Interoperable Communications Plan

Humboldt County

Office of Emergency Services

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Ganner Associates
Wireless Communications Solutions

Executive Summary

In 2006, Humboldt County, through the State of California, Governor's Office of Emergency Services, initiated a planning process to address interoperability and communications in the County. The Interoperable Communications Plan is the initial deliverable in the regional planning effort for improved interoperability.

The plan is based on a process that began with the identification of the needs and coverage considerations of the agencies for improving interoperable public safety communications. The user needs and coverage considerations provided the essential information for the proposed radio system solution and direction identified in this plan.

Why an Interoperable Communications Plan?

Many public safety agencies struggle with outdated and inefficient telecommunications equipment that can prevent them from sharing vital information in a timely manner. Citizens' demands for public safety services continue to increase, as do their service expectations. The growing need for public safety communications interoperability to meet emergency management requirements has been accelerated by the events of 9/11 and Hurricane Katrina. "The lives of citizens and the protection of property often depend on the ability of public safety personnel from one agency to communicate via mobile radio with personnel from other agencies, on demand, in real time, when needed and as authorized."[1] – *Interoperability.* The term "interoperability" refers to the ability of public safety emergency responders to work seamlessly with other systems and products without special effort.

> "Interoperability is not only important in managing a terror-related incident, but also critical in answering the call of other emergencies. Federal, State and local governments work together to answer many other types of emergencies."
>
> September 8, 2004, House Subcommittee On Technology, Information Policy, Intergovernmental Relations And The Census, Adam H. Putnam, Florida, Chairman

Today, more than ever, the requirement for communications interoperability between public safety agencies plays a significant role in the implementation of new technology solutions. Without a collaborative approach, public safety communications between agencies will not approach a level that can be reasonably defined as interoperable.

[1] SAFECOM - www.safecomprogram.gov/SAFECOM/interoperability/default.htm

Interoperability Continuum

Technology alone will not solve the communications problems. The approach followed to develop the plan includes a mixture of all the key elements identified in the *Interoperability Continuum* developed by SAFECOM.

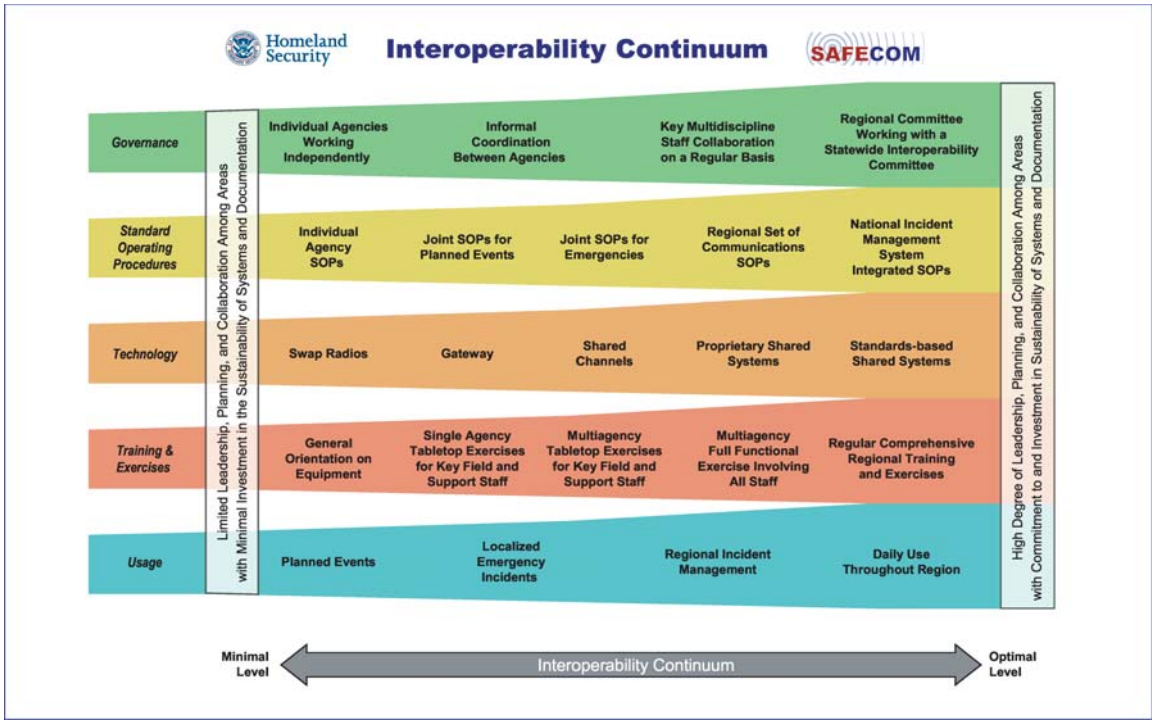

Figure 1 – Interoperability Continuum

Key SAFECOM elements identified in building the solution are:

- The proposed solution supports day-to-day operations throughout the County.
- The solution in the plan proposes a governance structure for multiple agencies working together across the County pursuant to formal written agreements.
- The plan proposes standards (technical and operating) to develop procedures, processes, and training requirements to enable effective use of the technology.
- The technical solution proposes standards-based, shared voice communications functionality.

Governance

The number of Public Safety Answering Points (PSAPs) and dispatch centers is impacting the level of service provided in Humboldt County. A consolidated communications center will provide more rapid emergency response times and will offer an economy of scale that may yield significant savings.

Recommendation: Retain a consultant and/or form a commission to develop a model and implementation plan for a fully integrated emergency communication system. Such a plan is a critical "next step". A consolidated emergency communication system will provide a more efficient approach and will produce a more effective solution than the current decentralized approach.

Ideally there will be one communications center (with backup capability somewhere else in the County). This communications center will take emergency calls and dispatch the appropriate emergency response vehicles. Because staffing for such operations must be designed to cover peak workloads, substantial opportunities exist for realizing economies of scale, providing better service, and saving taxpayer money.

Consolidated communications will result in better service to the communities and opportunities to save taxpayer money.

Standards

Incompatible radio systems and equipment, along with a lack of standards, are contributing to ineffective communications and inhibiting interoperability within the County. Though standards may be inconvenient to some and may result in higher initial costs, standards are essential to protect the overall investment of all agencies and insure interoperability.

Recommendation: Establish a minimum level of acceptable technology and operational standards for all public safety agencies in Humboldt County. These standards will form the baseline for improving communications and interoperability. Develop and publish technical and operational standards for voice subscriber equipment. Develop and publish environmental, installation, and equipment standards for all equipment rooms and radio vaults/sites.

Technology

The architecture and, in some instances, the equipment of the existing radio systems is dated and not meeting the needs of the first responder agencies. Any proposed change to the existing communications system must address these driving factors:

- The first responder agencies have day-to-day communications, mutual aid, and interoperability needs (functional and coverage).
- US Forest Service (USFS) and Bureau of Land Management (BLM) have radios operating in the VHF band.

- Digital communications protocol is the standard that has been adopted by Federal agencies such BLM, USFS and DOD.
- Existing opportunities to share and reduce costs among local and county, agencies.
- The limited financial resources and personnel to support a radio system.

Recommendation: The core of the proposed communications system is a voice radio system using digital trunking to provide radio coverage to law and fire first responders and other local governmental agencies in Humboldt County. In addition, Med-Net channels for ambulance operations will be connected to first responder channels. On demand, corrections, and schools channels may be connected to other users.

The solution provides expanded portable coverage for rural radio users with in-band mobile repeaters.

The proposed solution provides centralized and consolidated control of a common shared infrastructure and radio system. By design, this provides wide area connectivity for local agencies. It is also part of a scalable and expandable solution that will allow interconnections from local, regional, and state agency systems.

System costs

The cost estimates presented here are based on information available through the Western States Contracting Alliance (WSCA) contract and from vendors. As a preliminary design, the solution portrayed in this report is conceptual and is not based on any specific vendor solution. Therefore, the estimates are as accurate as possible without formal proposals from vendors. However, the overall cost estimates are expected to be within 20% of the costs that would result from a formal procurement process. The costs are shown by system component and infrastructure site.

The following tables show the estimated system acquisition costs and the estimated annual recurring costs.

System acquisition costs	
System component	**Extended costs**
Infrastructure	**$1,134,280**
Subscriber equipment	**$3,032,700**
Communications Center / Remotes	**$1,110,360**
Total acquisition costs	**$5,277,340**

Table 1 – Estimated system acquisition costs

Recurring costs	
System component	Extended costs
Infrastructure	$165,040
Subscriber equipment	$60,654
Communications Center / Remotes	$181,480
Total annual recurring costs	$407,174

Table 2 – Estimated annual recurring costs

Summary

The level of interoperability today is limited to swapping radios, having multiple radios in a vehicle, and, to a limited degree, sharing regional channels. The proposed plan provides a standards-based shared system, standards, and organization for the County. In making this investment, first responder and other local agencies will receive significant benefits with dramatic improvement in communications and interoperability.

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1 Introduction

First responder agencies realize that new technologies emerge, frequently providing capabilities not previously available. Many of the needed and desired capabilities center on an agency's communication systems. Current systems in use by the County, cities, and other emergency service providers are of varying ages. These systems may not be effective or interoperable with each other or with the newly available technologies.

Humboldt County (County) is developing a comprehensive, coordinated *Interoperable Communications Plan* to enhance communications and interoperability among public safety agencies in the County. The completed plan will guide the County in making final communication equipment procurement decisions.

This plan addresses all public safety, emergency response, and other agencies in the County that are typically called upon during major events or wide-scale emergencies.

The purpose of this plan is to provide sufficient information so that decisions can be made to best serve the County. This plan does the following:

- Addresses system compatibility issues with the state system, local agency systems, cross-border systems (neighboring states), federal system, and the interoperability plans of the State of California.
- Identifies other resources, such as microwave, available from state and local agencies that may be used in building an interoperable radio system.
- Addresses FCC actions, such as new spectrum availability, that impact land mobile radio systems.
- Addresses data transfer possibilities and limitations within each frequency band.
- Provides estimated radio infrastructure and subscriber costs for VHF radio systems in digital and narrowband analog operations.

The end product is a regional interoperable communications plan for Humboldt County, California. The plan assesses all the systems currently in use by the stakeholder agencies and identifies mechanisms or alternatives to overcome interoperability incompatibility, eliminate communication gaps, and facilitate response in the event of a wide-scale emergency.

2 Background[2]

Humboldt County, located in Northwest California, is bound on the north by Del Norte County, on the east by Siskiyou and Trinity counties, on the south by Mendocino County, and on the west by the Pacific Ocean. The County encompasses 2.3 million acres, 80 percent of which is forestlands, protected redwoods, and recreation areas.

The southern part of the County includes Alton, Carlotta, Hydesville, Rio Dell and Scotia; the Avenue of the Giants communities; Garberville and Redway; the Eel, Mattole, and Van Duzen River communities; Humboldt Redwoods, Richardson Grove, and Grizzly Creek State Parks; and the King Range National Conservation Area.

The northern part of the County includes the City of Trinidad, Orick; Redwood National Park; Prairie Creek and Humboldt Lagoons State Parks; most of the Yurok Indian Reservation; and several State Beaches.

The eastern part of the County includes Willow Creek, Hoopa Valley Indian Reservation, Orleans, and a great deal of Six Rivers National Forest land.

The County is linked by Coastal Highway 101 to the rest of California to the south and the Oregon Coast to the north. Highway 299 links the County to Interstate 5 to the east.

The January 2005[3] population of Humboldt County was 128,376. The County has seven incorporated cities[4] (Arcata, Blue Lake, Eureka, Ferndale, Fortuna, Rio Dell, Trinidad) ranging in size from approximately 400 to 35,000 persons. Approximately half of the County's residents live in incorporated communities, while 59 percent of the population of the County lives in the area surrounding Humboldt Bay. This area includes the cities of Arcata, Ferndale, Fortuna, Eureka and the unincorporated community of McKinleyville.

County population projections over the next two decades estimate the 2020 population for County will be 140,000, with the chief growth areas of the County around the communities of McKinleyville and Garberville and the cities of Arcata and Fortuna.

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[2] http://co.humboldt.ca.us/portal/about.asp

[3] Source: National Association of Counties, http://www.naco.org/

[4] Source: National Association of Counties, http://www.naco.org/

2.1 Present communications systems and user agencies

The regional first responder and supporting agencies communicate with many different agencies on many radio systems. These agencies are:

Law enforcement agencies

Local law enforcement services in Humboldt County are provided by the Humboldt County Sheriff's Office, police departments for the incorporated cities, Humboldt State University, and California State Patrol. Humboldt County Sheriff's Office operates out of four stations. The main station is in Eureka and the three remote stations are located in Garberville, McKinleyville, and Hoopa.

The seven incorporated cities in Humboldt County provide law enforcement services. These cites are:

- City of Arcata
- City of Blue Lake
- City of Eureka
- City of Ferndale
- City of Fortuna
- City of Trinidad
- City of Rio Dell

Fire organizations[5]

Local fire departments in Humboldt County include a total of 42 fire protection organizations. The County's fire departments range in composition from a paid, full-time city fire department (City of Eureka) to very rural volunteer fire companies whose members house fire engines at their own residences.

Volunteer firefighters are the fire protection backbone in rural Humboldt County. Although almost all fire departments in Humboldt County are staffed by volunteers, most departments are associated with a local government organization such as a city or special district.

In Humboldt County, the cities of Eureka and Trinidad have city fire departments. The City of Eureka is the only city in Humboldt County that provides fire protection services with full-time staff members and also maintains a contingent of volunteer firefighters. The City of Trinidad receives service from an all-volunteer City fire department.

All of the other cities in the County receive fire protection services from a volunteer fire department associated with a fire protection district.

[5] Humboldt County Master Fire Protection Plan FSC Draft Plan – March 2006

Five Community Service Districts are responsible for fire protection in Humboldt County. Community Service Districts are staffed entirely by volunteer fire personnel. The Community Service Districts are:

- Carlotta Community Services District
- Fieldbrook Community Services District
- Miranda Community Services District
- Orick Community Services District
- Weott Community Services District

Sixteen Fire Protection Districts provide fire protection and emergency medical services. All but three of the Fire Protection Districts in Humboldt County (Eureka, Humboldt Fire Protection District No. 1, and Arcata Fire Protection District) are staffed entirely by volunteer fire personnel. The Fire Protection Districts are:

- Arcata Fire Protection District
- Blue Lake Fire Protection District
- Ferndale Fire Protection District
- Fortuna Fire Protection District
- Garberville Fire Protection District
- Humboldt Fire Protection District No. 1
- Kneeland Fire Protection District
- Loleta Fire Protection District
- Myers Flat Fire Protection District
- Petrolia Fire Protection District
- Redway Fire Protection District
- Rio Dell Fire Protection District
- Samoa Fire Protection District
- Telegraph Ridge Fire Protection District
- Whitethorn Fire Protection District
- Willow Creek Fire Protection District

Eighteen Volunteer Fire Companies provide fire protection services in Humboldt County. These Companies have no government affiliation. The Volunteer Fire Companies are:

- Beginnings Volunteer Fire Department
- Fruitland Volunteer Fire Department
- Honeydew Volunteer Fire Department
- Hoopa Volunteer Fire Department
- Korbel Fire Brigade
- Maple Creek Volunteer Fire Department
- Orleans Volunteer Fire Department
- Palo Verde Volunteer Fire Department
- Phillipsville Volunteer Fire Department
- Prosper Ridge Volunteer Fire Department
- Redcrest Volunteer Fire Department

- Salmon Creek Volunteer Fire Department
- Scotia Volunteer Fire Department
- Sprowel Creek Volunteer Fire Department
- Westhaven Volunteer Fire Department
- Whale Gulch Volunteer Fire Department
- Yurok Volunteer Fire Department

Shelter Cover Resort Improvement District and County Service Area No. 4 also provide fire protection services in Humboldt County and are staffed entirely by volunteer fire personnel.

Emergency medical services

The medical emergency services provided in Humboldt County are overseen and authorized by the North Coast Emergency Medical Services Authority (North Coast EMS). Paramedic and transport services in Humboldt County are provided by:

- City Ambulance of Eureka
- City Ambulance Fortuna
- Hoopa Health Association
- City Ambulance Garberville
- Arcata-Mad River Ambulance

North Coast Emergency Medical Services Pre-hospital Med-Net system provides the ability to communicate with:

- Mad River Hospital - Arcata
- St. Joseph Hospital - Eureka
- Redwood Memorial Hospital - Fortuna
- Gerald Phelps Community Hospital – Garberville

Emergency Service Dispatch - Public Safety Answering Points

<u>Primary Public Safety Answering Point (PSAP)</u>

The communications equipment and capabilities in each dispatch center vary from well-equipped communications consoles to desktop radios.

- Arcata Police Department (9-1-1 calls initiated within the City and fire calls transferred from Sheriff Office).

  Arcata Police Department provides 9-1-1 call-taking and dispatch for Arcata Police Department, Arcata Fire Protection District, Blue Lake Fire Protection, and the Samoa Fire Protection District.

- California Highway Patrol (cell-phone-initiated 9-1-1 calls only).

  CHP transfers calls to appropriate primary or secondary PSAP.

- Eureka Police Department (9-1-1 calls initiated within the City and fire calls transferred from the Sheriff's Office).

Eureka Police Department provides 9-1-1 call-taking and dispatch for Eureka Police Department and Eureka Fire Department as well as dispatch for Humboldt #1 Fire Protection District.

- Fortuna Police Department (9-1-1 calls initiated within City).

  Fortuna Police Department provides 9-1-1 call-taking and dispatch for Fortuna Police Department and Fortuna Fire Department. In addition, Fortuna Police Department provides dispatch services for Ferndale and Rio Dell Police Departments.

- Humboldt County Sheriff's Office.

  Humboldt County Sheriff's Office is the primary PSAP for Humboldt County, except for the incorporated cities of Arcata, Eureka, and Fortuna. The Sheriff's Office provides dispatch services for itself, as well as for Blue Lake and Trinidad Police Departments.

- Humboldt State University Police Department.

Secondary Public Safety Answering Point and/or dispatch centers

The communications equipment and capabilities in each dispatch center vary from well-equipped communications consoles to desktop radios.

- City Ambulance.
- Fortuna Interagency Command Center (aka CDF).

  Fortuna Interagency Command Center provides dispatching services for the Humboldt Dispatch Cooperative (29 local fire protection organizations in Humboldt County) and for the Fortuna Ambulance Company. California Department of Forestry provides contract dispatch services for Fortuna interagency Command Center.

- Hoopa Police Department.

  Hoopa Tribal Police Department provides dispatch for Hoopa Tribal Police Department, Hoopa Fire Department, Hoopa Wildland Fire Department, and Hoopa Ambulance.

Interoperability in the County

Interoperability is generally defined by the needs of an individual agency and is not defined or implemented at the county level. The following list describes the communications system(s) and interoperability capabilities of each agency. Other agency radio channels are installed (where feasible) in vehicle radios.

Law enforcement agencies

All law enforcement agencies in Humboldt County are operating on VHF High (VHF) band frequencies except that 1) California Highway Patrol is operating on VHF Low (LOW) band frequencies and 2) Sheriff's Office jail facility is operating on UHF channels.

Where technically possible, the CALCORD, CLEMAR, NALEMAR, OES1, and OES2 frequencies shall be available in every VHF radio. None of these frequencies is repeated.

A few law enforcement personnel (fewer than 10) carry UHF portables for communications with schools, ambulances, etc.

Humboldt County Sheriff's Office

The Sheriff's Office radio system backbone has four VHF repeater sites: Horse Mountain, Pratt Mountain, Pierce Mountain, and Rodgers Peak. Pierce Mountain is the hub of the radio system with a microwave link to the Sheriff's Office dispatch center located at the courthouse. All repeater sites are on the same repeated frequency pair, with PL tones controlling the keying of a specific sites base station. Sheriff officers have scanners in vehicles to listen to CHP radio traffic. Agencies communicate by listening to other agencies' frequencies on the scanner.

A UHF radio system provides local coverage for the Humboldt County jail.

Police departments

Eureka Police Department dispatches on a repeated VHF channel and the TAC channel is on a repeated VHF frequency. Both have voting receivers to aid portable coverage. TAC channel also provides backup should the dispatch channel fail.

Arcata and Fortuna Police Departments dispatch on repeated VHF frequencies. Fortuna Police Department is setting up a second non-repeated VHF frequency for TAC/command operations and backup operations.

Humboldt State University dispatches on a repeated VHF frequency and has a backup base station should the dispatch channel fail.

All other local police departments in Humboldt County operate on non-repeated VHF frequencies.

California Highway Patrol

California Highway Patrol (CHP) is operating on VHF Low (LOW) band frequencies. CHP uses VHF portables that communicate with a mobile LOW band radio system. Assuming VHF radio coverage, CHP will use the CLEMARS frequency to communicate with other agencies. CHP has scanners in vehicles to listen to other agency radio traffic. Agencies communicate by listening to other agencies' frequencies on the scanner

Fire organizations

Fire-Net is the only channel (VHF frequency) available to all fire agencies In Humboldt County. Fire-Net is the primary fire dispatch frequency for most agencies. California Department of Forestry (CDF) holds the license for the Fire-Net frequency and the equipment is housed in CDF sites/vaults. Fire-Net is a dispatch frequency – not to be used for command/tactical operations.

Where technically possible, the CALCORD, CLEMAR, NELMAR, OES1, and OES2 frequencies shall be available in every VHF radio. . None of these frequencies is repeated.

Eureka Fire Department and Humboldt Fire District

Eureka Fire Department has a VHF repeated frequency for dispatch. Humboldt Fire district has a VHF repeated frequency and several VHF non-repeated frequencies for command/tactical operations and backup operations

Fortuna Fire Department

Fortuna Fire Department has a VHF non-repeated frequency for dispatch and tactical operations.

Arcata Fire Department

Arcata Fire Department has a VHF non-repeated frequency for dispatch and tactical operations.

Volunteer Fire Departments/Districts

Unless otherwise mentioned above, all other volunteer fire departments and districts are dispatched on the VHF Fire-Net frequency by California Department of Forestry.

California Department of Forestry

California Department of Forestry operates a VHF non-repeated radio system.

US Forest Service (USFS) / Bureau of Land Management (BLM)

USFS and BLM operate a narrowband VHF system.

Emergency Medical Services

Emergency Medical Services (EMS) is dispatched by City Ambulance and California Department of Forestry (CDF) on VHF non-repeated VHF frequencies. CDF dispatches EMS on the VHF Fire-Net channel in rural areas and City Ambulance dispatches on its own channel in the Eureka/Arcata area.

Ambulance-to-hospital communications are on the UHF Med-Net channel. Med-Net has four UHF repeater sites, eight control points, and about twenty mobiles. The Med-Net radio system uses the same repeater sites used by Sheriff's radio system and has similar coverage issues.

EMS vehicles are equipped with a UHF and VHF radio.

Allied non-first responder organizations

Humboldt County Public Works and other county departments

These departments use a VHF repeated frequency for dispatch tactical operations. Radio equipment is co-located with the same sites used by the Sheriff's Office and shares the same radio coverage issues.

North Coast Schools

The thirty-four school districts in Humboldt County operate on a UHF radio system through North Coast School's Insurance Group. Each of the thirty-four schools has a base station in each school enabling communications with the school buses.

Amateur Radio Emergency Service (ARES)

Amateur Radio Emergency Service (ARES) has four radio clubs in Humboldt County. ARES has a station (for radio equipment) at each hospital, courthouse, public health facility, some schools, and in a mobile unit. Each station has UHF and VHF capabilities and some stations have digital capabilities.

Other local government agencies in Humboldt County

Unless otherwise stated, these agencies use a VHF non-repeated frequency for dispatch tactical operations.

3 Methodology

The *Interoperable Communications Plan* provides a roadmap to improved operability and interoperability among all public safety agencies in the County. The plan creates a highly interoperable architecture by building on existing system capabilities and laying a roadmap for future system enhancements.

Ganner Associates followed the methodology recommended by SAFECOM[6] to develop the plan. The SAFECOM methodology maintains a degree of standardization across similar projects and ensures an ongoing linkage with similar efforts in other counties and at the state and federal level. The planning process included six regional focus group meetings. The focus group sessions captured perspectives from numerous local public safety representatives throughout each region. These perspectives became the foundation for the key initiatives defined in the plan.

County focus group meetings

Focus meetings were conducted in the County during the week of October 2, 2006 at the County Courthouse in Humboldt County. Kimberly A. Kerr, Risk Management Director/Deputy CAO, advised first responder agencies and scheduled the focus group meetings.

Representatives from 38 agencies, the vendor community, and interested parties participated in group meetings. The local agencies participating in the meetings are listed in the following table.

[6]The SAFECOM Program was established by the Office of Management and Budget (OMB) and approved by the President's Management Council (PMC) as a high priority E-Gov initiative. The SAFECOM Web site (http://www.safecomprogram.gov/SAFECOM/library/interoperabilitybasics/1190_interoperabilitycontinuum.htm) provides additional information about the Interoperability Continuum.

American Red Cross	Humboldt County - Environmental Health
Arcata-Mad River Ambulance	Humboldt County - Health and Human Services
Blue Lake Fire Department	Humboldt County - Probation
California Department of Forestry	Humboldt County - Public Health
California Fish and Game	Humboldt County - Public Works
California Highway Patrol	Humboldt County - Risk Management
California State Parks	Humboldt County - Sheriff's Office
City of Eureka - Information Services	Humboldt Fire District
Eureka Fire and Police	Humboldt State University Police
Eureka Fire Department	McKinleyville Community Services District
Ferndale Fire Department	National Park Services
Fortuna Fire Department	North Coast Emergency Medical Services
Fortuna Police Department	Palo Verde Volunteer Fire Department
Garberville Fire Protection District	Phelps Hospital
Humboldt Amateur Radio Club (ARES)	Redway Fire District
Humboldt Bay Municipal Water District	US Forest Service
Humboldt County - Code Enforcement	Willow Creek Community Services District
Humboldt County - Communications	Willow Creek Volunteer Fire Department
Humboldt County - Coroner	Yurok Tribe

Table 3 – Participating agencies

Stakeholder contributions were significant and provided an excellent set of user needs and issues.

The information gathered was analyzed and interpreted as goals and high-level system capabilities. The high-level capabilities were further refined into desired future operational, functional, and system technical needs. The focus group notes may be found in Appendix A: Focus Group Meetings.

The objectives of the focus group meetings were to introduce the county interoperability planning project, review objectives, discuss the inventory, and brainstorm ideas regarding systems, improvements, and modifications for the future.

General areas of discussion focused on:

- current operational needs
- what’s working and not working today
- future needs

4 Current situation

The County and the local agencies are struggling to provide their users with a basic level of wireless connectivity as evidenced by feedback collected at the focus group meetings. Key points identified in the focus group meetings and documented in the needs assessment are:

- All fire and law first responder agencies in the County (except CHP) use conventional VHF frequencies.
- EMS is dispatched on VHF frequencies and uses conventional UHF frequencies for transport operations.
- Some first responder agencies equip vehicles with UHF and VHF radios.
- No first responder agency is using 800 MHz frequencies.
- Non-public safety first responder agencies (schools, utilities, etc) use conventional VHF and UHF frequencies.
- Most agencies have an open and collaborative mindset.
- Some agencies are embracing new technology.
- Most first responder agencies are operating on simplex (not repeated) frequencies.
- Some agencies have interoperability agreements in place, others are not sure.
- Most fire agencies share a VHF frequency bands.
- PSAP and dispatch services are provided from nine operations centers.
- Two police agencies use a mobile data system.
- Funding for many fire agencies is non-existent or insufficient to meet fire service standards.
- No agencies use trunked systems as their primary communication system.
- No agency has identified funding to forge ahead with new technologies; most agencies operate with 20-year old technology.
- Backup communications capabilities are limited or non-existent for most agencies.

The County intends to provide all users in the County with an approach to improve interoperability that addresses the needs of each agency.

The primary focus of the Needs Matrix (Appendix B Needs Matrix) is for first responder agencies, although input was collected county-wide. The eventual system solution is intended to serve all agencies, including agencies that are not first responders. All identified needs were considered to some extent when evaluating solution alternatives.

The focus groups identified functional, technical, and operational needs within the County. These needs are documented in the Appendix B Needs Matrix in this report. The following sections contain a summary of the key issues identified.

Operability

Operability is the ability for agencies to work together effectively to accomplish common, basic day-to-day tasks of providing service to the community.

Operability issues are:

- Agencies with limited or no radio capabilities.

  Several fire departments are not dispatched via radio, instead using phone trees, pagers, sirens for call out. At least one department does not own radios.

- 9-1-1 PSAP organizations in Humboldt County.

  The number of PSAPs and dispatch centers is impacting the level of service provided in Humboldt County. In some instances, 9-1-1 emergency calls must be transferred multiple (2 or more) times before all first responder agencies are notified.

  Inadequate staffing at all PSAPs and dispatch centers is impacting the service level and response times.

Regional mutual aid

Public safety responders are not able to communicate effectively or directly with their federal, state, regional, or local agency counterparts.

Mutual aid frequencies are not consistently available, usable, or reliable in times of need. In most situations, these frequencies are not being monitored by a dispatch center, usage is limited by poor coverage, and many users do not know how to use – or are reluctant to use – the mutual aid channels.

Interoperability

Agencies are working to improve collaboration and coordination of improvements to public safety communications. Some excellent efforts directed at improving regional interoperability have surfaced and will bear good results. Despite these efforts funding, technology, and operations remain obstacles to achieving interoperability.

The level and definition of interoperability varies by agency. Some agencies define “communications interoperability” as swapping radios or having additional radios in their vehicles, some define it as sharing frequencies, and some define it as coordinating operational procedures.

The *Interoperability Continuum* developed by SAFECOM defines five levels to achieve communications interoperability (see Technology section). Public safety first responders in the County are not able to communicate effectively on the mutual aid frequencies as they are not consistently available, usable, or reliable in times of need. Most have frequencies for other agencies loaded into their radios. The responders rely on direct talk capabilities for communications interoperability.

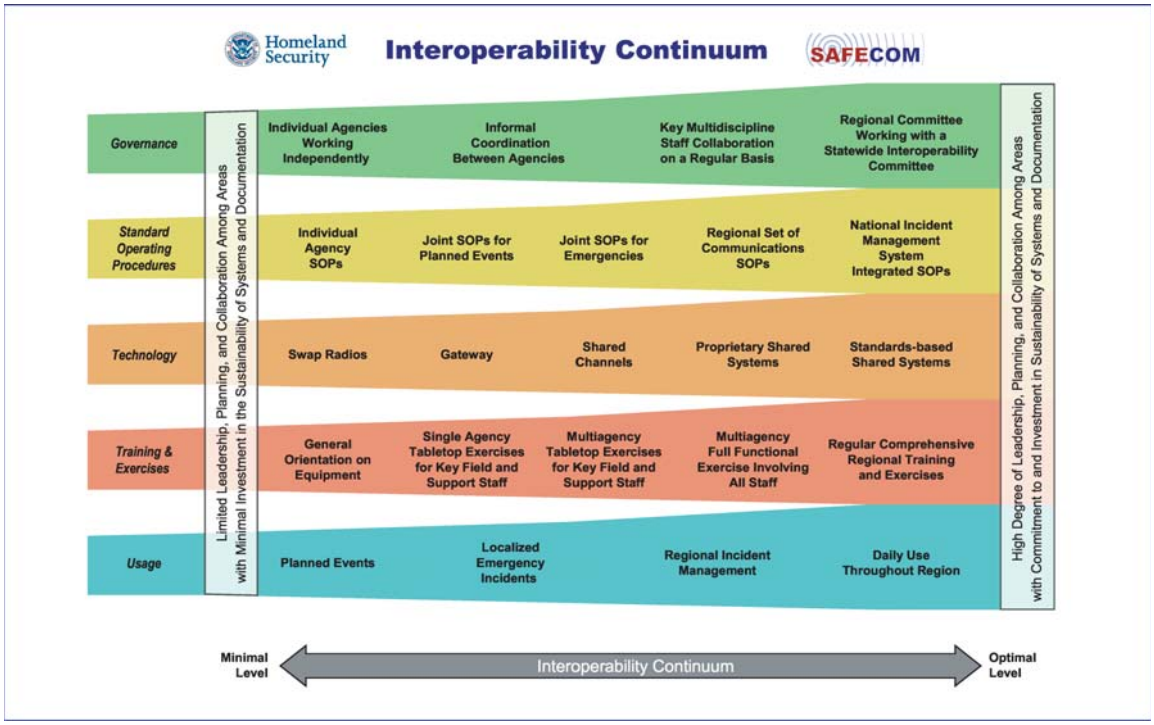


Figure 2 – Interoperability Continuum

Limited equipment and equipment standards

Incompatible radio systems and equipment, along with a lack of equipment, are contributing to ineffective communications. These are technical barriers that impede interoperability.

Available funding

There is a lack of financial resources to support the vision of interoperability. Inconsistent funding streams for equipment purchases, implementation, training, maintenance, and operations are hampering the ability to coordinate strategic planning efforts.

Mobile data communication

The importance of mobile data communications vary widely from agency to agency. Most agencies agree that mobile data communications will be important in the future as the number and capability of mobile applications continue to grow.

Humboldt County primary radio sites

Though the primary radio sites are adequate for the existing systems and major communications system failures are rare, the sites do not meet today's requirements for electronic systems. In preparation for the installation of the new

microwave system and forthcoming radio system, the County should complete work on upgrading and correcting site deficiencies.

The general condition of the each site is described below. A punch list of corrective actions and pictures will be provided under separate cover to Humboldt County.

Rogers Peak-Solar Site east of Big Lagoon

Overall, this site is not in good condition; however, the physical condition of the tower is good. The installation of equipment (radio and tower) is substandard. The Solar and DC distribution system needs to be completely rebuilt. The DC distribution is unsafe, as there is the chance of shorting. There is insufficient grounding, and no lightning protection for all radios. The building needs to be cleaned up and sealed against creatures and weather. The County has undertaken a program to upgrade the power system and improve the site.

Horse Mountain County Vault above Berry Summit

Overall condition of this site is good and the tower is in excellent condition. The generator is also in good shape. The building is in good condition, but the building needs to be cleaned up and sealed against creatures and weather.

Pierce Mountain County Vault above Scotia

The tower is in excellent condition but lacks an ice bridge. The building is older, and needs to be cleaned up and sealed against creatures and weather. The onsite generator has been abandoned and power is supplied by a generator in the Pacific Lumber vault. The master receive antenna is mounted low on the tower and the transmit antenna is mounted high on the tower, contributing to an unbalanced radio system for HCSO and HCPW.

Pratt Mountain County Vault east of Garberville

The tower is in excellent condition. However, the building is a converted shipping container with no foundation. There is evidence of water intrusion in the building. The building needs to be cleaned up and sealed against creatures and weather. The installation of equipment is substandard.

5 Radio spectrum and technology

Within the last decade, radio spectrum and associated technologies have become an issue, as well as an opportunity, for all radio users. Due to new FCC spectrum rules and the phase-out of old radio technologies, new options are available to provide improved quality of service and enhanced radio capabilities.

Demand for radio frequency spectrum (radio channels) is increasing. While this valuable resource is limitless, in theory, there are practical considerations, such as:

- The distance over which signals in different frequency ranges can be expected to reliably travel.
- The number of signals or radio channels that can be placed in a given amount of radio spectrum.

In reality, these factors do limit the number of frequency ranges that are suitable for given forms and types of communications.

For public safety agencies in the United States, the Federal Communications Commission (FCC) is chartered with defining the criteria for use of the spectrum, including frequency assignment and technical standards for equipment, all with the benefit to the public in mind.

Several FCC spectrum initiatives impact public safety radio services and interoperability. These initiatives are summarized below.

5.1 VHF/UHF narrowband refarming

In 1992, the FCC began a series of proceedings to promote more efficient use of the radio spectrum. These changes have come to be known as “refarming”. The ultimate goal of refarming is to reduce the space between adjacent radio channels, thereby increasing the number of radio channels. The initial goal is to increase the radio channels by two-fold. The result is the new channels (12.5 KHz narrowband) are half as ”wide” as the old (25 KHz wideband) channels.

In 1995, the FCC adopted refarming rule changes. In February and December 2004, the FCC adopted final deadlines for migration to narrowband technology and adopted interim steps.

The FCC December 2004 order mandates:

- The deadline for migration to narrowband (12.5 KHz) technology is January 1, 2013.
- Applications for wideband operations (25 KHz channels) will be accepted until January 1, 2011.
- Applications for new radio systems or modifications of existing radio systems that expand the authorized contour (service area) using wideband (25 KHz) base station equipment will be accepted until January 1, 2011.

- Manufacture and importation of any equipment on 25 KHz channels will be permitted until January 1, 2011.

The mandate means that all licensed radio systems now in use in the County must move to narrowband technology by 2013.

In addition, FCC rules prevent the manufacture or purchase of equipment that will operate on existing wideband systems after January 1, 2011.

The FCC refarming initiative adopted safe harbor ERP regulations. The safe harbor ERP regulations limit antenna height and power of new systems and existing systems adding frequencies. In areas of extreme terrain, the FCC has granted some waivers to the safe harbor ERP regulations.

These FCC-mandated policies and standards will affect public safety communications systems in the County. They will limit the ability to provide communications and to use the current FCC-licensed frequencies.

5.2 New VHF & UHF band interoperability frequencies[7]

The FCC has recognized the need for more mutual aid channels and has designated additional frequencies for this application in the traditional public safety bands. The FCC tried to minimize the impact on existing agencies licensed on adjacent channels when they designated the mutual aid channels.

The VHF and UHF interoperability frequencies shown in Table 7 – Interoperability channels in the 150-174 & 450-512 MHz are available and designated as “primarily” used for interoperability-only communications. Users with interoperable communications needs are “primary” and have priority in the use of these channels. Agencies on adjacent channels can only transmit on a non-interference basis (when the interoperability channel is not being used for interoperability).

Issues of adjacent or co-channel interference must be resolved through the regional frequency coordinator.

[7] FCC 00-348: (WT Docket No. 96-86) THIRD MEMORANDUM OPINION AND ORDER AND THIRD REPORT AND ORDER, Released October 10, 2000 for the specific details regarding the public safety interoperability channels below 512 MHz. FCC web site: http://wireless.fcc.gov/releases/fcc00-348.pdf.

CHANNEL (MHz) [8]	LABEL [8]	NOTES [8]
151.1375 base/mobile	VTAC 1	not available in PR/VI
154.4525 base/mobile	VTAC 2	not available in PR/VI
155.7525 base/mobile	VCALL	
158.7375 base/mobile	VTAC 3	
159.4725 base/mobile	VTAC 4	
157.250 mobile 161.850 base/mobile	RTAC 1 RTAC 1 a	VPC Ch. 25 (25 kHz pair) Available in all 33 EAs
157.225 mobile 161.825 base/mobile	RTAC 2 RTAC 2a	VPC Ch. 84 (25 kHz pair) Available in 22 EAs
157.275 mobile 161.875 base/mobile	RTAC 3 RTAC 3a	VPC Ch. 85 (25 kHz pair) Available in 11 EAs
453.2125 base/mobile 458.2125 mobile	UCALLa UCALL	
453.4625 base/mobile 458.4625 mobile	UTAC 1a UTAC 1	
453.7125 base/mobile 458.7125 mobile	UTAC 2a UTAC 2	
453.8625 base/mobile 458.8625 mobile	UTAC 3a UTAC 3	

Table 4 – Interoperability channels in the 150-174 & 450-512 MHz

5.3 800 MHz band

Interference problems have been plaguing public safety users of the 800 MHz frequency band in major metropolitan areas. Most, though not all, of these problems have been attributed to the Nextel network, which uses frequencies interspersed with those assigned to public safety agencies. The FCC is committed to resolving this interference issue, and released its rebanding Report and Order, FCC 04-168, in August 2004.

This plan will reconfigure the 800 MHz band. Nextel will fund all of the reconfiguration costs. To ensure a smooth transition to the new 800 MHz band plan, the reconfiguration process is managed by an independent Transition Administrator. The FCC requires that the band reconfiguration be completed within 36 months of release of a Public Notice announcing the start date of reconfiguration in the first NPSPAC region, through a tracked transition process.

No agency in the County is utilizing the 800 MHz band.

5.4 700 MHz band

In the Balanced Budget Act of 1997, Congress directed the FCC to reallocate spectrum in the 700 MHz band to commercial and public safety services from its previous exclusive use for television broadcasting service. The FCC established

[8] FCC 00-348: (WT Docket No. 96-86) THIRD MEMORANDUM OPINION AND ORDER AND THIRD REPORT AND ORDER, Released October 10, 2000 for the specific details regarding channel use, label and notes. FCC web site: http://wireless.fcc.gov/releases/fcc00-348.pdf.

rules for licensing a 24 MHz section of the 700 MHz band and established a band plan for use of this spectrum. The FCC also established a Public Safety National Coordination Committee (NCC) in January 1999 to advise on issues regarding the use of the 700 MHz Public Safety spectrum. The NCC formulated a national interoperability plan, recommended P25 technical standards to achieve interoperability, and provided policy recommendations regarding Public Safety regional planning committees for FCC licensing coordination. In January 2001, the FCC released their Fourth Report and Order in which P25 was specified as the interoperability standard following the NCC recommendation. FCC regulatory measures reference the P25 standard for use on interoperability channels in the newly allocated Public Safety 700 MHz band.

Regional Planning Committees (RPCs) were created and are allowed maximum flexibility to meet state and local needs. The FCC encourages innovative use of the spectrum and accommodates new and as-yet-unanticipated developments in technology equipment. The RPCs are responsible for creating and managing the regional plans. The California Region 6 Planning Committee is responsible for the development of a plan for the 700 MHz frequencies in Northern California. The 700 MHz Public Safety Band (764-776 and 794-806) rules can be found under Part 90, Subpart R. at http://wireless.fcc.gov/rules.html.

As of October 2006, the Region 6 Planning Committee has not submitted a 700 MHz Region Plan to the FCC Wireless Telecommunications Bureau.

In the *Eighth Notice of Proposed Rulemaking*[9] (*NPRM)*, released March 21, 2006, the FCC has sought comments on proposals to create broadband channels in the 700 MHz public safety band. Specifically, the Eighth NPRM seeks comment on proposals to accommodate broadband and/or wideband operations on the current wideband spectrum (twelve megahertz) of the current 700 MHz public safety spectrum allocation, including a proposal by the Public Safety National Coordination Committee to adopt a wideband data interoperability standard, commonly known as “SAM” (Scalable Adaptive Modulation). The proposal requires that all wideband radios be capable of supporting the SAM standard. At this time, the FCC has not adopted a wideband data interoperability standard.

5.5 4.9 GHz band

The FCC has recently allocated a significant amount of spectrum at 4.9 GHz for digital services in the mobile environment. A portion of the 4.9 GHz band has been allocated to public safety for broadband technologies. Communications must be related to the protection of life, health or property. Examples of types of uses are:

- Wireless LANS for incident scene management
- Mobile data
- Video security

[9] http://ftp.tiaonline.org/Public_Policy_Committee/Spectrum_Policy_WG/20060322/PPC-SPWG-20060322-005_FCC_NPRM_700MHz_PS.doc.

- Voice over IP (VoIP)
- PDA connectivity
- Hotspots
- Mobile video
- T1 line replacement (permanent fixed point-to-point operations are secondary to base mobile and temporary fixed operations)

There are public safety groups working closely with the manufacturing community, federal interests, and standards bodies to create a modified 802.11 series standard that includes all of the functionality of Wi-Fi, but operates at a frequency that is exclusive to public safety.

The potential is enormous. Public safety agencies can take advantage of the development in the commercial market and make it work in a radio spectrum dedicated to public safety with very little alteration.

5.6 Project 25 (P25)

Recognizing the need for common standards for first responders and homeland security/emergency response professionals, representatives from the Association of Public Safety Communications Officials International (APCO), the National Association of State Telecommunications Directors (NASTD), selected federal agencies, and the National Communications System (NCS) established Project 25, a steering committee for selecting voluntary common system standards for digital public safety radio communications.

Project 25 is the set of standards produced by the joint effort of APCO, NTIA, and NASTD, and standardized under the TIA. These standards encompass interoperable digital two-way wireless communications products and systems. The published standards suite is administered by the TIA in their Mobile and Personal Private Radio Standards Committee (TR-8). TIA TR-8 facilitates such work through its role as an ANSI-accredited Standards Development Organization (SDO), and has developed the 102-series of technical documents in TR-8.

The P25 standard has been adopted by the National Telecommunications and Information Administration (NTIA), which manages spectrum for the federal government. Many US government agencies (e.g., Treasury, Interior, Defense [DoD], and Justice) have specified P25 for procurements of new radio communications systems and equipment. An overview of the status of the Project 25 standards may be found at: http://ftp.tiaonline.org/WCD/P25-LAX/P25-LAX-006_Project_25_Standards_Status_9-28-2005.doc.

To improve the rate of P25 compliance, the Department of Commerce's National Institute of Standards and Technology (NIST) is working with the Office for Interoperability and Compatibility's (OIC's) SAFECOM Program and other federal partners to develop a P25 conformity assessment program. The program will ensure that public safety agencies purchasing wireless devices and systems designated as P25-compliant can be confident that the purchased equipment actually meets P25 standards.

P25 conformity assessment program components will include:

- SAFECOM grant guidance requiring that P25 products purchased with federal funds meet the requirements of the conformity assessment program.
- Third-party testing by NIST-accredited independent laboratories to evaluate compliance with P25 standards.
- Establishment of a formal supplier's "declaration of conformity" to P25 requirements, with results made available to the public safety community.

NIST expects to complete preliminary implementation of the program by the end of 2006.

6 Governance

Though not specifically called out in this deliverable, governance is a key element of any interoperability plan. This plan proposes a solution consolidating all first responder and local government communications systems in the County into one system. A single consolidated radio system provides the interoperability required by the radio users. In addition to interoperability, local government agencies are working together to share radio system infrastructure and reduce the overall cost for each user. Radio system consolidation in many regions and states is being driven by the cost to replace and support the communications systems as well as by interoperability.

A consolidated shared system requires a structure or an organization for governance. Generally, the structure of the organization is either 1) one local government agency providing contracted services to others or 2) a legal entity per state statutes.

The immediate and long term work of this organization will be to address:

- Emergency Service Dispatch
- Frequency spectrum
- Interagency agreements
- Standards

6.1 Emergency Service Dispatch

Currently there are nine (9) Emergency Service Dispatch / Public Safety Answering Points (PSAPs) in Humboldt County. They are performing twin functions of an emergency communications operation: call-taking and dispatching.

A substantial number of all fire and EMS calls must be transferred to the jurisdiction and organization serving the area where the call originated to dispatch the public safety response. In some instances, 9-1-1 emergency calls must be transferred multiple (2 or more) times before all first responder agencies will be notified.

The number of PSAPs and dispatch centers is impacting the level of service provided in Humboldt County. A consolidated communications center will provide more rapid emergency response times and will offer an economy of scale that may yield significant savings.

Recommendation: Retain a consultant and/or form a commission to develop a model and implementation plan for a fully integrated emergency communication system. Such a plan is a critical “next step”. A consolidated emergency

communication system will provide a more efficient approach and will produce a more effective solution than the current decentralized approach.

Ideally there will be only one communications center (with a backup system somewhere else in Humboldt County). This communications center will take emergency calls and dispatch the appropriate emergency response vehicles for all first responder agencies in Humboldt County.

The consolidated communications center will:

- Provide improved services to residents in Humboldt County. Consolidated communications reduces 1) the number of times a caller is transferred, 2) the repetitive questions to the caller, and 3) the overall response of the first responder agencies.
- Provide improved staffing for the consolidated communications center. Combining the current staffing from the existing centers will increase staffing options. Because staffing for operations must be designed to cover peak workloads, substantial opportunities exist for realizing economies of scale,
- Provide operational standards-based 9-1-1 and dispatch services for first responders. Operational standards are key to interoperability and inherent to consolidated communications operations.
- Provide the needed foundation for shared technologies (mobile, data, video, etc) that are not feasible with small decentralized communications centers.

Consolidated communications will result in better service to the communities and opportunities to save taxpayer money.

6.2 Frequency spectrum

Effective allocation and management of the frequency spectrum is essential to the success of the new radio system. Centralized frequency planning and coordination is necessary for the County to implement the channels required by the proposed solution. Sharing and reuse of existing frequencies across all agencies is vital in the VHF band.

6.2.1 Narrowband coordination

Coordinating the use of existing spectrum among the agencies, protecting existing spectrum, and adding to the spectrum pool when possible will enhance interoperability.

Recommendation: Local agencies and first responder organizations should immediately undertake the process of licensing narrowband channels to protect the existing channels from interference from new narrowband users.

6.2.2 Frequency planning

The FCC encourages voluntary partnering of local and state agencies with federal entities. Recently, a joint effort between the State of Alaska, U.S. Department of Defense, and local governments demonstrated the feasibility and

advantages of pooling channels. The single infrastructure and pooling of channels improved interoperability, increased the safety and security of first responders, and saved money through a cost-shared approach. With more than 50 percent of the County being federal lands, pooling channels will increase interoperability among local, state, and federal agencies.

Recommendation: Humboldt County should begin work on a frequency plan identifying frequencies suitable for deployment in the proposed radio system. This plan may identify additional frequency resource requirements, FCC licensing needs and partnership opportunities with state and federal agencies.

6.3 Interagency Communications Agreements

Under FCC section §90.179 (a) "Persons may share a radio station only on frequencies for which they would be eligible for a separate authorization". And §90.179 (b) states, "The licensee of the shared radio station is responsible for assuring that the authorized facility is used only by persons and only for purposes consistent with the requirements of this rule part [Part 90]." And §90.179 (d) states, "… this shared use must be pursuant to a written agreement between the licensee and each participant".

Recommendation: To facilitate the sharing of frequencies and other radio resources, Humboldt County Sheriff's Office, Office of Emergency Services should create an "*Interagency Agreement Form*" to document the authorization of the shared resources with and between other agencies.

7 Standards

Incompatible radio systems and equipment, along with a lack of standards, are contributing to ineffective communications and inhibiting interoperability within the County.

7.1.1 Operational standards

The County should establish a framework for interfacing among disparate systems and operations. The framework will enable a common set of standards, processes, and training approaches regionally. It will support nationally sanctioned standards sponsored by public safety associations such as the Association of Public Safety Communications Officials (APCO), Telecommunications Industry Association/Electronics Industry Alliance (TIA/EIA), the International Association of Chiefs of Police (IACP), the Association of Sheriffs, International Association of Fire Chiefs (IAFC), and others.

The framework will allow the agencies to fulfill requirements in support of emerging federal standards for the National Incident Management System (NIMS), Department of Homeland Security (DHS), SAFECOM, Department of Justice (DOJ), Office of Domestic Preparedness (ODP), and others.

Recommendation: Develop and implement standard radio templates, channel nomenclature, and clear text radio protocols. While an effective communications plan involves many operational standards, perhaps the most important component is the user's understanding of the radio system. When a first responder is handed a portable radio, they are really receiving a computer with an antenna. Radio systems are becoming more complex. It is critical that users fully understand how to navigate the channels that reside in the radio, what they are named, and what protocols are used on each channel.

Consequently, an interagency agreement (or agreements) on channel nomenclature and channel protocols is a crucial precursor to effectively communicating. The ability of first responders to communicate with each other, particularly across agency lines, improves dramatically when everybody agrees that there must be at least some common channels with common names.

Recommendation: NIMS has put forth an initiative for the elimination of codes (for example: "10 codes") in communicating on voice radio systems and the use of "clear text" only. Communication codes can be an interoperability issue. The current protocol for Humboldt County first responder agencies is a mix of "clear text" and "10 codes". The original NIMS initiative tied the use of "clear text" to 2006 Federal interoperability grants; however, NIMS has relaxed this initiative.

> In Virginia police-speak, a 10-50 means a motor vehicle accident. But in Montgomery County, Md., 10-50 means "officer in trouble".

7.1.2 Technical standards

As stated in the Governance section, this report recommends the formation of a governance body or organization. The governance body will establish a minimum level of acceptable technology standards going forward. These standards will form the baseline for improving communications and interoperability in support of new procurement initiatives and funding approvals.

Recommendation: Develop environmental, power, cable, and wire standards for public safety communications, equipment rooms, radio vaults, and sites. The State of California Department of General Services, Telecommunications Division has technical requirements for sites controlled by the California Department of Forestry. These requirements will provide the foundation for site requirements used by Humboldt County first responder agencies.

Recommendation: Implement a preventive maintenance and support program for all infrastructure radio equipment. In addition to the traditional radio equipment, the program should address the connected systems (power, air, etc) and structures that may impact the performance and availability of the radio system. Update and/or execute new contracts with service organizations to include maintenance program requirements. In the near-term, complete work on upgrading and correcting site deficiencies.

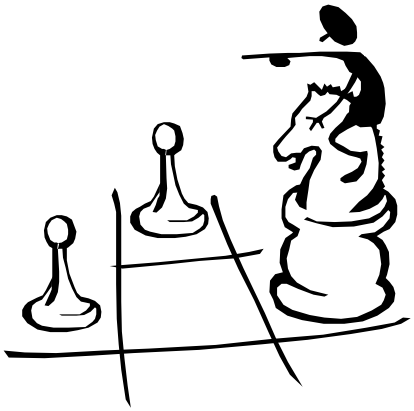
Recommendation: Develop and publish subscriber voice equipment standards.

The standards will specify equipment attributes such as radio protocol, capacity, and encryption standards as well as physical and environmental specifications (mil specs).

8 Technology

8.1 Voice communications

The solution presented in this report is a conceptual design based upon requirements of first responder agencies in the County. The solution is designed to meet the technical, operational, and functional requirements expressed by the participating agencies. The proposed solution provides for the highest levels of radio interoperability possible between agencies by providing appropriate interface points for other agencies to access the regional system or, where practical, to partner with the other agencies to take advantage of the benefits of the system.



8.2 Voice communications considerations

Ganner Associates evaluated alternative technical options to determine which solutions best met the needs of the regional agencies. Candidate solutions were evaluated with respect to frequency bands, coverage and other considerations.

Frequency bands and communications protocols considered were:

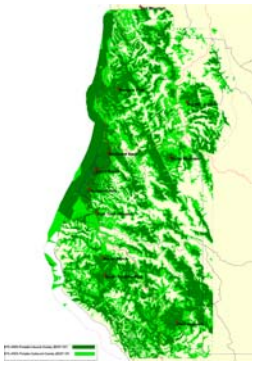
- Communications protocol (analog or digital).
- Frequency bandwidth.

Other considerations were:

- Communications, mutual aid, and interoperability needs of the first responder agencies.
- Availability of spectrum.

8.2.1 Frequency bands and communications protocols

Providing adequate coverage to meet the operational needs of end users is always a challenge, and maintaining reliable coverage for agencies is hampered by technical limitations, licensing obstacles, and cost.



Ganner Associates' experience in developing coverage requirements for radio systems indicates there is a progressively diminishing return on investment that develops once certain levels of radio coverage are achieved. Based on studies completed for other radio systems, the threshold for optimal levels of mobile coverage versus cost typically occurs when radio coverage is between 90 and 95 percent.

The stated mobile coverage goal in the *Needs Matrix* varies by agency and county. Specific coverage requirements will be further defined and documented at the time the County enters into a contract with a land mobile radio supplier or system integration vendor.

As called for in the contract, *Ganner Associates* generated coverage maps for the specific sites under consideration for the proposed solution. For security purposes[10], coverage maps and site reference information will be delivered to the County under separate cover and will be released only to authorized personnel.

The selection of the eleven sites, shown in Table 5 – Coverage map sites and the specific coverage maps are based on inputs from the focus group meetings and discussions with the vendors providing services in the County. The sites were selected for: 1) the different terrains and 2) agency familiarity with existing radio coverage off these sites. Representative VHF frequency was selected to generate the coverage maps.

Site name	VHF					
	Wideband		Narrowband		Narrowband	
	Analog		Analog		Digital	
	Mobile	Portable	Mobile	Portable	Mobile	Portable
Big Hill - Hoopa					X	X
High Tower - Eureka					X	X
Horse Mountain	X	X	X	X	X	X
Humboldt County Court House					X	X
Humboldt Hill	X	X	X	X	X	X
Humboldt State University					X	X
Pierce Mountain					X	X
Pratt Mountain					X	X
Red Mountain					X	X
Rogers Peak					X	X
South Rainbow Peak					X	X

Table 5 – Coverage map sites

The Humboldt Hill and Horse Mountain sites were the baseline for comparison of wideband/narrowband and analog/digital coverage on a VHF frequency.

To compare the characteristics of frequency protocols, the coverage maps were created with similar site parameters and equipment specifications. The maps are only for the comparison of frequency bandwidth and protocols and are not intended to be or to replace the engineering required to design a radio system.

Technical – coverage map parameters

Per industry standard TSB-88, all maps were created for 97% talk-in (from portable and mobile radio) coverage reliability for portable and mobile radios. Portable coverage shall be modeled using remote speaker microphones with the portable radio on the hip.

The general technical specifications for the mobile, portable, and base station equipment used for the coverage maps are:

- Mobile: 30 watt transmit

[10] California Government Code Section 6255

- Portable: 3 watt transmit, with portable radio on hip
- Base station: 70 watt (maximum) transmit

Effective Radiated Power (ERP) for the coverage maps is contained in Table 6 – ERP below. These ERP levels were used in accordance with the FCC safe harbor ERP regulations for VHF and the 70 watt transmitter power limit.

Name	Elev. (AMSL)	Height to Tip - Used (m)	ERP (W)**	HAAT (m)	Antenna Gain	Required Service Area Radius(km)**
Big Hill - Hoopa	1090	12	52.5	200	3 dBd	32
HC Court House	15	18.3	52.5	-37	3 dBd	13
High Tank - Eureka	30	18.3	52.5	-70	3 dBd	13
Horse Mountain	1509	15	52.5	751	3 dBd	64
Humboldt Hills	163	18.3	52.5	111	3 dBd	32
Humboldt State U.	73	10	52.5	-98	3 dBd	13
Pierce Mountain	999	15	52.5	528	3 dBd	64
Pratt Mounain	1143	15	52.5	746	3 dBd	64
Red Mountain	1280	18.3	52.5	837	3 dBd	64
Rodgers Peak	837	18.3	52.5	569	3 dBd	64
South Rainbow Peak	1104	18.3	52.5	703	3 dBd	64

** Service Area Radius (km) required for ERP of 52.5 W without gaining waivers per FCC Table in 90.205

Table 6 – ERP

Identical antenna and combining system were used in this report.

ERP levels were used in accordance with the FCC safe harbor ERP regulations (for VHF and UHF) and the 70 watt transmitter power limit.

8.2.2 Other considerations

Interoperability

The day-to-day communications, mutual aid, and Interoperability needs of the first responder agencies in the County vary from agency to agency. Many agencies see little need to communicate when outside the County. However, all agencies acknowledge the importance of communicating within the County and with federal and state agencies. Current considerations include:

- US Forest Service and Bureau of Land Management radios operate in the VHF band and must be narrowband by 2009. (This is a mandate by NTIA for all federal agencies.)
- California Highway Patrol (Humboldt District) radios operate in the VHF LOW band and there are no plans for CHP to migrate to a different band in this District.
- Digital communications protocol is the standard that has been adopted by Federal agencies such BLM, USFS, and DOD.

Spectrum

- VHF and UHF band frequencies are subject to the FCC narrow band rules.
- There are no frequency planning requirements for VHF and UHF frequency bands.
- Generally, VHF and UHF band frequencies are available on a shared basis only with other users on the same frequency; however exclusive use of these frequencies is granted in certain situations.

8.2.3 Summary

Several candidate solutions were eliminated due to incompatibilities with the baseline requirements or because they were viewed as technologies with an uncertain future.

Commercial services

A solution based on private sector commercial services as a primary voice communications system was seen as too risky for a public safety agency that requires a very high level of service reliability for mission-critical operations.

UHF and 700/800 MHz frequency based systems

The limitation of UHF frequency pairs and the fact that no local, state, or federal law or fire agency is using UHF or 700/800 MHz radios in the County makes these spectrum-based radio systems less desirable than a VHF high band radio system.

Non-digital based systems

The communications protocol will be based on the planned direction from the State of California Division of Telecommunications and the Department of Homeland Security grant application criteria. Both agencies stated the desire for digital transmission technology.

Seamless wire area roaming system

Often touted as the “Lexus” of the radio systems, seamless wide area roaming has not been identified as a requirement for an interoperable system. Should the County’s requirements change and seamless wire area roaming become a requirement, the proposed solution will become a key component of a system supporting seamless wire area roaming. A cost estimate for seamless wide area roaming is provided in the Budgetary Cost Estimate Section of this report.

8.3 Proposed voice radio system solution

Ganner Associates is recommending a multi-band hybrid radio solution for voice communications for the County.

The radio system solution is based on the operational and functional requirements identified by first responders in the *Needs Matrix.* The solution also enables local government agencies to meet the growth requirements of the next

twenty years and to partner with other agencies in providing radio service, thereby reducing the ongoing operational costs to local agencies.

8.3.1 Voice radio system overview

The core of the system includes the placement of radio sites in strategic locations within Humboldt County for wide area coverage. Thought not seamless, these sites permit wide area roaming for all first responder agencies in Humboldt County. The radios sites, also known as the RF infrastructure, will consist of five (5) VHF P25 trunked subsystems located at Humboldt Hill, South Rainbow Peak, Pratt Mountain, Horse Mountain, and Rodgers Peak. Additionally, the Humboldt Hill subsystem will include receive-only sites to assist with improved portable talkback communications from inside buildings in the urban area. Accessing the trunked subsystems from the communications center will be accomplished with the use of control stations located at or near the communications center and at Pierce Mountain.

A conceptual view of the solution is presented below.

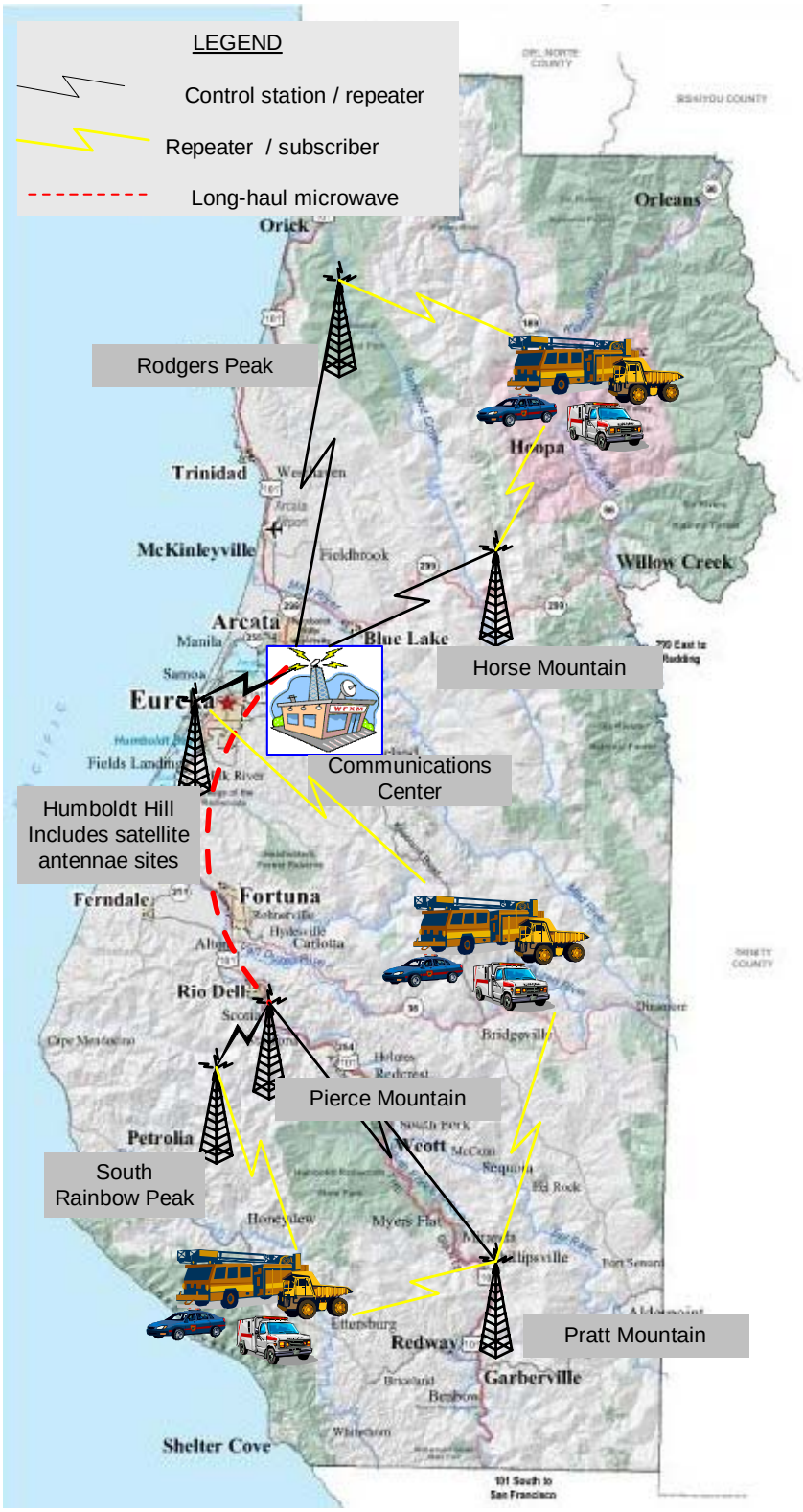


Figure 3 - Proposed System – Conceptual View

Today, each individual agency has frequencies licensed to them and then uses those licensed frequencies just for themselves. Aggregating VHF frequencies into a trunked system will provide a radio system with additional talk time and channel capacity and will support user needs not readily available on conventional systems.

The basic concept of any trunked radio system is based on the efficient sharing of radio channels. At any moment, a limited number of radio repeaters are available to the system for assignment of conversations. Users on the system have radios that are partitioned into “talkgroups”, not frequencies. When a radio is selected for a specific talkgroup, the user will 3993hear only the transmissions for that group. Through processor control, the system automatically makes channel assignments for talkgroup conversations. A typical conversation between a dispatch operator and a mobile unit might take place on one frequency at a certain moment and on another frequency at a later time. As the processor makes assignments and sees available channels, it weaves talkgroups in and out of the network for the most efficient use of the radio spectrum.

See *Appendix E: Trunking Radio Systems* for a high level description of trunked radio system operations.

The solution provides improved radio coverage by the addition of new RF transmission sites and receiver sites. Specifics are detailed in the *Radio Transmit and Receiver Sites* section of this report. In addition to the expanded VHF radio infrastructure, in-band VHF mobile repeaters are proposed to improve portable radio coverage for first responders operating in rural areas (Sheriff’s Office and other responders as needed).

This solution is an integrated standards-based design incorporating P25 digital radio system capabilities in the VHF spectrum and access to the existing UHF analog systems for allied non-first responder users. The solution continues use of UHF conventional analog radio channels for EMS pre-arrival, schools, and Humboldt County corrections.

Tactical gateways, patches, and audio switches will be used to bridge legacy equipment, bridge system-to-system infrastructure (UHF/VHF), and to create deployable, tactical interoperability capabilities.

The solution assumes that sufficient frequencies in the VHF MHz frequency band are available for the efficient deployment of digital channels through consolidation of current licensed spectrum in the County.

The nature of the system will require the agencies to centralize and consolidate control, management, and maintenance of the common, shared infrastructure equipment. Furthermore, the agencies should manage licensed radio spectrum used by agencies on a centralized basis for the benefit of all agencies. This centralized frequency management approach is necessary to realize sufficient channels for effective deployment of the system solution.

The infrastructure solution is organized and presented in the following component sections:

- Digital Transport (backhaul) system
- Transmit (RF) sites
- Dispatch centers
- Subscriber equipment

8.3.2 Digital transport (backhaul) system

The system solution described in this report requires digital transport (backhaul) services for some RF sites and the consolidated dispatch center. Backhaul services may be a combination of digital microwave, fiber, or telephone services to connect the communications center to the control stations located at the communications center and Pierce Mountain. Backhaul services are also required to connect the satellite receiver sites to the receiver comparator located at Humboldt Hill. The proposed VHF trunked repeater sites do not require backhaul connectivity to the communications center.

Preliminary research indicates many, if not all, the radio sites required to provide radio coverage have: 1) aging service using County-owned equipment, 2) microwave access using a commercial services provider, or 3) state-owned microwave equipment.

The research also identified constraints and concerns regarding the feasibility of using the existing microwave systems. The concerns identified are: 1) monthly lease rates may be too costly, 2) one or more of these systems may not be considered capable of providing public safety grade service, and 3) systems may not have available capacity to support the proposed radio system.

Design assumptions were made regarding the digital microwave and fiber systems for this report:

- For purposes of this report, the communications center and all RF sites will require access to digital transport capabilities. The specific technology of the vendor selected may eliminate and/or reduce some backhaul requirements.
- Backhaul services for satellite receivers to the comparator at Humboldt Hill will be provided by leased telephone lines.
- All other backhaul paths will be replaced with equipment capable of supporting digital data transmissions (digital microwave or equivalent).
- All RF sites required for deployment are capable or will be made capable of supporting the equipment proposed in the system solution.
- In order to minimize overall costs, existing agency-owned and/or agency-managed sites will be used wherever possible. This may lead to some

consolidation in the overall number of sites needed by local and county agencies for radio communications.

The costs associated with a digital transport system are based the construction of new short and long haul digital backhaul paths. Construction costs are identified for the construction (see Appendix C Detail Costs) of new digital backhaul paths. However, the costs associated with the addition and/or expansions of existing sites are not included in the cost of the system solution.

Though the primary radio sites are adequate for the existing systems and major communications system failures are rare, the sites do not meet today's requirements for electronic systems. In preparation for the installation of the new communication systems, the County should complete work on upgrading and correcting site deficiencies identified in the site review. This work has been submitted to the County in earlier correspondence.

8.3.3 Transmit (RF) sites

The solution provides improved radio coverage by the consolidation of existing local agency transmitter sites and the addition of new RF sites. The five VHF digital trunked repeater subsystems will provides voice radio services for the Sheriff's office, local police and fire services, dispatch operations, incident command, and local government agencies.

The actual number of channels deployed on each site will vary based on multiple factors including spectrum availability, user needs, and tower site limitations. The channel allocation will be determined during the engineering phase by the vendor implementing the trunked radio system.

The trunked repeater subsystem providing urban coverage will be located at Humboldt Hill. The subsystem will be equipped with six[11] (6) channels. The five[11] (5) satellite receivers located throughout the urban area will be connected to the comparator located at Humboldt Hill by leased telephone lines.

The four trunked repeater subsystems providing rural coverage will be located at South Rainbow Peak, Pratt Mountain, Horse Mountain, and Rodgers Peak. Each subsystem will be equipped with three[11] (3) channels each.

To access the urban repeater site, six[11] (6) control stations will be located at the communications center. To access South Rainbow Peak and Pratt Mountain repeater sites, six[11] (6) control stations will be located at Pierce Mountain. To access Rogers Peak and Horse Mountain repeater sites, six[11] (6) control stations will be located at the communications center.

The communications center accesses the five (5) trunked radio subsystems through control stations. Control stations located at (or near) the communications center will be used to communicate with the three (3) trunked subsystems

[11] Dependent on vendor equipment architecture and traffic loading analysis

located at Humboldt Hill, Rogers Peak, and Horse Mountain. These control stations will be connected by cable, short haul microwave, or telephone lines. The control stations at Pierce Mountain will be used to communicate with two (2) trunked subsystems located at South Rainbow Peak and Pratt Mountain. These control stations will be connected to the communications center via microwave.

The proposed solution incorporates:

- The three (3) existing UHF analog radio systems used by Med-Net, schools and correction operations.
- A permit “patch” to connect a Med-Net channel to an EMS ”talkgroup” on the VHF trunked radio system.
- Gateway (patch) equipment to provide connectivity with legacy systems and analog interoperability channels. Connectivity between other users not on the VHF trunked system may be provided as needed with gateway equipment.

The primary design considerations required for all VHF sites are:

- The failure of RF transmit capabilities on a single site will not significantly impact the operation of the voice radio system.
- All backhaul paths will be capable of supporting digital data transmissions (digital microwave or equivalent).
- All RF sites required for deployment are, or will be made, capable of supporting the equipment proposed in the system solution.

8.3.4 Consolidated communications center

The 9-1-1 PSAP and dispatch center for the first responder agencies in the County will access the voice radio system through microwave or wire-line links to connect to control stations which access the trunked repeater sites. The existing dispatch center(s) equipment may not be capable of operating in a digital environment (based on manufacturer, age and model) and may need to be replaced.

For planning and funding purposes, eight (8) radio dispatch consoles will be proposed for the consolidated communications center. Satellite dispatch locations such as public works, AMR, fire, and others will use radio dispatch desk sets for dispatch, administrative, or tactical operations. These centers will consist of one voice radio dispatch desk set connected via radio to the repeater.

8.3.5 Subscriber equipment

Subscriber equipment consists of the mobile and portable radio equipment that will be used for voice on the proposed radio system solution. (Mobiles are data capable.) The design considerations for the subscriber equipment are as follows:

- Voice portable and mobile radios will operate primarily in a

P25 trunked narrowband mode but will retain backward compatibility with analog radios for interoperability.

- Typical configurations for P25 trunked mobile radios and portables used by public safety agencies will be a 35-50 watt mobile radio and a 1-5 watt portable radio.
- Mobile radios (VHF) are capable of providing a data interface to voice radio network for basic low-speed data network capabilities.
- P25 trunking capable subscriber units, both mobile and portable, will be required for all users on the VHF system in Humboldt County.
- In-band VHF mobile repeaters will be used for first responders operating in rural areas (Sheriff's Office and other responders) as needed.

8.4 Mobile data communications

Mobile data solutions provide first responders with access to computer applications that solve a problem or perform a function. These functions often involve accessing or updating databases, such as NCIC, 9-1-1 incidents, plat maps, etc. While some federal and state databases are compatible, local agency databases are unique in structure and are not compatible with other agency databases. It may be expensive to provide computers and computer applications to permit mobile users access to the information in local databases.

Mobile data solutions should integrate mobile data network(s) and computer applications into a secure encrypted communication system, enabling the mobile computer users to use the network that best fits their needs.

Based on the specific first responder mobile client application software, the mobile computers manage the transfer of data from the application to the host computer systems.

The bandwidth of the data network is dictated (or restricted) by the requirements of the computer applications. The computer applications are dependent on network availability (coverage), message size (speed of network).

Data network capabilities may be defined as basic, high speed, and broadband.

8.4.1 Basic data networks

Applications with limited data radio needs (size and number of messages) are suitable on basic data networks. Applications such as text messaging, dispatch orders, and some NCIC/DMV inquiries are candidates for these networks. Basic data network characteristics are:

- Data transmission rates between 4800 and 19200 bits per second (bps).
- Traditional data networks operated in the public safety spectrum.

- 9600 bit per second data services integrated into the voice P25 standards architecture. Mobile voice radio serves as the radio modem without additional dedicated data infrastructure.

8.4.2 High speed data networks

Applications such as mobile field reporting, mobile printing, card swipes, and still images are candidates for high speed data networks, as is any application with large text messages. High speed data network characteristics are:

- Overall data transmission speeds in the range of 96 Kbps.
- Requirement for a dedicated radio/modem. Modem may be an external device or a PC card, or it may be built into the data terminal.
- No industry standards for modem interfaces and communications protocols. Primary providers of proprietary modem equipment operating in the public safety spectrum are Data Radio, Motorola and IPMobilenet.
- Capability to automatically adapt the speed of the mobile data transmissions based on the radio coverage area and bit error rates (BER) in most radio modems.
- Commercial service providers, such as Cingular, also provide data network services.

8.4.3 Broadband data networks

Broadband capabilities are generally deployed in selected areas for specific applications. The term “broadband” comes from the words "broad bandwidth". It is used to describe a high-capacity, two-way link between an end user and a network capable of supporting full-motion interactive video applications, voice mail services, voice recording, and mobile office. Broadband data network characteristics are:

- The basic and primary data networks may be supplemented by wireless LAN systems, such as Wi-Fi and meshed networks.
- Coverage is limited and networks are usually deployed in selected high density areas.
- Depending on frequency availability, deployment configuration, and the data radio vendor capabilities, higher speed data capabilities could be added in later phases.
- High network costs, which prohibit a wide-area deployment of these technologies currently.

8.4.4 Mobile data network coverage

Private mobile data networks today are generally dedicated to data and are separate and not part of voice radio networks (except for basic P25 data).

Therefore, the coverage for these systems is not the same and is generally less than the mission-critical voice systems.

The cost of building a mobile data network on top of (overlay) of an existing voice data network is often cost-prohibitive and may not meet the performance requirements of the user.

Many agencies are currently using commercial carriers (AT&T, Verizon, etc) instead of building a private dedicated network. The commercial carriers are cost-effective, as no infrastructure costs are required, and are immediately available. Generally, the commercial carriers systems stay current with technology (i.e., increased speed), allowing the users to continue to install mobile applications requiring more and more bandwidth. The shortcoming of commercial carrier systems is that the carrier is willing to build infrastructure only in urban populated areas. With this limitation, commercial carrier based mobile data systems are not feasible for users requiring rural wide area coverage.

8.4.5 Summary

Though it is technically possible to build high speed wide area data systems for rural areas in Humboldt County, it is may not be cost effective.

Technologies supporting mobile data applications are evolving at a fast pace. New broadband technologies and enhanced performance of basic and high speed networks are being announced on an almost-daily basis and no standards exist for mobile data systems.

A mobile data network for a specific user is dependent on the capabilities of the computer hardware, application software, and network access to the wireless data network. Generally, no user agency applications are compatible with one another.

Recommendation: Each user agency should look at the wireless network options based on their coverage and throughput needs.

In many instances, commercial system providers may be able to meet user needs with limited startup costs and without requiring the agency to invest in fixed infrastructure. Commercial systems permit the users to update or change networks to take advantage of improvements in bandwidth and coverage.

8.5 Budgetary cost estimates

Cost estimates for voice radio system replacement projects are based on an order of magnitude estimate. The approach used for this cost analysis is based on the following:

- Costs estimates are categorized according to the major architecture components.
- The estimates are based on public safety grade equipment pricing that is available through the Western States Contracting Alliance (WSCA) and from vendors. Mid tier pricing is used for all subscriber equipment

- Costs estimates are based on the replacement of all VHF equipment. Estimates do not consider cost reductions associated with the reuse of existing equipment, as reuse may dependent on the radio systems provider selected to build the system.
- The overall cost estimates are expected to be within 20% of the costs that would result from a formal procurement process.

Proposed system components are:

Radio sites: repeaters, control stations, and base station equipment.

Dispatch center: backroom equipment, desk top control stations, and consoles for the 9-1-1 communication center.

Voice subscriber equipment: digital portable and mobile radios, including installation.

8.5.1 Cost assumptions

The following basic assumptions were used to estimate the system acquisition and annual recurring expenditures:

- All VHF, dispatch and microwave infrastructure radio equipment in Appendix C Detailed Costs replaces existing infrastructure equipment in the County.
- Subscriber radio equipment in Appendix C Detailed Costs replaces all first responder and other local government agency subscriber equipment in the County.
- Digital transport system costs shown either replace existing equipment microwave links or lease telephone circuits.
- Maintenance and leased expenditures are considered as annual recurring costs. Estimated yearly contracted maintenance costs, based on industry average. Maintenance costs are either 1) percentage based on equipment costs or 2) flat rate, determined by level of maintenance provided by agencies as noted in detail cost breakdown.
- Implementation costs include all non-equipment costs associated with the implementation of the voice radio system (installation, project management, one-time training, etc.). Estimate is a percentage of equipment costs as noted on the detail cost breakdown
- Number of transmitter sites, channels, digital transport links, subscriber, and console equipment is an estimate solely for the purpose of providing a budgetary cost estimate. These costs are based on a preliminary analysis of terrain and user requirements. Final number of channels, site locations, and subscribers will be determined during design phase for and with selected radio systems provider.
- Subscriber encryption cost is shown as an option. The proposed digital architecture supports encryption.

- Mobile data network infrastructure costs are not included in the voice radio budget (see Cost Summary).

8.5.2 Cost estimates

The system acquisition cost estimates are expected to be within 20% of the costs that would result from a formal procurement process for the initial system acquisition and recurring costs. Projected recurring costs for the system are provided and based on outside support for some components. The County may elect to provide this support themselves, thereby reducing system support agreement costs. Appendix C Detail Costs includes the detailed cost estimates for each of the major components.

- **System acquisition costs** are one-time expenditures incurred for purchase, installation, and initial maintenance of new systems equipment and services.
- **Recurring costs** are expenditures for operation, maintenance, and licensing of systems and equipment components that occur throughout the lifecycle of the system.

The table below shows the system acquisition costs for the proposed solution. The system acquisition cost estimate details are included in Appendix C Detail Costs.

System acquisition costs	
System component	**Extended costs**
Infrastructure	**$1,134,280**
Rogers Peak	$105,000
Horse Mountain	$84,000
South Rainbow Peak	$84,000
Pierce Mountain	$164,080
Pratt Mountain	$105,000
Humboldt Hill	$592,200
Subscriber equipment	**$3,032,700**
Fire Agencies	$1,108,800
Law Agencies	$976,800
EMS Agencies	$90,000
Other Agencies	$857,100
Communications Center / Remotes	**$1,110,360**
Communications Center	$780,360
Fire Stations	$302,500
City Ambulance	$27,500
Other	$50,000
Total acquisition costs	**$5,277,340**

Table 7 – System acquisition cost estimate

The table below shows the annual recurring costs for the proposed solution. The recurring cost estimate details are included in Appendix C Detail Costs.

Recurring costs	
System component	**Extended costs**
Infrastructure	**$165,040**
Rogers Peak	$15,000
Horse Mountain	$12,000
South Rainbow Peak	$12,000
Pierce Mountain	$23,440
Pratt Mountain	$15,000
Humboldt Hill	$87,600
Subscriber equipment	**$60,654**
Fire Agencies	$22,176
Law Agencies	$19,536
EMS Agencies	$1,800
Other Agencies	$17,142
Communications Center / Remotes	**$181,480**
Communications Center	$111,480
Fire Stations	$55,000
City Ambulance	$5,000
Other	$10,000
Total annual recurring costs	**$407,174**

Table 8 – Annual recurring cost estimate

8.5.3 Cost summary

- Infrastructure equipment is less than 25% of the system acquisition costs.
- Recurring costs include some level of manufacturer support for all equipment in the proposed solution. These costs may be reduced based on individual agency requirements for service.
- Infrastructure costs, depending on vendor selected, to expand the proposed system to support ‘seamless wide area’ roaming and wide area data networks will be several times the infrastructure costs stated in Table 7 – System acquisition cost estimate.

9 What next?

Where should Humboldt County go from here?
Now, by following the recommendations presented in this plan, Humboldt County can take action and initiate the next phase of this project.

Implement a regional governance structure.

- Select a lead organization (person) to chair this effort.
- Evaluate alternative structures and recommend an appropriate governance structure.
- Establish the proposed system program organization structure and proceed with consolidated communications and standards recommendations.

Initiate the system engineering phase of the project.

- Develop a Request for Proposal for detailed system engineering, procurement, and installation for the proposed communications project.
- Obtain technical assistance and support in finalizing the system design and further developing the project plan as needed.

Develop a funding plan.

- Prepare funding report, grant applications, and documentation to secure funding.
- Develop a long-term strategy for funding a system implementation spanning multiple years.
- Develop cost recovery and apportionment formulas to fund ongoing operations.

Appendix A: Focus group meetings

October 2, 2006 – 13:30, Focus Group Meeting

Participants:

RWS Services
Humboldt County - Sheriff's Office
Humboldt County - Public Works
Six Rivers Communications
Motorola
Humboldt County - Public Health
Humboldt County - Health and Human Services
Humboldt County - Code Enforcement
McKinleyville Community Services District
Humboldt County - Probation
Humboldt County - Communications
Humboldt County - Risk Management

Voice – Coverage

- Sheriff's Office, Public Works and other County agencies use the same repeater sites. Probation department uses Sheriff's Office frequencies.
- 4 repeater sites: Horse Mountain "A" (NE), Rodgers's Peak "B" (NW), Pierce Mountain "C"(SW), Pratt Mountain "D" (SE).
- Repeater in Shelter Cover (for portables), however dispatch center cannot communicate with units in Shelter Cover area. Shelter Cover uses the "D" repeater, coverage is 75% on "D" repeater.
- Very poor portable coverage outside of Arcata and Eureka and a couple of dead spots within the City (i.e., SW corner of courthouse).
- Overall Sheriff's Office coverage for portables radios is 30%.
- N.E. County, Orleans, Johnson areas coverage is poor, even for 100 watt mobiles.
- Poor mobile coverage in NE County, Highway 36, McKinleyville to Rio Dell area, east of McKinleyville to Blue Lake, in the Orick and Hoopa areas, Fortuna, Garberville and Petrolia.
- Jail has a UHF system for inmate supervision.
- McKinleyville Community Services District has mobile coverage from Trinidad to Eureka – 97% mobile coverage.
- Red Cross has a VHF base station.

Interoperability

- All Fire and Law agencies are using VHF, except CHP which is on LOW (VHF Low) band and EMS Med-Net which is on UHF band.
- CHP has VHF portables that communicate with mobile LOW band radios (in car repeater).

- CHP portables (assuming coverage) will use the CLEMARS frequency to communicate with other agencies.
- LOW scanners in Sheriff's vehicles and VHF scanners in CHP cars. Agencies communicate via listening to the frequencies of other agencies on the scanner.
- 5 VHF frequencies are (or will soon be) loaded into every radio. These are CALCORD, CLEMAR, NELMAR, OES1, and OES2. The frequencies are NOT repeated. Not known whether 5 nationwide narrowband interoperability frequencies are (or will be) loaded into the radios.
- LAW communications with users on the UHF (SCHOOL NORTH and SCHOOL SOUTH) band is done via portables. A few command units (fewer than 10) carry UHF portable radios.
- Med-Net has 4 UHF repeater sites, 8 control points, and about 20 mobiles. Same repeater sites used by Sheriff's radio system. Similar coverage problems of Sheriff's Office.
- Public Works (VHF) has a need to work with Med-Net and schools but unable to communicate.
- Fire would like to communicate with schools and Med-Net.
- Amateur (ARES) radio is critical in the County. ARES equipment at the hospitals, courthouse, American Red Cross, and in some of the schools. ARES is installing equipment in all main schools, with redundancy in case of an emergency.
- Agencies unable to talk in Hoopa Valley. Looking to purchase a link to the 4 main repeater sites from Bald Hills.
- Forest Service is on VHF narrowband (wideband capable) frequency and other agencies need to communicate with US Forest Service. Need an agreement to use their TAC frequencies.
- Need to communicate with other county medical organizations.
- Sheriff's Office backup systems at repeater sites are in poor condition. Propane, solar panels, and infrastructure are aging.
- City of Eureka, Arcata, Fortuna, HSU, City Ambulance, CDF use telephone lines to communicate between centers (no radio capability). City Ambulance and CDF talk across City Ambulance frequency. (CDF dispatches south County City Ambulance business,)
- One dispatch center in Eureka for police, fire and EMS.
- In Southern Humboldt, fire and EMS are dispatched by CDF, which dispatches for 30 volunteer fire departments and EMS. Occasionally have had problems with CDF dispatch as their personnel sleep at night.
- In unincorporated areas of the County, 9-1-1 calls go to Sheriff's Office and then are transferred to appropriate fire and/or EMS agency.
- Only one transfer of a 9-1-1 call is allowed (at one time).
- Coast Guard in this area is on channel 16 and sometimes 83.
- BLM is on USFS frequencies.

Non-Voice

- Would like to have data and video capability on mobile computers, sending video between computers using TCP/IP network protocol. Video would be encapsulated in data packets. Also use satellite phones for data-redundant communications.
- National Guard satellite link/converts to IP, could be used in emergencies.
- Department of Water Resources has camera on radio to relay pictures to computer.
- Sheriff's Office not currently using non-voice comm, currently testing mobile data terminals on cellular phone system. May need to use radio (private) system.
- Eureka and Fortuna Police Departments using a data mobile data system built on a proprietary UHF (two sites) radio system architecture.
- Sheriff's Office would like to do reports, license checks, plates, etc. on mobile computers and are interested in vehicle location.
- Cameras and wireless – no traffic stop cameras in currently in vehicles.
- Need to bring PGE in to this process. Radio interoperability with PGE is important.

Goals

- One infrastructure for all users in the County.
- Solutions to existing communications problems.
- More dependable voice communications.
- Humboldt County Public Works states desire for 90% coverage for mobile and portable.
- Fill in poor coverage areas.
- Simulcast broadcast of an incident to fire and EMS would be great.
- Smaller agencies need a wide area frequency permitting interoperability between agencies, specifically when telephone lines are down.

October 2, 2006 – 15:30, Focus Group Meeting

Participants:

California Highway Patrol
American Red Cross
California State Parks
Six Rivers Communications
Humboldt County - Communications
Humboldt County - Risk Management

Voice – Coverage

California Highway Patrol (CHP)

- CHP is installing JPS1000 gateway in Humboldt County for non-tactical operations for LAW agencies. FIRE and EMS will not be on CHP gateway. Humboldt County purchased a gateway for tactical operations.
- CHP radio coverage is 80-90%.
- CHP has VHF portables that communicate with mobile LOW band radios (in car repeater). VHF portables good to about 250 ft from mobile – CHP is installing a new system permitting the VHF portable to operate up to 1000 feet from the mobile
- CHP portables (assuming coverage) will use the CLEMARS frequency to communicate with other agencies.
- LOW band scanners in Sheriff's vehicles and VHF high scanners in CHP cars. Agencies communicate by listening to frequencies of other agencies on the scanner.
- Poor coverage – Honeydew to Petrolia, "Lost Coast" between Cape Mendocino and Petrolia – no cell phone either.
- Poor coverage – Garberville, Highway 168 and parts of Highway 101.
- Use cell phones and scanners to talk with Sheriffs. Scanners standard equipment with the vehicle. Every officer has a cell phone.
- CHP has only two dispatchers dealing with emergencies, easier for officers to use cell phones than wait for dispatch. Many CHP officers carry personal cell phones (not CHP-issued).
- Would be nice to have another frequency to use for call in and more dispatch personnel.
- CHP district is Humboldt, Del Norte and Mendocino Counties.
- Wireless phase II is here but not operational.

Other

- American Red Cross has a VHF base station at its facility and few portable radios. No ARES (Ham) equipment at this location.
- Sheriff has gateway unit in command vehicle for tactical operations.
- NIMS frequencies incident-specific, must have OES approval to use.
- Eureka Police Department has frequency scrambler (not DES) for secure operations.
- County-wide encryption is not a requirement for day-to-day LAW operations.
- Humboldt County Fire-Net for rural operations.

- Several TAC frequencies are needed for both LAW and FIRE (repeated would be nice).
- State agencies do not use local agencies' microwave system. System maintained by California General Services.
- East side of County has poor radio coverage (state and local agencies).

Non-Voice

- CHP is in the process of installing MDT in cars, will be using cellular phone technology as primary communications links. Areas without cell phone coverage will use satellite phone technology.
- State parks do not have non-voice communications ability.
- CHP uses data for plates, licenses inquiry and will have GPS technology.
- CHP is not using cameras for traffic stops (starting to deploy), CD-ROM storage and transfer.

Goals

- One universal frequency (TAC frequency) for specific incidents.
- Reprogramming radios, hoping to have "plan" to effectively set up programs for radio.
- Toni Tyson has list of PL tones.
- Red Cross would like to know what they need to design for.
- Define what interagency communications agencies will have if microwave system is down.

October 4, 2006 – 08:00, Focus Group Meeting

Participants:

Eureka Fire Department
Phelps Hospital
City of Eureka - Information Services
Ferndale Fire Department
Eureka Fire Department
Humboldt Fire District
Humboldt County - Risk Management

Voice - Coverage

- Eureka Fire Department – mobile coverage is good in city – 97%.
- Eureka Fire Department – portable lacking in buildings, in some areas, specifically the hospital basement and jail.
- Ferndale – Shadow of mountains, iffy for dispatch. Mt. Pierce provides best coverage. Poor coverage at valley end and base of mountain.
- Fire-Net – primary fire dispatch frequency for most agencies. CDF holds license for Fire-Net and equipment is housed in CDF sites/vaults.
- Fortuna Fire department dispatches for itself.
- Orick Fire Department – dispatched on CFD frequencies.
- Fire-Net is a dispatch frequency – not used for tactical operations.
- Garberville Ambulance – Med-Net frequency, poor coverage, more places it does not work than it does. CDF dispatches for Garberville Ambulance. Relies on cell phones and telephone lines. No communications with Mendocino County ambulances.
- UHF mobiles and VHF portables for ambulance companies.
- Shelter Cover repeater not operational.
- Eureka Public works radios 20+ years old – supporting old equipment is a critical problem.
- City of Eureka is considering an equipment replacement fund and exchange program.
- Eureka Fire Department has spent $80K over the past 3-4 years on new radio equipment.
- Humboldt Fire District building a radio system that will include redundancy with Eureka Fire Department.
- First responders not always getting the message.

Interoperability

- Simplify use of tactical frequencies for regionalized use – without interoperable black box.
- Improve mutual aid request. First responder calls communications center, which in turn requests assistance through another agency's communication center. Message relayed too many times. Example of a problem: for a large fire EFD contacted CFD requesting equipment. CFD sent grass fire units, not suitable to structure fire.
- Unable to communicate among fire agencies. No one agency responsible for (or coordinating) frequency plan for all agencies.

- Interoperability is now either face-to-face or center-to-center.
- Build a co-op paging system – Alpha capability for callout and messaging. Also could be used by hospitals for callout for staffing – especially during winter season.

Non-voice

- Eureka Fire Department has mobile data capabilities including access to incident data and status changes. Need access to internet and mapping capabilities.
- Ambulance – need for EKG transmissions, vehicle location, and mapping.

Goals

- Need easier way to communicate when on-scene.
- Systems should be built for the greatest good for the greatest number.
- Ferndale FD – eliminate dead spots in valley and base of hills.
- Consolidated public safety dispatch center.
- Digital incident information transfer of 9-1-1 call between dispatch centers.
- Baseline existing communications system capabilities.
- Plan for the future.
- Take “build” first couple of steps toward the future.
- Uncluttered avenues of communications.
- Reduce the number or relay points to get a message delivered.

October 4, 2006 – 10:30, Focus Group Meeting

Participants:

Fortuna Fire Department
Redway Fire District
Humboldt County - Environmental Health
Eureka Fire and Police
Yurok Tribe
Fortuna Police Department
Fortuna Police Department
Six Rivers Communications
Willow Creek Volunteer Fire Department
Willow Creek Community Services District
Arcata-Mad River Ambulance
Humboldt County - Communications
Humboldt County - Risk Management

Voice – Coverage

Eureka Fire Department

- Setting up parallel radio system – two frequencies, one for command and one for dispatch.
- Relocating repeater site to water tower site on Humboldt Hill. After move to new site, radio system expected to have 90-95% coverage.
- Portable coverage holes in buildings such as St. Joseph hospital, jail, and courthouse.
- All equipment is analog narrowband capable. Goal is P25 digital operations.

Arcata-Mad River Ambulance

- Little reception in buildings, such a Safeway, Kmart, etc. Will be installing a repeater in Mad River Hospital.
- Ambulances operate on the UHF Med-Net frequency.
- Ambulances carry both UHF and VHF radios.
- No coverage in Hoopa Valley, Hwy 96.
- MCI frequency being implemented in the Med-Net. New frequency will be available in all hospitals, permitting communications with ambulances. Needs activation by CDF. Still in testing phase, latest test failed (operational problem).
- Hoopa Ambulance does not have Med-Net.
- No Med-Net repeater near Hwy 96. Looking to install a repeater on Baldwin Hills.

Eureka PD

- Eureka PD looked at deploying an 800 MHz system, stayed on VHF so they could communicate with the other agencies on VHF.
- Trying to move to digital (P25), however no money to complete the transition.
- Interoperability issue. Many responses require multi-agency operations. Only communications are on simplex frequencies such as CLEMARS.
- Portable connectivity is poor. Using cell phones for backup.

- CHP has portables programmed to VHF EPD frequencies. Need common frequency for portable use.
- UHF channel used for mobile data. Trying to work with Edge wireless (cellular carrier) for mobile data.
- City Ambulance has listen-only capabilities on EPF, EFD, and Sheriff Office frequencies.
- Weak radio coverage in south Broadway and Humboldt hills. Bluff areas also causing portable coverage area.

Willow Creek Services District
- Uses portables. Dispatches for Willow Creek Fire Department. Fire department has own VHF frequency.

Fortuna PD
- Dispatches for Rio Dell and Ferndale PD. Portable coverage issues due to terrain.
- Poor coverage by College of the Redwoods – issue when transporting to jail. Rio Dell and Ferndale linked by UHF link. Ferndale has own VHF frequency.
- Ferndale communications somewhat adequate; holes, dead spots, and weather created problems. Portables and mobile coverage issues outside Ferndale.
- Interoperability issues with other agencies.

Yurok Tribe
- Also doing a communications interoperability study.
- Yurok Public Safety, Yurok Fire District, Sheriff's Office have no radio coverage in fisheries and watershed area. No 9-1-1 coverage.
- Going to build own emergency communications system.

Fortuna Fire Department
- Used to be dispatched by CDF, now dispatched by Fortuna Police Department.
- Frequency is not repeated, base station is in Hydesville.
- 97% coverage in service area.
- Portables coverage reaches Hwy 36, North past Palmer Creek has poor coverage. Can't reach Hydesville or Starvation flats area.
- Base equipment: pre-1995, portables: post-1995.

Southern Humboldt Fire Departments / Fieldbrook Fire Department
- Dispatched by CDF.
- Terrain and toning issues.
- Would like to see a consolidated dispatch. In some instances dispatch may be delayed 10-15 minutes. CDF would like to remain as dispatch services, but wants to charge for services.

City Ambulance - Southern Humboldt County
- Mendocino County Ambulance dispatched by one source using one tone - would like a system similar to Mendocino County Ambulance.

- CDF dispatches City Ambulance during the daytime hours only – at night City Ambulance dispatches its own ambulances.
- City Ambulance plans to pull out of CDF co-op services. Decision of City Ambulance will impact co-op as City Ambulance is the primary source of funding and the largest agency in the co-op.
- Most equipment 1995 vintage Kenwood radios.

Non-Voice

- Eureka PD uses mobile data on a Motorola 19.6 bps network now. MDT functions included inquiry, dispatch orders, messaging. Would like to add mapping.
- Humboldt Fire District uses laptops and an integrated mapping solution. GPS on the rig and address look-up on the map provides routing between the rig location and incident. (No data link with CAD system.)
- Eureka is looking to deploy public access cameras in the 5.8 MHz band instead of 4.6 MHz.
- Eureka Police Department desires the ability to send photos of people to officers.
- Eureka desires a less proprietary, more interoperable solution. Considering a cellular backbone as the primary infrastructure.
- Eureka Fire Department desires the ability to transmit incident information to vehicles from CAD system with vehicle location and incident status information.
- No traffic stop cameras in vehicles.
- Eureka desires a mobile data network with bandwidth capabilities to support broadband data applications.
- Agencies desire a mobile network supporting on-scene network between units.
- Eureka Police Department wants all agencies to purchase subscriber equipment that may be disabled over-the-air.
- Encryption to be user/incident selective, not system wide.

Interoperability

- Multi-agency training is an issue.
- EMS cannot talk on LAW frequencies, listen only. Need equipment and interagency agreements.
- Interoperability issue: getting all agencies on the same plan.
- Training issue: getting all agencies trained on equipment, procedures, and communications.
- Need frequency plan for all agencies.
- Need interagency agreements for all agencies.

Goals

- UHF and VHF users able to communicate with each other – interoperability.
- Multi-agency communication agreements.
- Agencies (EOC, Dispatch center) able to communicate with each other via radio (command frequencies).

October 4, 2006 – 13:30, Focus Group Meeting

Participants:

Humboldt Bay Municipal Water District
Humboldt Amateur Radio Club (ARES)
Blue Lake Fire Department
Six Rivers Communications
Humboldt County - Communications

Voice – Coverage

Amateur Radio (ARES)

- ARES has VHF, UHF, and digital capabilities.
- 4 radio clubs – Eel River Valley, Southern Humboldt, Eureka, and Arcata & North.
- ARES has radio systems at each hospital, Penesula School, Public Health, courthouse, and mobile unit.
- Not all locations have digital capabilities.
- Continues to expand capabilities into all schools (antennas and power supplies) as well as other locations.
- Would like to be able communicate directly between agencies.
- ARES has handhelds which they give to "shadowers" to communicate between other agencies.
- ARES has difficulty finding sites (affordable).

Humboldt Bay Municipal Water District

- Able to communicate with Sheriff's Office, not with OES.
- Needs to communicate with key command centers.
- Also needs more communications with public work agencies on a day-to-day basis.

Blue Lake Fire Department

- Dispatched now by Arcata Police Department, just signed up with CDF for dispatching services.
- Units cannot communicate with dispatch.
- Too many dispatch agencies in the area.
- County not willing to take responsibility for fire dispatch.

Non-Voice

- HBMWD – SCATA network for alarm monitoring. Uses radio modems, wire lines and fiber.
- ARES and Blue Lake Fire Department do not need mobile data.

Goals

- ARES – could use a couple of repeater sites on hilltops, such as Horse Mountain, for interagency communications.
- A "road map" for government grants funding.
- A priority list for purchase of equipment and services.

October 4, 2006 – 15:30, Focus Group Meeting

Participants:

North Coast Emergency Medical Services
Garberville Fire Protection District
Palo Verde Volunteer Fire Department
California Fish and Game
US Forest Service
California Department of Forestry
National Park Services
California Department of Forestry
Humboldt State University Police
Humboldt County - Coroner
Humboldt County - Communications

Voice – Coverage

Med-Net

- UHF system with 4 mountain top repeaters.
- Need to expand coverage – east and Hoopa Valley.
- Need bandwidth to support patient EKG, ambulance-to-hospital links.
- Need to talk between Med-Net users and VHF users – unified incident command.

Other

- Humboldt State University coverage is good on Arcata campus. Bad coverage on 12 remote campuses (and ship) in other parts of County.
- Fish and game can talk to everyone except CHP.
- Fish and Game patrol in Pacific Ocean.
- US Forest Service and National Park Service are VHF narrowband analog operational.
- US Forest Service and National Park Service have capability to talk-in on existing VHF wideband frequencies.
- Humboldt County Fire-Net is the only frequency available to all fire agencies.
- Medical life flight, CDF, and CHP have air units.
- Need ability to communicate with Coast Guard.
- Need to set aside command frequencies for EOC-to-EOC communications.
- OES frequencies (OES1, OES2, and Fire-White): who owns and manages these resources.

Non-voice

- Commercial paging services used for call-out. Also use radio alert monitors for call-out.

- Data for field units would be nice – online. Paramedic reporting from units with GPS and dispatch services.
- Ambulance and Fish/Game using satellite radios in addition to mobile/portables.
- University has satellite phones and setting up satellite radio. Would like to be able to join CSU talk group and Sacramento OES.

Goals

- Better coverage /interagency communications / reception / satellite use.
- EOC-to-EOC radio communications.
- Expansion of existing coverage capabilities.
- All entities connected with voice and data communications.
- Disaster preparedness progressing.

Appendix B: Needs Matrix

The Needs Matrix provides the baseline for the formation of the interoperable communications system. The needs defined here are not intended to be used as specifications to select a specific vendor solution.

The Needs Matrix contains the following elements:

Ref #	Need	Source	Comment

Reference Number (Ref #)
A unique identifier assigned to each requirement.

Need
A statement and brief description of the need.

Source
The origin of the requirement is identified in the table structure by the following terms, and trace back to their respective document section or input source:

- FOCUS – stakeholder focus group meetings or interviews.
- GA – consultant's recommendation.
- ENG – engineering and/or industry practice.

Comment
Any additional information used to define the intent and need for the requirement.

Table 9 – Operational needs

Req #	Need	Source	Comment
1.	Interoperability: improve interoperability within and among county, state, and other local agencies	FOCUS	Strategic Goal: Provide first responders with access to an interoperable communications system for day-to-day, mutual aid, and task force events.
2.	Operability – within agency; see Coverage Needs Table.	FOCUS	
3.	Interoperability – between county agencies. Provide improved communications between first responder agencies in the County.	FOCUS	
4.	Operability – dispatch for Fire and EMS. Provide improved communications between PSAP, dispatch center and first responders.	FOCUS	County PSAP, California Department of Forestry, and volunteer fire departments.
5.	EOC interoperability – provide wireless EOC-to-EOC communications	FOCUS	Command frequencies for EOC-to-EOC communications.
6.	Improved interoperability between EMS and Fire/Law agencies.	FOCUS	For unified incident command. EMS user operations are on UHF and Fire/Law user operations are on VHF.
7.	Improved interoperability between public works users, schools & Med-Net users.	FOCUS	Public Works (VHF) has a need to work with Med-Net (UHF) and schools (UHF).
8.	Improved interoperability – service districts and utilities: provide improved communications between service districts/utilities and public works.	FOCUS	
9.	CHP interoperability – CHP with other agencies: need common repeated VHF frequency.	FOCUS	
10.	Improved interoperability – federal agencies: provide improved interoperability with federal agencies.	FOCUS	Coast Guard, US Forest Service, Bureau of Land Management, National Park Service
11.	Interoperability – State agencies: provide improved interoperability with state agencies.	FOCUS	
12.	Improved interoperability – training: Multi-agency training.	FOCUS	Getting all agencies trained on equipment, procedures, and communications.
13.	Improved interoperability – interagency agreement: execution of interagency agreements.		Need interagency agreements for all agencies – getting all agencies on the same plan.

Req #	Need	Source	Comment
14.	Channel capacity: add additional channels for tactical, backup, and major incident emergency response.	FOCUS	Some departments and non-first-responder agencies are sharing the same frequencies.
15.	Roaming: provide users with capability to travel and communicate within the County and region.	FOCUS	Roaming capabilities are a function of the specific agencies' deployment of their frequencies.
16.	Talk around capability: provide direct unit-to-unit talk capability without reliance on infrastructure.	FOCUS	
17.	Mixed-mode capability: the system shall support analog and digital technologies.	GA	No voice digital communications equipment deployed by local agencies at this time.

Table 10 – Functional needs

Req #	Need	Source	Comment
1.	Channel capacity: add additional channels for tactical, backup, and major incident emergency response.	FOCUS	Some departments and non-first-responder agencies are sharing the same frequencies.
2.	Alerting and call-out capability.	FOCUS	Fire, hospital, and other personnel.
3.	Automatic Vehicle Location (AVL): provide capability for all system subscribers.	FOCUS	AVL is currently not being used by any agency except on Humboldt Fire District vehicles – not connected to CAD.
4.	Call-out: provide capability for callout of first and near-first responders.	FOCUS	Currently a combination of radio alerting and paging.
5.	Mobile data capability: provide mobile data capability in selected areas for specific applications such as computer aided dispatch (CAD) system information.	FOCUS	Mobile data capability limited to Eureka PD/FD and Arcata PD.
6.	Telemetry: bandwidth to support patient EKG ambulance to hospital links.	FOCUS	
7.	Broadband capability: provide broadband capability in selected areas for specific applications such as field report writing and transmitting images.	FOCUS	
8.	Emergency alert transmission: transmission of an emergency “person needs help” alert message.	GA	
9.	Channel efficiency: improve and maximize channel efficiency.	GA	All agencies using wideband VHF or UHF radios. The equipment is not operating compliant with FCC Docket No. 95-96.
10.	Patching capability: provide responders with the ability to communicate with external organizations.	GA	
11.	Dispatcher center interface: provide an efficient and straightforward method to connect the proposed system(s) to legacy dispatch equipment.	GA	
12.	Tactical networks: create ad-hoc voice networks at the scene of an incident.	GA	Humboldt County Sheriff’s Office has tactical “gateway” equipment.
13.	Voice quality: provide an acceptable level of quality such as a Delivered Audio Quality (DAQ) of 3.4 (in the worst case).	ENG	Defined in Telecommunications Industry Association (TIA) Standards CommitteeTR-8.

Req #	Need	Source	Comment
14.	System availability: provide a high availability system that will support the loss of critical site(s) without degrading overall system coverage or the system's capability to continue to process calls.	FOCUS	This requirement implies a certain level of redundancy and backup systems and/or center capability.

Table 11 – Technical needs

Req #	Need	Source	Comment
1.	P25 standards: mobile voice communications systems shall be based on the P25 digital standard.	FOCUS	P25 has been acknowledged as the direction to proceed with new radio equipment purchases.
2.	Narrowband capable equipment: upgrade with only narrowband equipment for systems below 512 MHz.	GA	FCC Docket No. 95-96 orders the migration of radio systems below 512 MHz to narrow band by 2013.
3.	Security: provide security features to prevent unauthorized access to voice and data communications.	GA	On the current systems, a non-authorized person may transmit on a channel and receiving parties will not know the transmission is unauthorized.
4.	Encryption: provide on-demand voice subscriber encryption capabilities.	FOCUS	Encryption may be selectively turned on and off by the users.
5.	Encryption: encryption algorithm used shall be the Data Encryption Standard (DES) as specified in the Federal Information Processing Standards Publication 46-2	GA	Only applicable for equipment requiring encryption.
6.	Encryption: provide county-wide end-to-end data encryption capability.	FOCUS	Data transmitted shall be secure, employing at least 128 bit DES encryption. All applications accessing CJIS data bases must use encryption.
7.	Resilient Operations: sustain resilient operations with system availability greater than 99.99% including tolerance to individual system failures	ENG	Goal
8.	Scalability: the system shall be dynamic and scalable and have the ability to accommodate growth.	ENG	
9.	System management: centralized management system should provide technical and administrative support and be scalable to an agency level.	ENG	
10.	Maintainability: the system shall be designed such that personnel will be able to perform routine maintenance on any component of a system without affecting the critical communications functions.	ENG	

Table 12 – Coverage needs

Req #	Need	Source	Comment
1.	Mobile coverage: expansion of existing coverage capabilities	FOCUS	GOAL: to provide 90% mobile coverage in agency service area.
2.	Portable coverage: expansion of existing coverage capabilities, specifically in-building coverage.	FOCUS	GOAL: none stated.
3.	Improved portable coverage – Arcata-Mad River Ambulance: in-building coverage.	FOCUS	Safeway, Kmart, etc.
4.	Improved mobile coverage – Arcata-Mad River Ambulance: Hoopa Valley, Hwy 36.	FOCUS	
5.	Improved mobile coverage: Blue Lake Fire Department: dispatch coverage in service area.	FOCUS	Units cannot communicate with dispatch.
6.	Improved portable coverage – Eureka Police Department. In-building coverage for courthouse, jail and hospital.	FOCUS	Reported portable coverage: 75%.
7.	Improved mobile coverage – Eureka Police Department. South Broadway, Humboldt Hill and bluff areas.	FOCUS	Reported mobile coverage – 97% in service area.
8.	Improved portable coverage – Eureka Fire Department: in-building coverage for courthouse, jail, and hospital.	FOCUS	
9.	Improved mobile coverage – Ferndale: portables and mobile coverage issues outside Ferndale.	FOCUS	
10.	Improved mobile coverage – Ferndale Fire Department: end of valley and base of hills.	FOCUS	Marginal coverage for dispatching. Reported mobile coverage – 97% coverage within service area.
11.	Improved portable coverage – Fortuna Fire Department: Highway 36 north of Palmer Creek, Hydesville and Starvation Flats.	FOCUS	
12.	Improved mobile coverage – Yurok Tribe: fisheries and watershed areas.	FOCUS	Yurok Public Safety, Yurok Fire District, Sheriff's Office have no radio coverage in fisheries and watershed area.
13.	Improved portable coverage – Fortuna Police Department: College of the Redwoods and when transporting to County jail.	FOCUS	
14.	Improved mobile coverage - Garberville Ambulance: Med-Net frequency in service area.	FOCUS	Poor coverage – more places "no coverage" than coverage.

Req #	Need	Source	Comment
15.	Improved mobile coverage – Humboldt County: NE County, Orleans, Johnson area, Highway 36, McKinleyville to Rio Dell area, east of McKinleyville to Blue Lake, in the Orick and Hoopa areas, Fortuna, Garberville and Petrolia.	FOCUS	Sheriff's Office, Public Works, and other county agencies use the same repeater sites – similar coverage issues.
16.	Improved portable coverage – Humboldt County: outside of Arcata and Eureka and a couple of dead spots within the City (i.e., SW corner of courthouse).	FOCUS	Sheriff's Office, Public Works, and other county agencies use the same repeater sites – similar coverage issues. Overall Sheriff's Office coverage for portable radios is 30%.
17.	Improved coverage – Humboldt State University. Remote campuses	FOCUS	Good coverage on main campus, bad coverage on 12 remote campuses.
18.	Improved Coverage – East side of County for all agencies.	FOCUS	East side of County has poor radio coverage (all state and local agencies).
19.	Improved mobile coverage - Med-Net: East County and Hoopa Valley.	FOCUS	

Appendix C: Detailed costs

Rogers Peak			
Infrastructure	**Qty**	**Unit Costs**	**Extended Cost**
Equipment Acquisition costs			
Microwave backhaul link - end	0	$38,000	$0
Control Stations	0	$10,000	$0
VHF P25 trunked base stations	3	$20,000	$60,000
Static patch	1	$15,000	$15,000
Total - Equipment Actuation costs			**$75,000**
Other acquisition costs			
Installation and Project Management		40%	$30,000
Total - Other Actuation Costs			**$30,000**
Total - Actuation Costs			**$105,000**
Recurring Costs (Yearly)			
System support agreements		20%	$15,000
Lease circuit	0	$600	$0
Total - Recurring Costs (Yearly)			**$15,000**

Table 13 – Rodgers Peak costs

Horse Mountain			
Infrastructure	**Qty**	**Unit Costs**	**Extended Cost**
Equipment Acquisition costs			
Microwave backhaul link - end	0	$38,000	$0
Control Stations	0	$10,000	$0
VHF P25 trunked base stations	3	$20,000	$60,000
Static patch	0	$15,000	$0
Total - Equipment Actuation costs			**$60,000**
Other acquisition costs			
Installation and Project Management		40%	$24,000
Total - Other Actuation Costs			**$24,000**
Total - Actuation Costs			**$84,000**
Recurring Costs (Yearly)			
System support agreements		20%	$12,000
Lease circuit	0	$600	$0
Total - Recurring Costs (Yearly)			**$12,000**

Table 14 – Horse Peak costs

South Rainbow Peak			
Infrastructure	**Qty**	**Unit Costs**	**Extended Cost**
Equipment Acquisition costs			
Microwave backhaul link - end	0	$38,000	$0
Control Stations	0	$10,000	$0
VHF P25 trunked base stations	3	$20,000	$60,000
Static patch	0	$15,000	$0
Total - Equipment Actuation costs			**$60,000**
Other acquisition costs			
Installation and Project Management		40%	$24,000
Total - Other Actuation Costs			**$24,000**
Total - Actuation Costs			**$84,000**
Recurring Costs (Yearly)			
System support agreements		20%	$12,000
Lease circuit	0	$600	$0
Total - Recurring Costs (Yearly)			**$12,000**

Table 15 – South Rainbow Peak costs

Pratt Mountain			
Infrastructure	**Qty**	**Unit Costs**	**Extended Cost**
Equipment Acquisition costs			
Microwave backhaul link - end	0	$38,000	$0
Control Stations	0	$10,000	$0
VHF P25 trunked base stations	3	$20,000	$60,000
Static patch	1	$15,000	$15,000
Total - Equipment Actuation costs			**$75,000**
Other acquisition costs			
Installation and Project Management		40%	$30,000
Total - Other Actuation Costs			**$30,000**
Total - Actuation Costs			**$105,000**
Recurring Costs (Yearly)			
System support agreements		20%	$15,000
Lease circuit	0	$600	$0
Total - Recurring Costs (Yearly)			**$15,000**

Table 16 – Pratt Peak costs

Humboldt Hill			
Infrastructure	**Qty**	**Unit Costs**	**Extended Cost**
Equipment Acquisition costs			
Microwave backhaul link - end	0	$38,000	$0
Control Stations	0	$10,000	$0
VHF P25 trunked base stations	6	$20,000	$120,000
static patch	1	$15,000	$15,000
Satellite Receiver - each		$9,000	
Comparator - per channel		$3,000	
Receivers per site	6		
Satellite Receiver sites	5		$288,000
Total - Equipment Actuation costs			**$423,000**
Other acquisition costs			
Installation and Project Management		40%	$169,200
Total - Other Actuation Costs			**$169,200**
Total - Actuation Costs			**$592,200**
Recurring Costs (Yearly)			
System support agreements		20%	$84,600
Lease circuit	5	$600	$3,000
Total - Recurring Costs (Yearly)			**$87,600**

Table 17 –Humboldt Hill costs

Pierce Mountain			
Infrastructure	**Qty**	**Unit Costs**	**Extended Cost**
Equipment Acquisition costs			
Microwave backhaul link - end	1	$38,000	$38,000
Control Stations	6	$10,000	$60,000
Antenna system	1	$19,200	$19,200
VHF P25 trunked base stations	0	$20,000	$0
Static patch	0	$15,000	$0
Total - Equipment Actuation costs			**$117,200**
Other acquisition costs			
Installation and Project Management		40%	$46,880
Total - Other Actuation Costs			**$46,880**
Total - Actuation Costs			**$164,080**
Recurring Costs (Yearly)			
System support agreements		20%	$23,440
Lease circuit	0	$600	$0
Total - Recurring Costs (Yearly)			**$23,440**

Table 18 – Pierce Mountain costs

Communications Center / Remotes	Unit Cost or percent	Communications Center	Fire Stations	City Ambulance	Other
Equipment Acquisition costs					
Radio dispatch center positions		8			
Microwave backhaul link - end	$38,000	1			
Communications center - backroom	$65,000	1			
Communications Center - consoles	$37,000	8			
Remote/satellite desktop radios	$5,000	0	55	5	10
Control Stations	$10,000	12			
Antenna system	$38,400	1			
Total - Equipment costs		**$557,400**	**$275,000**	**$25,000**	**$50,000**
Other acquisition costs					
Installation & Project Management - Consoles	40%	$222,960	$0	$0	$0
Installation & Project Management - Desktop	10%	$0	$27,500	$2,500	$5,000
Total - Other Actuation Costs		**$222,960**	**$27,500**	**$2,500**	**$5,000**
Total - Actuation Costs		**$780,360**	**$302,500**	**$27,500**	**$55,000**
Recurring Costs (Yearly)					
System support agreements	20%	$111,480	$55,000	$5,000	$10,000
Digital transport	$0	$0	$0	$0	$0
Total - Recurring Costs		**$111,480**	**$55,000**	**$5,000**	**$10,000**

Table 19 – Communications Center / Remotes

Voice	Unit Cost or Percent	Units	Extended Cost
Equipment Acquisition costs			
Mobiles			
DES Encryption option	$500		$0
Fire Agencies	$3,300	120	$396,000
Law Agencies	$3,300	125	$412,500
EMS Agencies	$3,300	15	$49,500
Other Agencies	$3,300	209	$689,700
Total - Mobiles		**469**	**$1,547,700**
Mobile Repeater	$2,000	20	$40,000
Portables			
DES Encryption option	$500		$0
Fire Agencies	$2,700	264	$712,800
Law Agencies	$2,700	209	$564,300
EMS Agencies	$2,700	15	$40,500
Other Agencies	$2,700	62	$167,400
Total - Portables		**550**	**$1,485,000**
Total - Equipment costs			**$3,032,700**
Other Costs			
Installation - mobiles	$250		$122,250
Total - Other costs			**$122,250**
Total acquisition costs			**$3,154,950**
Recurring costs			
Return to depot support agreements	2%		$60,654
Total recurring costs			**$60,654**

Table 20 – Voice subscriber costs

Subscriber Equipment*		
VHF User Agencies	**Mobiles**	**Portables**
Humboldt County		
Sheriff office	20	30
Corrections	--	--
Other Departments	55	30
Eureka, City of		
Police	55	75
Fire	20	40
Other Departments	20	10
Arcata, City of		
Police	15	30
Fire	10	20
Other Departments	30	--
Blue Lake, City of		
Police	4	8
Fire	2	10
Other Departments	4	2
Ferndale, City of		
Police	6	12
Fire	2	10
Other Departments	4	--
Fortuna, City of		
Police	15	30
Fire	5	20
Other Departments	10	--
Trinidad, City of		
Police	4	8
Fire	2	2
Other Departments	2	--
Rio Dell, City of		
Police	6	16
Fire	3	10
Other Departments	4	--
EMS	15	15
Other Fire Departments	76	152
Service Districts	80	20
Total - VHF Users	**469**	**550**
UHF Users	**Mobiles**	**Portables**
EMS	15	30
Schools	75	150
County Corrections	--	30
Total - UHF Users	**90**	**210**

* Estimates based HC Fire Master Plan, focus group meetings, and interviews

Table 21 – Subscriber Equipment

Appendix D: Glossary of terms and acronyms

Advanced Encryption Standard (AES)	A symmetric key encryption technique (128-, 192-, or 256-bit encryption) which replaces the commonly-used 64 bit Data Encryption Standard.
Analog	A type of radio signal that uses continuous changes in the amplitude or frequency of a radio transmission to convey information.
ANSI/TIA/EIA	American National Standards Institute, Telecommunications Industry Association, Electronic Industry Alliance.
ANSI	The American National Standards Institute is a private, non-profit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system.
APCO	Association of Public Safety Communications Officials.
ARES	Amateur Radio Emergency Service.
Band	The spectrum between two defined limited frequencies.
Bandwidth	The capacity of a telecom line or channel to carry signals. The necessary bandwidth is the amount of spectrum required to transmit the signal without distortion or loss of information. FCC rules require suppression of the signal outside the band to prevent interference.
Base station	A fixed, land station in the land mobile service (*e.g.*, the radio located at a fire or police station that either communicates directly or through a repeater to field subscriber units).
Channel	A single path provided by a transmission medium via an electrical separation, such as by frequency or frequency pairs.
Communications	Information transfer among or between users.
Communications interoperability	The ability of public safety agencies to talk across agencies and jurisdictions via public safety communications systems, exchanging voice and/or data with one another on demand, in real time, when needed.

Conventional Radio system with dedicated, single-purpose channels (can be shared among several users with different operational needs; *i.e.,* fire and police). User must select the specific channel to be used.

Coverage The geographic area included within the range of a wireless radio system.

Cross-band A repeater that receives in one frequency band and retransmits in a second frequency band (see *Repeater*).

Cycle One complete performance of a vibration, electrical oscillation, current alternation, or other periodic process.

DAQ Delivered Audio Quality is a numeric rating of speech intelligibility.

Dead spot Geographic area within the normal coverage envelope where signals are below specification for minimal quality.

Digital Radio transmission method, replacing analog FM systems, that transmits binary 1's and 0's much like a computer. Generally digital signals can travel greater distances (better coverage), however once the signal levels are below minimum no communications are possible. As data is normally digital, data transmissions are compatible with digital radios.

EIA Electronic Industries Alliance is a national trade organization that includes the full spectrum of U.S. manufacturers. The Alliance is a partnership of electronic and high-tech associations and companies whose mission is to promote the market development and competitiveness of the U.S. high-tech industry through domestic and international policy efforts.

Effective Radiated Power The power supplied to an antenna multiplied by the antenna gain (in a given direction).

Encryption Encoding (and decoding) or “scrambling” of transmissions to provide secure or private communications that can be unlocked only by the intended/authorized recipient(s). See *Advanced Encryption Standard*.

ERP See *Effective Radiated Power*.

First responders Individuals who are responsible for the protection of life and property, normally the first professionals called to an incident or emergency. These individuals provide immediate support services during prevention, response, and recovery operations.

Frequency The number of cycles or events of a periodic process in a unit of time.

Frequency bands The spectrum of transmission space where mobile radio systems operate in the United States. They are (from low to high):

High HF	25-29.99 MHz
Low VHF	30-50 MHz
High VHF	150-174 MHz
Low UHF	450-470 MHz
UHF TV Sharing	470-512 MHz
700 MHz	764-776 & 794-806 MHz
800 MHz	806-869 MHz
2.4 GHz	
4.9 GHz	

Gateway A device that can transparently interconnect radio audio paths so that agencies can patch into each other's radio channels in real time. A gateway provides interconnection between two networks with different communications protocols.

Infrastructure The hardware and software needed to complete and maintain a public safety communications system.

Interference Extraneous energy, from natural or man-made sources, that impedes the reception of desired signals.

Interoperability Ability of public safety personnel to communicate by radio with staff from other agencies, on demand, and in real time.

Jurisdiction The geographic territory where authority and operations are exercised.

Land mobile A public or private radio service providing two-way communication, service paging, and radio signaling on land.

Local agency	Includes any or all local city, county, regional, or tribal governing bodies, excluding state agencies.
Mutual aid	Generally describes a situation where a major emergency or incident requires a large number of agencies, including agencies from remote locations, working together to mitigate the crisis.
Mutual aid channel	A radio channel specifically allocated for use during emergency mutual aid situations.
Narrowband	In land mobile radio systems, the FCC has specified reducing channel bandwidth usage from 25 kHz to 12.5 kHz, thereby doubling the number of available channels. Narrowband operations will be mandatory by January, 2013.
NTIA	The National Telecommunications and Information Administration (NTIA) is an agency of the United States Department of Commerce that serves as the President's principal adviser on telecommunications policies pertaining to the United States' economic and technological advancement and to regulation of the telecommunications industry.
P25	APCO Project 25, digital radio interoperability standard adopted by federal government agencies and all users of the 700 MHz band. Phase I standard has been complete since October 1995; Phase II will extend Phase I standards into 6.25 kHz channels and TDMA transmission.
Paging system	Usually a one-way mobile radio system or service whereby a user carries a small, lightweight miniature radio receiver capable of responding to coded signals. These devices, called "pagers," emit an audible signal, vibrate, or display text messages when activated by an incoming signal. Two-way pagers are also available that allow the user to respond with a simple acknowledgment or send text messages.
PSAP	Public Safety Answering Point.
RACES	Radio Amateur Civil Emergency Service.
Receiver	The component(s) of a radio device that convert the radio waves into audible signals.

Repeater Special receiver/transmitter combination that receives a signal on one frequency and retransmits a new signal on another frequency, usually within the same frequency band. Sometimes referred to as a relay station.

Roaming Use of a wireless phone or public safety mobile communications (PSMC) equipment outside of the "home" service area defined by a service provider or system. Allows a user to travel countywide and communicate as if they were still within their local area.

Satellite phone Wireless phone that uses mobile satellite services to communicate where PSMC or cellular coverage is poor.

Spectrum The range of electromagnetic radio frequencies used in the transmission of sound, data, and television.

Subscriber A user on a system.

Subscriber unit Equipment associated with a person or vehicle in the field. All mobile and portable equipment, including but not limited to portable radios, mobile radios, mobile data computers (laptops, terminals, etc.), pagers, cellular and satellite phones, and hand held data equipment such as personal digital assistants (PDAs).

Talk group Users assigned to a specific group that normally communicate with each other. Primarily preprogrammed into a trunk system, but can be assigned on-the-fly to add other users to interoperate with the group during emergencies or joint operations.

TIA Telecommunications Industry Association represents providers of communications and information technology products and services for the global marketplace through its core competencies in standards development, domestic and international advocacy, as well as market development and trade promotion programs.

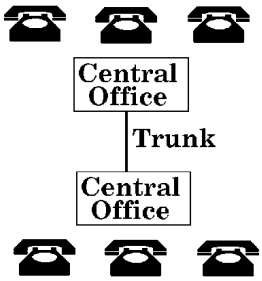
Transceiver Combination transmitter and receiver. PSMC base stations, mobiles, and portables are examples.

Trunked	Radio system with a group of channels available and assigned as needed to individual or groups of users. All channels are automatically system-assigned while in use, then released for other users. Maximizes traffic in a minimum number of channels. FCC-preferred method of operation, especially for new systems.
UHF	Ultra High Frequency, the part of the radio spectrum from 300 to 3000 MHz, which includes broadcast TV Channels 14 and higher, lower frequency microwave, and some marine, aviation, and land mobile services.
VHF	Very High Frequency, the part of the radio spectrum from 30 to 300 MHz, which includes broadcast TV Channels 2-13, the FM broadcast band, as well as some marine, aviation, and land mobile services.
VHF High Band	Frequencies between 150 and 174 MHz.
VHF Low Band	Frequencies between 25 and 50 MHz, also known as Low Band.
Wideband	In land mobile radio systems, channels of 25 kHz bandwidth for voice communications.

Appendix E: Trunked radio systems

What is trunking?

"Trunking" is a word borrowed from the telephone system to describe a large number of users sharing a much smaller number of communication paths. The wires from your home telephone, along with hundreds of others, connect to a local "central office". Your central office connects with other central offices around the country by way of "trunks," which are really just pairs of copper wires (or these days, strands of glass called fiber optics).



Many users share a common trunk.

When you pick up the phone and place a long distance call, your central office assigns one of its idle trunks to your call, linking you to the destination central office. That trunk remains dedicated to you for as long as your call lasts. When you finally hang up, the trunk returns to idle and is available for another call.

Since any particular telephone only needs a trunk while a call is in progress, the phone company can share these trunks among all the telephones. By examining the average and peak number of calls made through your central office, the phone company can figure out how many trunks they actually need. This number will be much lower than the total number of telephones, since they only need enough trunks to prevent someone from getting an "all circuits are busy" message.

Trunking radio frequencies

Radio system trunking is the use of several repeaters on different frequencies in the same band operating together under computer control to allow the pooling of resources for several agencies. The trunking radio is much more sophisticated than the simple transceiver previously used in a simplex or repeater configuration. The trunking transceiver is a frequency-agile radio capable of understanding signals it receives and changing frequencies on the fly, based on those signals.

In the trunked radio environment, each agency is assigned one or more talkgroups to be used by the agency's communications. All agencies on the system will have different talkgroups, but all will share the same pool of frequencies. In this type of system, all the radios on the system listen to a common control channel output frequency. The radios transmit (initially) on a common control channel input frequency, unless they are listening to a conversation on a talkgroup.

Operationally, in a trunked radio system a talkgroup is synonymous to a channel in a conventional radio system and talkgroups are often called “channels” by users of trunked systems.

Operational example

A Eureka police officer wants to tell dispatch that he is now in service. The following actions would take place in a very short time, much shorter than it takes you to read this (less than one-tenth of a second for steps 1 through 5).

1. The officer picks up his microphone and keys the mike.
2. The officer's radio sends a signal on a control channel, which the network switch understands as a request by the radio for a voice channel for the talkgroup assigned to Eureka Police.
3. The network switch looks for a voice channel not being used. It assigns the channel to the Eureka Police talkgoup and tells all radios on the system that are listening (monitoring) for communications on the Eureka Police talkgroup.
4. All radios monitoring the Eureka Police talkgroup, including the requesting officer, are switched to the channel assigned by the network switch without user intervention.
5. The requesting officer's radio then goes into transmit mode and the officer can start to talk.
6. As the officer talks, all the radios monitoring the Eureka PD talkgroup are now listening on the assigned channel and are ready to talk on the assigned channel.

This process continues until the requesting officer has finished transmitting.