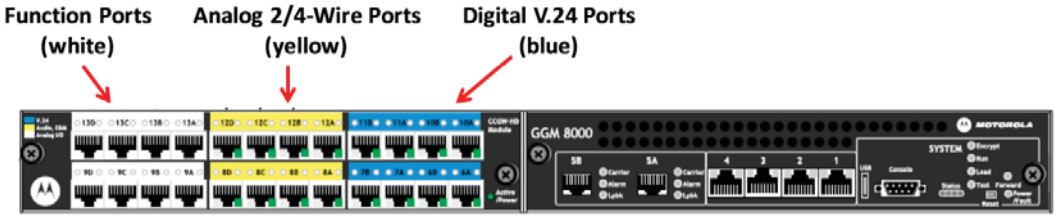


Figure 2-13: Backplane of the CCGW and the dedicated analog recording ports.

Figure 2-13 shows the backplane of the CCGW and the dedicated analog recording ports.

In addition to the conventional logging ports, each dispatch position has a dedicated 600 ohm balanced analog recording port which can be configured to log any combination of the audio sources listed below:

- Audio received from the currently selected radio resources (note that the level of this audio is not affected by either the individual volume setting of the radio resource or the master volume control on the speaker or headset jack).
- Microphone audio being transmitted to the currently selected radio resources by this dispatcher.
- Microphone audio being transmitted to unselected radio resources by this dispatcher.

- Any tones generated by the dispatch position which appear in its speakers (trunking tones, emergency tones, etc.)
- Tones generated by an external paging encoder.

2.4 MICROWAVE BACKHAUL CONNECTIVITY

See the microwave system description section for detail

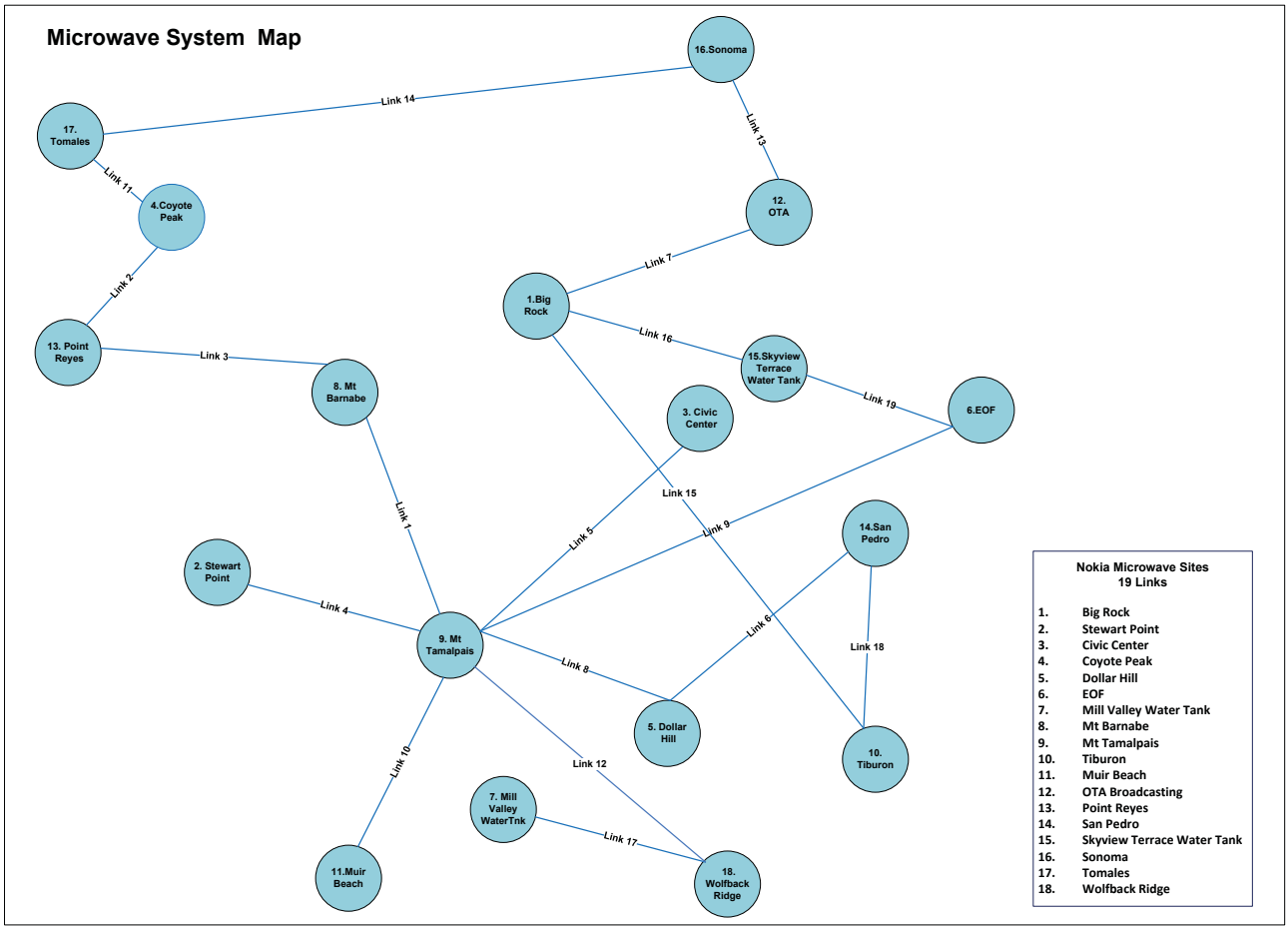


Figure 2-14: Microwave Overview

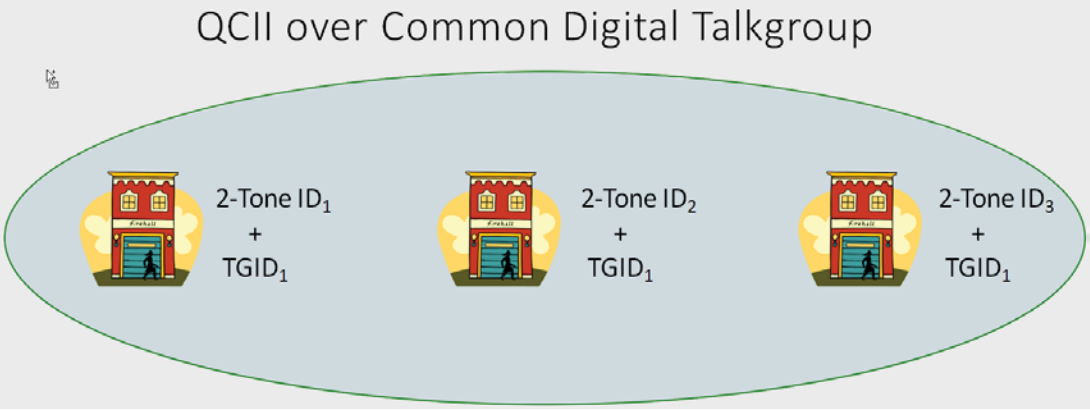
2.5 PAGING SYSTEM

(Volunteer Fire T&V Paging Protocol)

2.5.1 Unication Pager(TDMA Operation)

The proposed paging solution consist of a P25 compliant, receive only device, meaning, it does not register or affiliate on the Network; otherwise this would create unnecessary radio traffic. The proposed solutions maintains the current dispatch operational method that the county is utilizing. Currently Marin county dispatch utilized the Quick Call II, T&V (Tone & Voice) paging protocol; this protocol will operate in the proposed TDMA P25 system. The pagers will be configured to utilize a common digital talk group with each volunteer having the ability to page individually or in a group.

If the pager is out of range, it can be configured to sound an out of range tone. This may be a nuisance feature when the user is constantly in a weak coverage area.

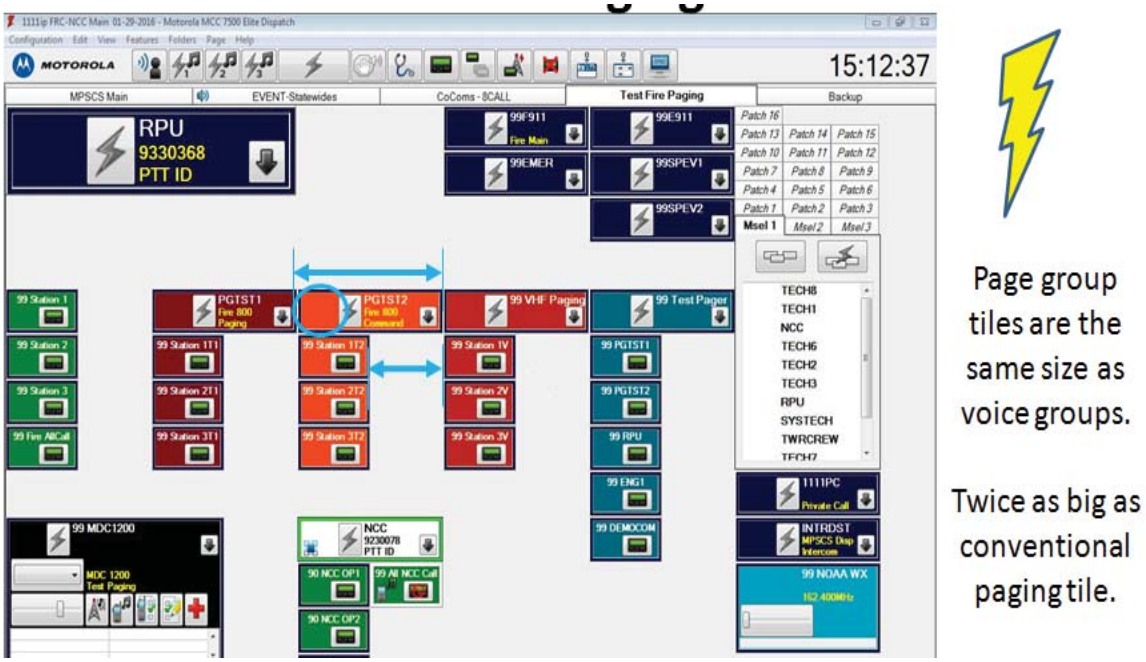


QCII Over P25 – This feature is supported by the Motorola Radio Network Infrastructure (RNI) and with the Unication G4 Pagers. From a Dispatching process, it is similar to sending 2 tone IDs over an analog RF Channel, but in this case the 2 tone IDs are digitized and sent over a TGID.

2.5.2 Volunteer Fire, Paging by QCII

To replace the existing Low Band VHF belt worn pagers, Motorola is supplying the Unication TDMA G4 P25 pagers. These pagers are similar in size and operation to MERA's existing pagers. The pagers operate on the 7/800MHz band and will operate on the same system as the P25 voice system.

The pagers do not transmit therefore cannot affiliate to the system therefore have no radio ID. Transmissions on the main fire dispatch talkgroup will be forced over both P25 subsystems without regard to subscriber affiliation. Talkgroups are configured in the Motorola RNI Provisioning Manager and, as an example, appear as blue Channel Control Windows (CCW) on the MCC7500 consoles dispatch screens similar to the figure shown below.



The operational configuration of the MCC 7500 folders will be set during the fleetmapping effort.

2.5.3 Volunteer Fire, Operational Scenario

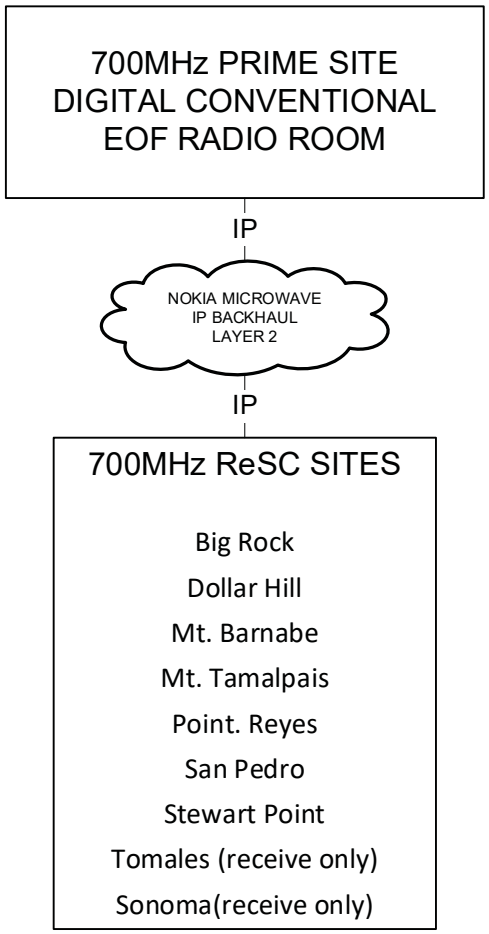
To alert a volunteer groups for emergency responses, the dispatcher selects the pre programmed button (shown green in the diagram as “99 Station 1, 2, 3, or 4”), executes the paging sequence, waits for the T&V protocol to finish, and then transits a voice message on the main fire dispatch talkgroup as they do in the current system. All subscribers will hear the paging tones on the main fire dispatch talkgroup. When a pager decodes the designated tones it will play an alerting sound followed by a voice message. The voice message is stored in the pager and can be replayed by the user. The pager alert sounds for the various paging groups are stored on the pagers themselves and are not transmitted over the radio system.

Additional buttons can be setup for non emergency paging on the volunteer talkgroup if desired. A scan list would be setup in the pagers with priority given to the main fire dispatch talkgroup and a volunteer talkgroup as secondary. Non emergency pages will not be heard by the subscribers on the main fire dispatch talkgroup. Dispatch will then use the volunteer talkgroup Channel Control Windows (CCW) to send non emergency voice traffic to the alerted volunteer user group. The non emergency paging will not be received by the pagers if the main fire dispatch talkgroup is active.

2.6 700MHZ MUTIAL AID SIMULCAST SUBSYSTEM

As part of the system design, the existing 700MHz mutual aid simulcast subsystem will be changed from a circuit based solution to a IP solution; the Prime Site equipment located at the Civic Center will be replaced and the new prime site equipment will be installed in the EOF Radio Room. This requires the replacement of the ASTROTAC 3000 comparator with a GCM 8000 comparator. The existing GTR 8000 stations at the remote site will be reprogrammed for IP simulcast operation.

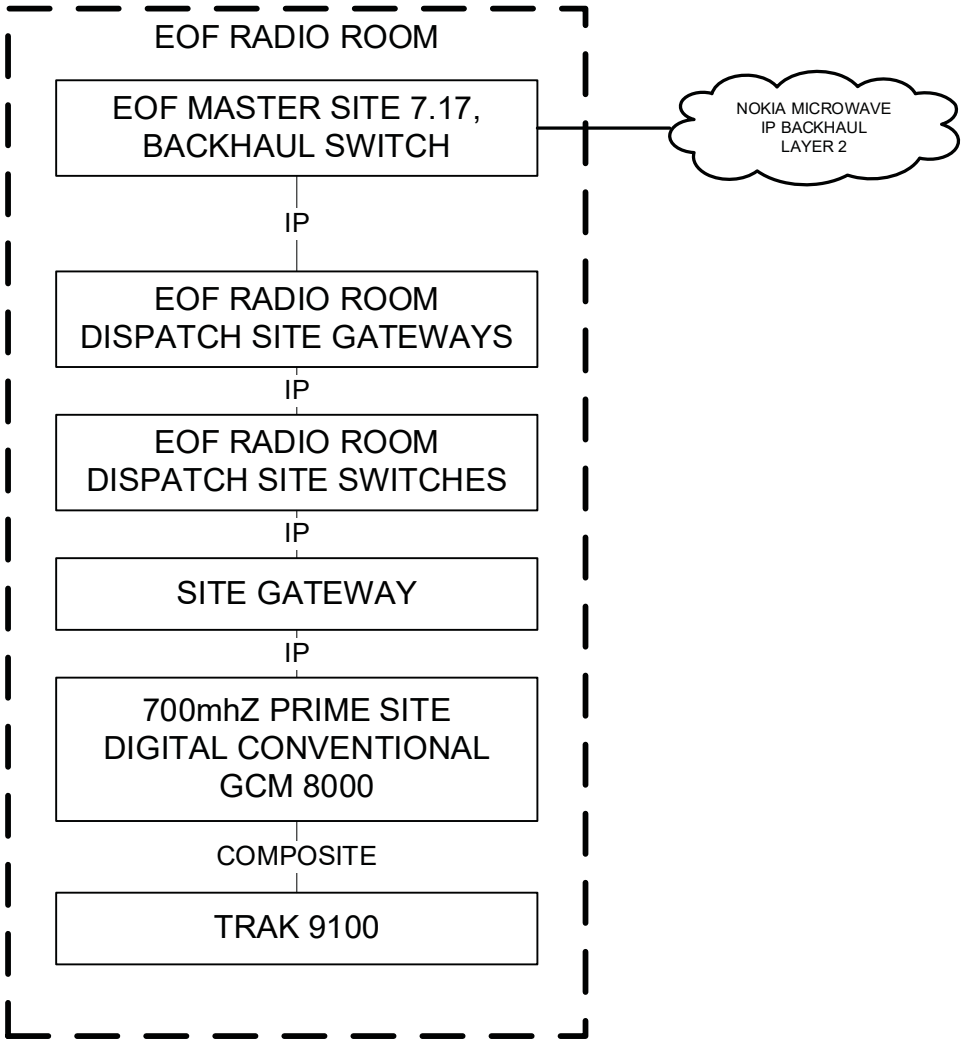
Figure 15: High Level 700MHz Simulcast Subsystem Block Diagram



2.6.1 700 MHz Mutual Aid Prime Site

The 700MHz mutual aid Prime Site will be collocated with the Master Site in the EOF Radio Room. The GCM 8000 comparator will be integrated into to the EOF Radio Room dispatch subnet. The GPS timing and frequency discipline will be provided by the local TRAK 9100 device. Primary power will be supplied by the existing DC plant located in the EOF Radio Room.

Figure 16: High Level 700MHz Prime Site Block Diagram



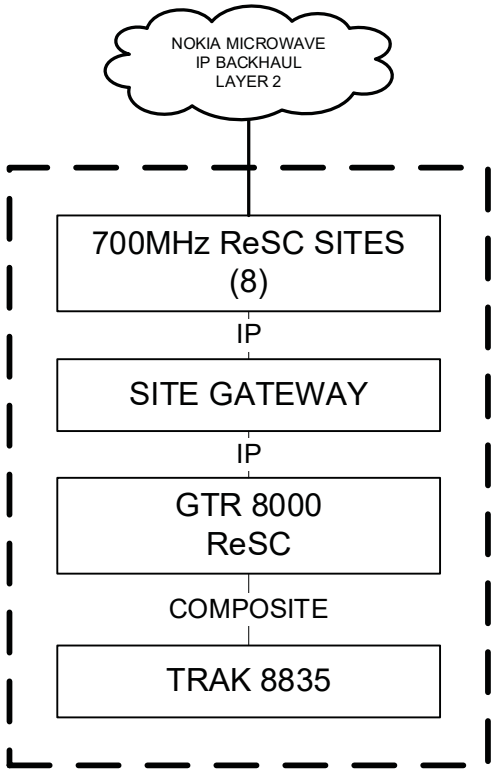
2.6.2 Simulcast Remote Sites

The GTR 8000 stations at the remote sites will remain in place except for Bay Hill receive only site which will be relocated by Marin County to the Tomales site. The GTR 8000 stations will be reprogrammed by Motorola for IP backhaul thru the local CCGW IP port. GPS timing discipline will be maintained by the existing TRAK 8835 hardware. Primary power for the GTR 8000 hardware will be supplied by the new DC plants. The ReSC sites will be collocated with the P25 remote sites as shown in Table 5:

Table 5: 700 MHz Mutual Aid Remote Sites

Site	IP Simulcast- Subsystem
1	Big Rock
2	Dollar Hill
3	Mt. Barnabe
4	Mt. Tamalpais
5	Point. Reyes
6	Stewart Point
7	Bay Hill→ Tomales (receive only)
8	Sonoma (receive only)

Figure 17: High Level 700MHz Remote Simulcast Site Block Diagram



2.6.3 Transition

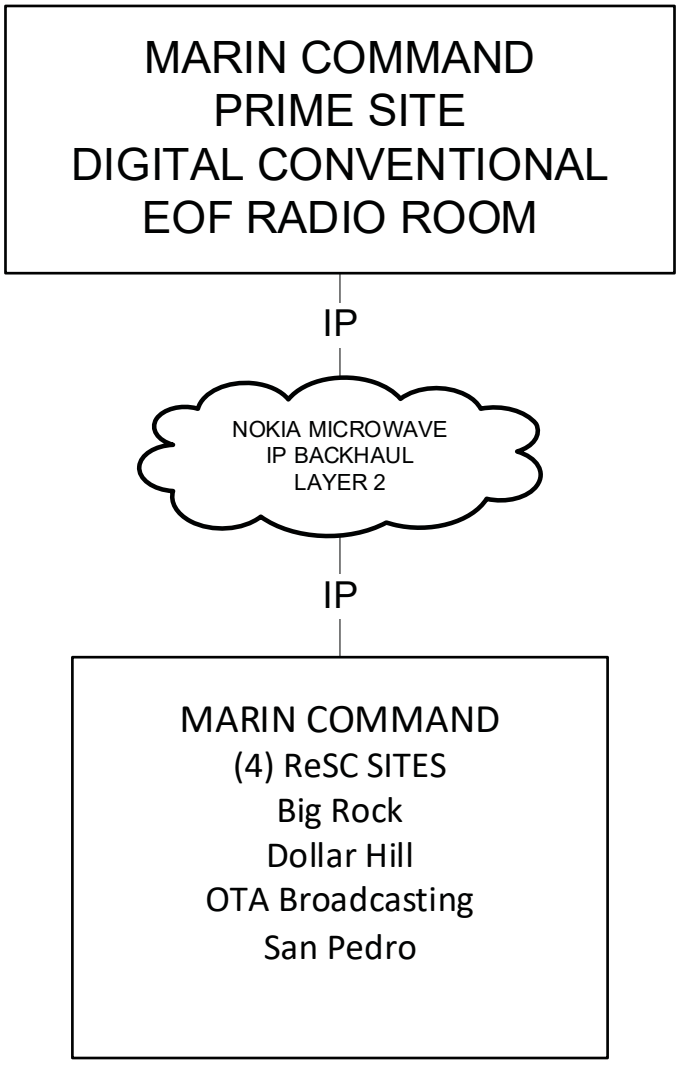
The existing CCGW that interfaces with the 700MHz Prime Site at the Civic Center equipment room will be transferred to the 7.19 Master Site during Cutover Events (refer to the cutover plan). Once the GCM 8000 is installed at the EOF Radio Room and all the P25 remote sites are implemented the GTR 8000 stations will be reprogrammed for IP simulcast operations and transferred to the IP backhaul one at a time and connected to the site gateway.

The Bay Hill receive only site equipment will be relocated by Marin County to the Tomales site. Motorola will reprogram the receiver for IP operation and interface the receiver to the IP backhaul at the Tomales site.

2.7 MARIN COMMAND SIMULCAST SUBSYSTEM

The existing Marin Command simulcast subsystem will be changed from a circuit based solution to a IP solution. The existing Marin Command simulcast subsystem will be migrated to an IP backhaul and the Prime Site relocated to the EOF Radio Room. This requires the replacement of the ASTROTAC 3000 comparator with a GCM 8000 comparator. The existing Quantar stations at the remote site will be connect to a new MLC8000 media converter and remain unchanged in their programming.

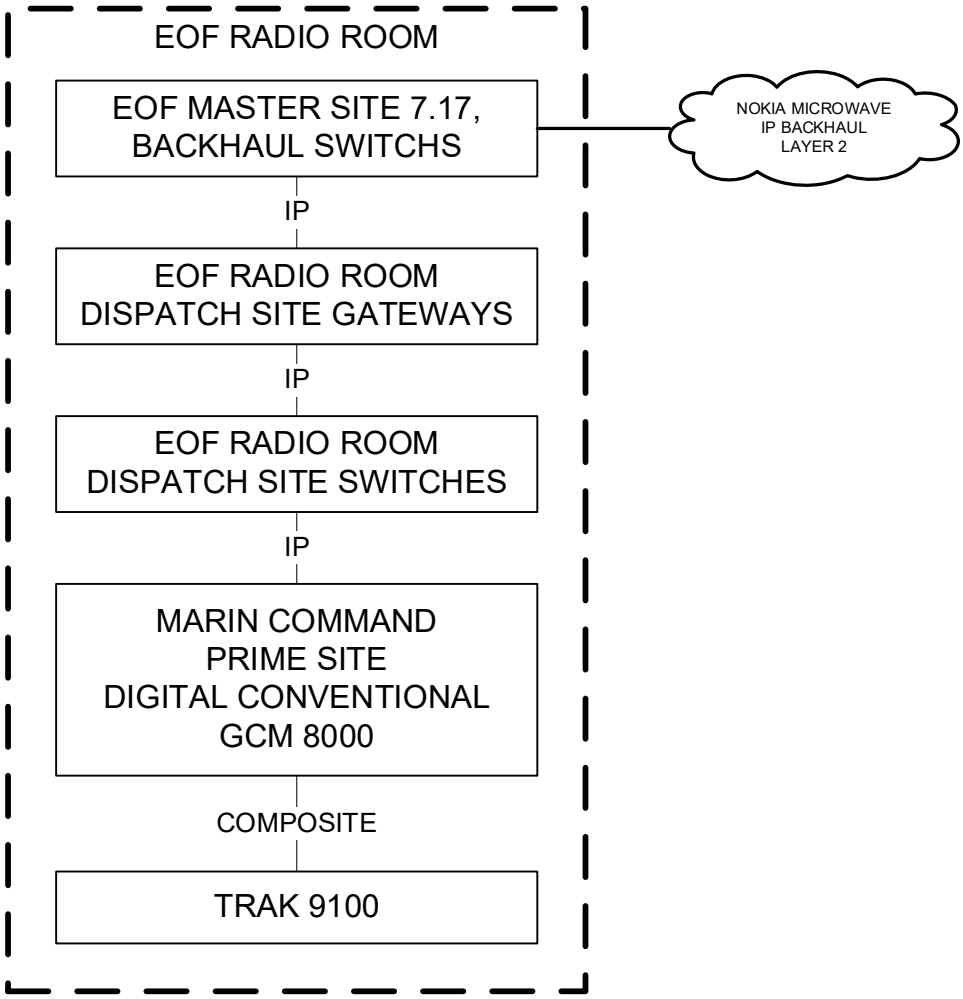
Figure 18: High Level Marin Command Simulcast Subsystem Block Diagram



2.7.1 Marin Command Prime Site

The Marin Command Prime Site equipment will be collocated with the Master Site in the EOF Radio Room. The GCM 8000 comparator will be connected to the EOF Radio Room dispatch subnet. GPS time and frequency discipline will come from the local TRAK 9100 equipment. Primary power will be supplied by the existing DC plant located in the EOF Radio Room.

Figure 19: High Level Marin Command Prime Site Block Diagram



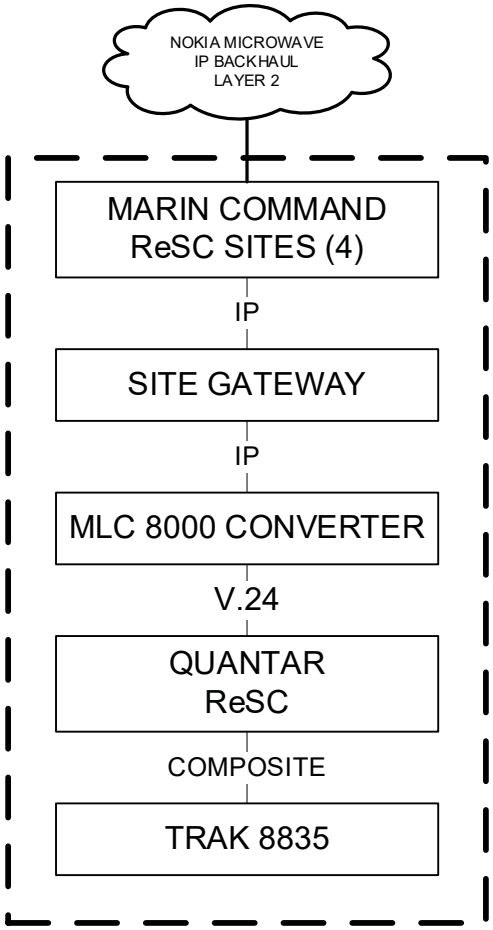
2.7.2 Simulcast Remote Sites

The Quantar stations at the remote sites will remain in place except for OTA Broadcasting site. Marin County will relocate the Quantar station and provide a GPS composite timing source from Mt. Burdell site to the OTA Broadcasting site. The Quantar stations retain their current programming and launch delays. GPS timing discipline will be maintained by the existing TRAK 8835 hardware at Big Rock, Dollar Hill, and San Pedro sites. Primary power for the GTR 8000 hardware will be supplied by the new DC plants. The ReSC sites will be collocated with the P25 remote sites as shown in Table 6:

Table 6: Marin Command Remote Sites

Site	IP Simulcast- Subsystem
1	Big Rock
2	Dollar Hill
3	Mt. Tamalpais (test radio-only)
4	Mt. Burdell ⟶ OTA broadcasting
5	San Pedro

Figure 20: High Level Marin Command Remote Simulcast Site Block Diagram



2.7.3 Transition

The existing CCGW that interfaces with the Marin Command Prime Site at the Civic Center equipment room will be transferred to the 7.19 Master Site during Cutover Events (refer to the cutover plan). Once the GCM 8000 is installed at the EOF Radio Room and all the P25 remote sites are implemented the Quantar stations will be transferred to the MLC 8000 converters one at a time and connected to the site gateway at each of the RF sites.

2.8 EQUIPMENT LISTS

ASTRO P25 Radio Network Infrastructure (RNI)

See RNI Equipment List addendum

NOKIA Microwave Network

See Nokia Equipment List addendum

APX™ Series P25Subscriber Radio Models

See Subscriber Equipment List addendum

2.9 TOWER PROFILE DRAWINGS

(Including antenna mounting locations and ancillary equipment)

See A&E drawing addendum

2.10 K.) EQUIPMENT ROOM DRAWINGS

See drawing addendum

2.11 L.) EQUIPMENT RACK ELEVATION DRAWINGS

See drawing addendum

2.12 M.) ADDITIONAL SUBSYSTEMS

(Knox Box activation)

2.12.1 Knox Box & Gate Activation

With the Portable and Mobile Radios, the user will switch to a simplex channel and key the radio for 30 seconds to open the gate. MERA is responsible for obtaining and defining the low power 800 MHz frequency to be programmed into the radios.

Motorola has researched the ability of the APX radios to decode the DTMF tone and present it to the Knox box in the cab of the fire trucks. The proposed APX radios have this capability and will operate in the same manner as the existing UHF radios.

Motorola originally quoted radios that were specific for Knox box functionality. These radios are not needed since the mobile in the fire truck will handle this operation. The originally quoted Knox Box radios will be removed from the price list.

The originally quoted gate activation radios are no longer required and have been removed.