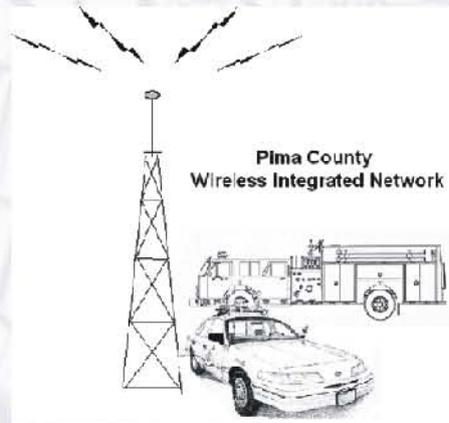




CTA COMMUNICATIONS, Inc. CONSULTANTS

FINAL Concept of Operations



Pima County, ARIZONA

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EXECUTIVE SUMMARY

When implemented, the PCWIN will facilitate significant changes in the way the public safety agencies that use the system are able to communicate within their own agencies and with other public safety agencies throughout Pima County and the State of Arizona. The PCWIN will be flexible and adaptable to new and changing environments. Now many agencies in Pima are restricted by the use of frequency or channel based technology. Specific channels are designated for certain functions. The new system will feature talkgroups and radio fleets that the users in the County define. The talkgroups and fleets are reconfigurable. It will be a relatively simple task, for example, to establish a talkgroup for a special need. Instead of having to adapt the way agencies operate in order to work within the technology, the technology can be configured to allow the agencies to operate the way they need to.

The process that led to the development of the *Concept of Operations* began with a thorough review and assessment of the needs of the user agencies, the systems that are currently in existence and the environmental, organizational and political factors that influence the project. Based on that assessment, the *Concept of Operations* describes the proposed system and facilities as well as the concepts for their use.

Each of the thirty-one participating agencies identified various agency-specific unmet needs and problems. The required user's needs were captured through direct interviews conducted by CTA with PCWIN participating agencies. In addition, a number of common, community-wide areas needing improvement were identified.

At present, there are a variety of separate radio systems in use by the public safety agencies in Pima County, operating on different frequency bands and using different technologies. Because of the diversity in technology and frequencies used, the ability of personnel from one agency to communicate with personnel from another agency by radio is often challenging. In addition, there are a number of deficiencies in some of the existing systems.

The current requirements for the voice communications system include:

- Robust system construction that will result in very reliable operation
- Simplified user operation
- Radio interoperability, both locally and with outside assistance
- Solid staffing and training coupled with advanced features such as an emergency function leading to a safe work environment
- In-building radio coverage



- Recorded on-scene incident and fireground channels

The current mobile data system environment ranges from no mobile data access to sophisticated systems that have recently been implemented. In general the systems do not allow for communication between other agencies. Mobile data system requirements include:

- Automatic vehicle location capabilities
- Increasing dependence on mobile information access
- Demand for increasingly sophisticated mobile applications
- Countywide service

Interoperability requirements for both in the area covered by the PCWIN and in the surrounding areas were identified as well.

Based on the needs assessment and the thorough review of the existing systems, recommendations were developed for each of the five major subsystems that comprise the PCWIN. The major system areas are:

1. Voice Radio Systems
2. Mobile Data Systems
3. Communications Center
4. Automatic Vehicle Location (AVL) Systems
5. Network Systems

Voice Radio System

The PCWIN voice radio system is based on Project 25 standards-based digital technology. The system design includes three separate, but interconnected, subsystems:

- **Simulcast Configuration:** In the Tucson metropolitan area, we have employed eight sites in a simulcast configuration. With simulcast coverage, users can operate anywhere in the area without adjusting radio settings.
- **Trunked Site Configuration:** In populated areas outside the Tucson service area we have placed trunked tower sites sized with 3 to 10 channels to handle the anticipated radio



traffic. Users will generally rely on automatic site selection by the system to keep them affiliated with a strong site.

- Conventional Repeater Configuration: In two areas, we have placed conventional repeaters to boost coverage in the local area. Each repeater is linked via radio back into the trunked radio network. Users manually switch their radio to the repeater when operating in specific areas.

Mobile Data/AVL System

The PCWIN conceptual design includes a hybrid mobile data system designed to provide an enhanced level of mobile information access to all participating agencies. PCWIN requirements indicate that three different types of networks are needed for supporting mobile information needs:

1. Dispatch Network: The day-to-day workhorse for carrying Sheriff, Police, and Fire dispatch and information queries. This network provides countywide service. Automatic Vehicle Location technology supports the asset location function over this network.
2. Private Broadband Network: Expansion of the County and City Wi-Fi networks at public service facilities and in other public spaces where public service experiences frequent activity.
3. Commercial Network: Commercial cellular service enables the use of handheld computers and provides out-of-county service and service for special applications.

The asset location function uses automatic vehicle location technology to deliver location data to the dispatch areas. The location data coupled with existing GIS information feeds the mapping functions that are part of the CAD systems.

The total PCWIN network is made up of several major systems that function together to provide a first class communications solution for the participating agencies:

- Tucson Metropolitan Area Simulcast System
- Mt. Lemmon Simulcast System
- Marana Simulcast System
- Countywide Trunked Radio System



- Coverage Gap Fillers
- System Management Equipment
- Alarm and Diagnostic System
- Communications Centers, Dispatch Consoles
- Backup Dispatch Desktop Control Stations
- 700 MHz Mobile Data and AVL System
- 800 MHz Mutual Aid Repeater System
- In-Building Coverage Systems

The system is designed to provide a signal availability of 95 percent to/from all in-building portables and 95 percent to/from mobile radios, with coverage evenly distributed over the service area for all operational functions. An important design goal is to minimize dead spots. In order to achieve these objectives, the conceptual design uses 26 sites: 12 new sites (sites where no 800-MHz channels are currently licensed) and 14 existing. The preliminary design includes 8 radio sites for the Tucson simulcast module. Each of these sites will be provisioned with capacity for 42 voice channels. In addition to the Tucson module, there are two other simulcast cells – one in Marana, and one in the mountainous area of Mt. Bigelow and Mt. Lemmon. The Marana simulcast network is comprised of three sites and will need to be expanded from 4 to 6 channels. The Mt. Bigelow / Mt. Lemmon simulcast module will only require 4 channels. The balance of the County will be covered by eleven (11) other trunked sites with channel capacities varying from 3 to 8 channels each. Supplemental coverage in remote sections of the County will be provided by two solar-powered sites with conventional repeaters.

A subset of the voice system radio sites comprises the network for the Mobile Data System. The PCWIN design concept includes mobile data as an independent infrastructure operating on 700 MHz channels. The mobile data coverage footprint is nearly identical to that for the voice system. Twenty-two (22) channels in the 700 MHz band are required for countywide operation. These channels will not require simulcast operation.

Automatic Vehicle Location (AVL) will be accommodated via Global Position System (GPS) receivers mounted in all trucks and automobiles that require this function. The infrastructure for this feature will be supplied through the Mobile Data System. The coverage footprint for AVL should be nearly identical to that for the Mobile Data System.

The design for the Connectivity Network is envisioned as a combination of PCWIN-owned microwave links, County or City owned fiber-optic lines, and leased lines. The network is designed as an overlay of interconnecting rings with only a few spurs to remote sites.



The interlocking rings will provide ultra-high reliability for quickly and efficiently routing voice and data calls to the proper sites.

Dispatch

One of the adopted PCWIN project objectives is to “design, construct, occupy and operate a regional communications center co-locating the 9-1-1 public safety answering points and dispatch functions of the Pima County Sheriff’s Department and the City of Tucson with the Pima County Emergency Operations Center.” Initially the design concept involved creating one facility to be shared by the Pima County Sheriff’s Department and the City of Tucson. As the design concept evolved, it became evident that a single facility was not the best solution for Pima County and the City of Tucson. Among the factors contributing to this were the space requirements required and the need for adequate backup capability.

As a result of the factors above, the PCWIN Executive Committee approved a revised conceptual design that calls for the Tucson Police Dispatch, the Pima County Sheriff’s Tucson Dispatch and Primary PSAP, and the Emergency Operating Center to be located in the 22nd Street facility. The Tucson Primary Public Safety Answering Point (PSAP) and the Tucson Fire Dispatch Center would continue to be located at the Thomas Price Service Center, 4004 South Park Street. The facility would be renovated and reconfigured to not only serve as the Primary PSAP and Fire/EMS dispatch center, but also to function as the back-up for the 22nd Street facility.

In addition, the fire departments outside of the City of Tucson (Northwest Fire, Golder Ranch Fire, Avra Valley Fire, Three Points Fire and Picture Rocks Fire) currently dispatched by the City of Tucson and the departments currently dispatched by the Drexel Heights Fire Department have decided to form a joint dispatch operation that will be organizationally independent of the City of Tucson, but co-located in the Thomas Price facility. Each operation will have separate dispatch areas, but equipment rooms and other support facilities will be shared.

Emergency Operating Center

Anytime the response to an incident involves more than one responder, coordination is required. As incidents grow in size beyond the day-to-day emergencies that are routinely handled by public safety agencies, the need for coordination and communications increases. The Incident Command System (ICS) was developed as a way to provide structured management of emergency incidents. It is designed to be scalable, consistent, and integrated with day-to-day operations.



As the size of the incident increases or multiple incidents occur simultaneously, then a multi-agency command structure is required. The basic purpose of an Emergency Operations Center (EOC) is provide a facility in which governmental can continue to function and provide interagency coordination and executive decision making during the large scale disasters or emergencies. The PCWIN project includes providing for a new EOC for Pima County.

The EOC will be sized to handle the maximum anticipated staff that will be called in. Pima County Emergency Management's Staffing Plan calls for a total of forty-eight people to fully staff the EOC. In addition to providing space for the Emergency Management Agency staff, adequate space is required for the following functions:

- The Operations Room is where agency representatives assemble to coordinate their efforts. The Direction and Control Annex of the Pima County Emergency Response and Recovery Plan, groups the activities in the operations room into four sections:
- Policy Section: Responsible for the strategic direction of county level emergency operations, the policy section performs or supports the command function.
- Operations Section: Responsible for tactical command and coordination as well as incident response assets, the operations section provides tactical level liaison as well as coordination of mutual aid.
- Plans Section: Responsible for providing incident analysis, the plans section provides incident action plans and assists in the coordination of operations requirements.
- Logistics Section: Responsible for the coordination of personnel and other resources required to augment the initial response, the logistics section is responsible for the validation of requests for resources and for documenting the utilization of those resources and handling the financial aspects of the emergency.

In addition to the Operations Room, adequate space is required for the following functional areas:

Communications Room
Conference/Breakout rooms
Kitchen/break area



The PCWIN public safety user community's vision has taken shape as a realizable system design. The design is developed on a concept that provides mobile coverage throughout the County, with in-building coverage provided in population centers. The City of Tucson will have primarily medium building coverage, with the denser urban areas meeting a heavy building classification. Channel requirements have been designed so that public safety personnel will have nearly immediate system access in almost all situations.



1.0 INTRODUCTION

The Pima County Wireless Integrated Network (PCWIN) will have wide reaching effects on the community's operations. This will be an improvement in technology as well as a profound realignment of how the community and communications technology relate to one another.

In the past, PCWIN agencies were required to define their dispatch and two-way radio operations so as not to exceed the limits of the radio technology that they possessed. The agencies' systems were confined by this older technology. Now with the implementation of the new PCWIN Project, the situation will reverse. The radio technology employed will become the servant of the PCWIN, not its master. For example, some agencies instead of being restricted to the available frequencies can now use talkgroups and radio fleets that they themselves define. The radio system will be configured around their own operational requirements. The system will be flexible and adaptable to new and changing environments.

The PCWIN community has asked for a Concept of Operations document that describes features and aspects of the anticipated system to satisfy the requirements of the PCWIN community. This document is the Concept of Operations for the PCWIN agencies. It is intended to validate that planners and system designers have heard the operational and functional needs of the PCWIN community and are able to apply the stated requirements to the conceptual design.

The Users' critical success factors such as reliability, capacity, performance, and special features required are dependant on the design and implementation of the PCWIN systems.

The PCWIN design will allow for the improvement of service delivery by each of the participating agencies by providing increased interoperable voice communications. The design will permit interagency and interdisciplinary communications to enhance communications while responding to events requiring multiple agencies. Shared radio networks and facilities will allow for consolidation of system maintenance operations. Co-location of dispatch operations will allow for improved information sharing and cooperation between the dispatch centers. New dispatch facilities will improve back up capabilities for 9-1-1 and dispatch services assuring the community of uninterrupted services.



2.0 CONCEPT OF OPERATIONS

“CTA Communications, Inc. (CTA) was contracted to analyze the user needs, system alternatives, existing legacy systems and environmental, organizational, and political factors that will influence the PCWIN project and present a “Concept of Operations Document”.

The Concept of Operations Document is to describe the existing systems and facilities that are to be replaced; provide justification for new systems and facilities and any restrictions; and describe the proposed system(s) and facilities and concepts for their use, management, maintenance, operation and sustainability. This Document bridges the gap between the user’s needs and visions and the developer’s technical specifications. The document should include:”

- A. *“A description of user’s operational needs without becoming bogged down in detailed technical issues.”*
- B. *Documentation of system’s characteristics and the user’s operational needs in a manner that can be verified by the user without requiring any technical knowledge beyond that required to perform normal job functions;*
- C. *User’s stated desires, visions, and expectations without requiring quantifiable testable specifications;*
- D. *A description of design constraints, the rationale for those constraints, and the range of acceptable solution strategies;*
- E. *A description of how interoperable voice communications will be used to improve the delivery of public safety services; and*
- F. *A description of how the planned concept of operations for the dispatch and emergency operations center will improve the delivery of public safety services.*

2.1 Users’ Operational Needs

CTA has established realistic operational requirements for the users and participants in the PCWIN. Special emphasis was placed on the ability to operationally establish voice communications with other PCWIN agencies on demand; and the ability to interact with



non-PCWIN agencies, which will be on separate networks. The specific agencies involved are listed below:

PCWIN PARTNER AGENCIES

Fire Agencies

Ajo/Gibson Volunteer Fire Department
Arivaca Volunteer Fire Department
Avra Valley Fire District
Corona de Tucson Fire District
Drexel Heights Fire District
Elephant Head Volunteer Fire Department
Golder Ranch Fire District
Green Valley Fire District
Helmet Peak Fire District
Mt. Lemmon Fire District
Northwest Fire District
Pascua Pueblo Fire Department
Picture Rocks Fire District
Rincon Valley Fire District
South Tucson Fire Department
Three Points Fire District
Tohono O'odham Fire Department
Tucson Airport Authority Fire Department
Tucson Fire Department
Why Fire District

Police and Emergency Services Agencies

Marana Police Department
Oro Valley Police Department
Pascua Yaqui Police Department
Pima College Department of Public Safety
Pima County Sheriff's Department
Sahuarita Police Department
South Tucson Police Department



Tohono O'odham Tribal Police
Tucson Airport Authority Police
Tucson Police Department
University of Arizona Police
Pima County OEM & Homeland Security

NON-PCWIN PARTNER AGENCIES

Federal Agencies

Customs and Border Protection
Immigration and Customs Enforcement
Federal Bureau of Investigation
Drug Enforcement Administration
Bureau of Alcohol, Tobacco, Firearms & Explosives
U.S. Marshal's Service
U.S. Forest Service
National Park Service

State Agencies

Arizona Department of Public Safety
Arizona Game & Fish Department

Each agency has its own specific unmet needs and problems which are herein listed; however jointly the areas of concern point to several community wide areas that need improvement. During the survey and interview process, CTA determined the concerns of users and here describe to the County the benefits and negatives, if any, for each agency participating in the project. This data enabled us to develop the specific PCWIN requirements, responding to projected needs and general design criteria, which in our professional opinion would be needed by the County.

2.1.1 Community Wide Areas Needing Improvement

CTA reviewed current operating procedures. It is expected that operations and procedures will be changed by the implementation of PCWIN. Much of the study was focused on the Users' critical success factors such as coverage, reliability, capacity, performance, and special features required. Determining an



understandable level of service desired by each agency was one of the particular items discussed in the interview process.

Normal operation within the coverage area

This includes all communications within the boundaries of the coverage area as defined. This requirement includes in-building portable coverage and mobile coverage throughout the area. The system is designed to provide communications point-to-point anywhere within the entire coverage area for both portable and mobile radios. For example, a portable or mobile at the extreme southwest corner of the coverage area shall have communications with a portable in a building at the extreme northeast edge of the PCWIN coverage area. The goal is to provide seamless radio coverage with minimum dead spots.

Mutual aid outside the coverage area

Communications is provided in the areas surrounding PCWIN to support mutual-aid responses. While the voice system was not required to cover the surrounding jurisdictions completely, the placement of transmitter sites to meet coverage requirements provides a certain amount of radio coverage extending into the neighboring jurisdictions.

Mutual aid also requires adequate radio communications with the requesting agency. This has driven the system coverage requirements and the assigned mutual aid frequencies available to responders. In particular, the radio users must be able to communicate with the statewide medical and law-enforcement channels, as well as with neighboring jurisdictions.

Additionally, included here is a listing and description of the various voice radio system characteristics that are of significance to the PCWIN community and are part of the Conceptual Design.

Wide-Area Coverage

The system is designed to provide a signal availability of 95 percent to/from all in-building portables and 95 percent to/from mobile radios, with coverage evenly



distributed over the service area for all operational functions. An important design goal is to minimize dead spots.

Dispatch Operational Concept

PCWIN plans to provide two co-located dispatch centers. The system should upgrade dispatch consoles and equipment in general to improve communications reliability. The system will also allow dispatch operations from centralized locations. Pima County Sheriff's Department, Tucson Police, Tucson Fire, Drexel Heights, and Northwest Fire (County Fire District) agencies dispatch operations will be conducted from centralized dispatch locations; however, the capability is provided for remote dispatch by individual departments utilizing consoles, as required by the individual agencies.

Survivability

The system is designed to survive in severe weather or emergency conditions. If dispatch points are shifted from their primary to a backup location, radio control will be available at the backup location to the same degree it was available at primary dispatch.

Capacity

The system will have enough channels and/or talkgroups to relieve the overcrowding problems that now exist. The system will provide sufficient capacity such that current routine, peak, and emergency overcrowding conditions will be alleviated.

- Routine Capacity: Alleviate existing crowded conditions with various channels at various times.
- Peak and Emergency Capacity: Provide reserve for peak and emergency situations. The system allows priority calls for critical users when the system approaches full loading.
- Growth capacity: Accommodates 20-year growth, to the year 2026.



The system also has sufficient channels and talkgroups to allow groups or departments with different functions to have their own channels or talkgroup, without interfering with or being interfered by other non-related groups or functions.

Future Expansion

The system is designed for future expansion of both the channels, and the numbers of users. System designs incorporate expansion to the level of usage predicted for the next 20 years with only the addition of equipment.

Intercommunications

The system provides portable-to-portable, vehicle-to-vehicle, and vehicle-to/from-portable communications. It also provides the ability to move anywhere in the coverage area and communicate using the same radio with the same access protocols, and without the users needing to know where the calling or called unit is located.

Interference Reduction

The system is designed to minimize inter-site (co-channel) and skip (distant users) interference.

Maintainability

The radio system is designed with an emphasis on preventive maintenance procedures, and with attention toward minimizing the time to diagnose, replace, and repair failed equipment.

Reliability/Failure Hierarchy

The radio system and equipment is designed such that single-mode failures do not perceptibly impact the routine operations of the system. Current radios, which are generally aged and becoming unreliable, shall be replaced by reliable new equipment.



System Operational Transparency

The radio system performs transmit/receive operations from multiple sites, and all switching operations are automatic and transparent to the radio user. System operation is logical, with the focus on whom the user wants to call rather than where they are located.

Console Features

All consoles shall be public-safety grade with keyboard, mouse, trackball, and/or touch-screen LCD operation, to include the following features:

- Capability for unique call functions
- Ability to support computer-aided dispatch (CAD)
- Audible/visual cues for acknowledgment of calls transmitted
- Audible/visual cues to announce incoming emergency calls
- Microwave link to the base station repeaters (to prevent downtime with leased telephone lines)
- Ability to support voice recording on a talk-group basis
- Ease of talk group patching
- Ease of Emergency call response by the operator
- User friendly All Call features

Consoles systems provide capacity for required positions, and space for future growth. The console capacity is designed with capacity when future dispatching operations increase.

Emergency Access

The system provides a universal emergency access throughout PCWIN via an emergency button on the radio unit. Emergency calls have the highest priority and are given exclusive use of a channel during the duration of the emergency situation. The Emergency alarms will be configurable so that the alarm receipt can be directed by talk group, agency, or function. This routing of alarms can be determined by the system programming. Routine radio traffic is allowed to continue uninterrupted on other channels.



Encryption (selected units only)

To prevent unauthorized release of confidential information, the system provides encrypted communications for law enforcement and other required personnel.

Operational Boundary Flexibility

PCWIN agency's operational boundaries are transparent to radio users. The radio system allows any group or department to operate with full communications capability within the entire service area.

Competitive Procurement Process

The system is to be procured using open, non-restrictive, competitive specifications. Award is to be based on the most cost-effective system meeting PCWIN's operational and functional requirements.

Commonality of Equipment

Subscriber equipment models and tiers are similar in operation and maintenance requirements.

Training

The System vendor will provide formal training for supervisors, dispatchers, field users, and maintenance technicians, as required.

2.1.2 Individual Agency Requirements Issues and Concerns

The agencies have enumerated several problem areas with their existing communications systems. These problems follow through into operational practices that the agencies use to overcome these problem areas. The desire of the agencies and of the project is to remedy these communications problems in a logical and efficient manner. In order to design an appropriate system, the problems to be overcome and required system characteristics were identified.



Some of the problems and characteristics identified for each agency are:

Pima County Sheriff's Department

Wide-Area Coverage
Dispatch Operational Concept
Survivability
Capacity
Future Expansion
Intercommunications
Interference Reduction
Maintainability
Reliability/Failure Hierarchy
System Operational Transparency
Console Features
Emergency Access
Encryption
Operational Boundary Flexibility
Commonality of Equipment
Training

The County requires a more robust system; the current system suffers an average of 64,000 call session failures annually.

The emergency function is not operationally efficient.

The equipment area is not provisioned with a grounding halo or any surge protection or surge suppression devices.

Long PTT (Push to Talk) delay (having to wait to speak).

No calling unit ID provided on the portables.

The media can too easily scan (eavesdrop) on law enforcement communications.



The current radio operation including talkgroup structure, and correct site selection is too complicated. This creates training needs that are unnecessarily high.

Specific coverage area problems such as the remote area between Ajo and the City of Tucson (Tohono O'odham Nation). Sometimes there may be no means of communication in certain areas such as Summerhaven and Arivaca.

Modulation / Voice volume levels vary.

There is some missing audio on the front of calls, and general call delays.

Officers wanting to monitor Fire operations must carry a second VHF radio. Automatic site selection requires scan to be ON. Auto registration seeks only an acceptable site, not the site with the strongest signal. County instructs radio users to run auto site selection ON and scan talkgroups OFF. Common practice is to leave scan OFF resulting in poor site selection.

Coverage problems area:

- Backside of the mountains at western national parks
- Northeast section of the county behind the mountains
- Green Valley District – Arivaca road and south
- Northeast parts of Tucson

The current mobiles have a problem of reliably getting a grant tone on motorcycle radios. The problem occurs between 2000 and 6000 RPM.

Encrypted operation is difficult and cumbersome. Secure communications is either not available or too problematic to use. Consoles are not equipped for encryption.

Radio coverage problems in several spots along Rte 85 south of Ajo.



A few interference problems on 800 MHz, due to close frequency reuse of the same frequencies in eastern Pima County.

Leased landlines connecting Ajo are unreliable, especially during severe weather.

PCSD and the fire departments need to operate on the same radio band and use gateway devices to link to other bands such as UHF for DPS and the Federal VHF bands.

Radio system coverage is an issue in a number of areas of the County. These areas include portions of the County that are experiencing rapid growth.

Corrections Bureau

The Corrections Division has experienced a high rate of repairs and maintenance for the pool of shared portable radios over the life of the present system (6 years).

Despite the use of BDA's for in-building coverage enhancement, there are still problem areas in the basement and parking garage at the County Courthouse. There are also some isolated spots that have poor coverage within the building at above grade level.

There are dead spots in the Adult Detention Center. With the use of BDA's, inside the facility coverage has, in fact, gotten better, but some dead spots do remain.

The three officers that work in the Central Control Room are overwhelmed at times with radio traffic. In addition to the 5 "channels" (talk-groups) that they monitor on the Sheriff's 800 MHz radio system, they also must monitor Facilities and Custodial staff. The Facilities maintenance staff use "business" radios, and these frequencies are not programmed into the Control Room. Facilities Management and the internal custodial staff carry conventional radios operating in a different frequency band (UHF). Communications are monitored on portable radios assigned to the control room.

The current radio system generates an unacceptably high number of "busies" when corrections officers attempt to access one of the assigned 5 talk-groups.



Because the system has an apparent software bug, queuing is disabled throughout the system. The automatic call-back function does not work, so users must initiate each call with a push-to-talk (PTT). The County had a “camp on tone” added to their EF Johnson radios because users would impatiently depress the PTT button before a previous call ended to be next in line to transmit. This was resulting in call collisions. When a user tries to access a channel before a previous call is ended, the camp on tone is generated by the radio indicating that the radio is still in receive mode and the user must try to transmit at a later time. This can result in repeated tries when the system is busy.

During a recent exercise, dubbed “Operation Southern Exposure”, a variety of problems were encountered when participating officers (from various departments and agencies) attempted to communicate within the Adult Detention Center. A Pima County Sheriff’s deputy (not a Corrections officer) could not talk on his 800 MHz radio back to his home talk-group when he was inside the jail facility. However, Corrections officers had no problem in using their radios in the same location. The deputy had failed to put the radio in “scan” mode so that it would automatically switch to the site supported by the building BDA system. PCSD deputies who work outside the jail and courthouses do not use the scan function in their radios due to problems with the algorithms employed in the E. F. Johnson software. Inside the Corrections facility, assigned officers must have their radios switched to the Tucson Mountain site because this is the only site affiliated with the BDA system.

The Tucson Fire Department does not use the County’s 800 MHz radio system for their communications. PCSD Corrections staff has observed that Firefighters cannot use their radios inside the Adult Detention Center. This poses a serious problem when there are fire or other emergency personnel inside the facility.

Transportation officers’ PCSD radios are not programmed for channels to use when out of the County.

The Jail is dependant on the Tucson Mountain tower site for radio coverage, when that site fails radio communications is lost and the entire detention center complex must be locked down. This happens one to two times a year for an hour or two.



Communications Unit (Dispatch)

There are continuing issues with the Orbacom consoles. The County has not had direct access to Orbacom support. Patching talkgroups requires a patch break for the console to transmit.

There are a number of issues as the result of inadequate space for the dispatch center. The break room contains small lockers, a small refrigerator, and a small couch. There are environmental issues as well such as lighting and climate control problems. There is virtually no storage area. There is also insufficient parking and parking lot security. The area is difficult to keep clean.

Interoperability is an issue. For the most part, communications with other agencies is done by hot lines (dispatcher to dispatcher).

Radio automatic tower site selection. Radio scan must be ON for radios to automatically switch to a tower with adequate signal. Knowing how to properly select talkgroup and tower site requires significant radio training and experience.

Because of operational problems, the system feature “system busy queuing” is turned off.

Under certain conditions, it is possible even with a trunked radio system, to have the effect of people talking over one another.

The radio emergency button is too easy to accidentally activate. This result is about 3 false emergencies per day.

Dispatch must clear the emergency before the declaring officer can return to his talkgroup – a serious officer safety problem.

Real emergencies are communicated using system all-call. Like patch, all-call can only be operated with a mouse (not keyboard or footswitch).

Routinely expect chopped front end audio when receiving from State Rte 83 area.



The design of the current dispatch and equipment rooms are not easily cleaned. The areas need surfaces, carpets, and consoles designed for ease of reach and cleaning.

Need noise reduction in the dispatch area.

Need a wire and cable management system to control and organize all of the wires and cables in and around the console positions.

There are insufficient electrical outlets at the positions.

The work area in the Ajo District is not comfortable.

Cable management is an issue for the Ajo District and the Tucson dispatch consoles.

Interoperability is an issue. Tucson Fire uses UHF channels and Rural Metro and Southwest use VHF channels.

2.1.2.1 Pima County Office of Emergency Management and Homeland Security

- Wide-Area Coverage
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

The EOC facility is a multi-use area not a focused facility for emergency management activities.



More room than the current 1300 square feet is needed, and the location is not ideal since the basement area could be prone to flooding and building collapse. Radio coverage for portable radios inside the EOC is poor to non-existent.

There is no viable “break-out areas” and no provision for a Joint Information Center.

There are many disparate frequency bands and trunking protocols used by first responders in Pima County. These range from VHF (150 MHz) to 800 MHz, and comprise analog conventional, analog trunking (E. F. Johnson), as well as digital P25 (conventional) systems. The problem is that many agencies do not have direct over-the-air communications capability with their neighbors. Interoperability is therefore a major issue, especially as it applies to mutual aid situations that would be part of any disaster response scenario.

2.1.2.2 South Tucson Police Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Encryption
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

South Tucson Police Department needs a common data link to access Tucson Police records concerning fugitives and other help wanted records.

South Tucson Police Department does not communicate on the same frequencies as Tucson. This is a problem during emergencies. During an emergency the



department switches to the Gateway frequency (Tri-band Repeater on Tucson MTN – VHF, UHF, and 800 MHz). There is no defined process for going to the Gateway repeater.

There are in-building coverage issues with portables and interference from another police agency. The interference appears to be jail operations traffic.

2.1.2.3 Oro Valley Police Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Encryption
- Operational Boundary Flexibility
- Training

Mobile data transmissions experience frequent disconnects.

Mapping capabilities cannot be extended to the vehicle.

Voice radio coverage and the need for an additional radio channel to relieve congestion has been identified as an occasional problem.

There is an interoperability channel (Gateway) available but the department is small and has trouble manning the channel for their operations.

Coverage is a problem in some areas of the town. There are not sufficient channels. The department is adding officers every year.



Interoperability with the neighboring Marana Police Department is a problem since Marana installed its 800 MHz trunked system. Marana has no conventional channels to be able to communicate with Oro Valley.

2.1.2.4 Tucson Fire Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

The current radio system infrastructure is old and worn out. Break-downs and repairs occur with more frequency in recent years.

The Fire Department has six operational channels. Capacity seems to be a problem.

There are coverage problems (dead spots) in both the east and west sides of the City.

Building penetration with the current radio system (from repeater sites) is not reliable city-wide. Communications with the dispatch center is critical on both fire and medical operations.



Interoperability via the Gateway system is cumbersome for field units. They forget to request the system be activated, and it is difficult to get units to switch frequencies.

The console equipment is beyond the end of its lifecycle.

Acoustic feedback with speaker/microphone accessories.

It is critically important to set up radios and have them stay set. A problem now is radio setting accidentally changing (ABC switch, volume, channel, etc.)

Coverage problems: outdoors on prison and jail properties , in-building in the jail and prisons, Kino Hospital basement, and at various locations in all the hospitals.

Because of existing radio coverage problems, understanding what channels work in which locations requires both training and experience.

General Services Department (Tucson Fire Dispatch)

The radio console equipment is at the end of its maintainable life. Parts are difficult to obtain.

The design of the room and equipment is not easily cleaned. They need surfaces, carpets and console designed for ease of reach and cleaning.

Need noise reduction in the dispatch area.

Need a wire management system to control and organize all of the wires and cables in and around the console positions.

There are insufficient electrical outlets at the positions.

2.1.2.5 Tucson Police Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity



- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Encryption
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Radio interoperability is limited with other agencies.

Coverage problems in-building – especially the larger buildings located in downtown and mid-town areas, down-town tunnels, and the main sub-station. Other locations include:

Tucson Mall

Starr Pass Area

Hospitals

Air Force Base

Houghton area

The area west of A-Mountain

West end of 36th street

In-building coverage for University of Arizona and north of Magee Road.

Specific coverage problems for each patrol division:

- Downtown: Problems in the (4th Avenue) tunnels and bunker, the Police Headquarters Building especially in the lower floors.
- South: Coverage dead spots south of A-Mountain.
- West: Coverage dead spots in the Tucson Mall, and the north-end, Macy's.



- Midtown: UMC, TMC (hospitals), Davis - Monthan Air Force Base, 22nd and Alvernon, and HQ.
- East: Coverage problems especially in the northern portion of their area.

Interoperability in many cases is not conducted by radio, but by cell phone communications.

Battery life duration is less than a typical shift for most portable radios.

Microphones are noisy and break often.

The University of Arizona operates on different frequencies and interoperability is an issue.

There are not enough common channels in the radios to support communications with others in TPD.

There are mobile data coverage problems near Fire Station 8.

There are voice coverage problems in the outer areas of city inside the jail, heavy building issues throughout the city.

The Sheriff's Department and Police Department operate on different frequencies.

There is radio static on the consoles causing difficulty in hearing communications.

Communications Division

There are radio coverage problems in several areas of the City. These include the Houghton Corridor, A-Mountain, west of the Catalina Mountains, and the west end of 36th Street. In-building coverage is very spotty and inconsistent. Radio interference has been a problem.

Several local agencies do not have the City frequencies and vice versa.

The 'Gateway' device is difficult to use.



2.1.2.6 University of Arizona Police Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Encryption
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Lack of encryption capability and lack of GPS location capabilities.

There are coverage issues below grade in the Medical Center.

Mobile data text messaging is fragmented.

2.1.2.7 Rural Metro/Southwest Ambulance, South Tucson Fire Department,
Corona de Tucson Fire Department, and Elephant Head Volunteer Fire
Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy



- System Operational Transparency
- Console Features
- Emergency Access
- Competitive Procurement Process
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Elephant Head Volunteer Fire Department would like better radio coverage.

Corona de Tucson Fire Department has coverage problems down Sahuarita Highway and cannot talk to Med. line on Interstate Highway 10.

All departments would like to have access to CAD records, mobile mapping, building mapping, and HazMat.

Rural Metro / Southwest Ambulance would like to have mobile data capabilities in the future.

2.1.2.8 Pascua Yaqui Police Department and Pascua Pueblo Fire Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Encryption
- Operational Boundary Flexibility
- Commonality of Equipment

- Training

Pascua Yaqui Police Department has in-building coverage problems mainly in the hospital and casino.

The Mobile Data system operates in only 50% of the service area.

There are no AVL or text-messaging capabilities. There is no ACJIS access. Interoperability with the FBI, Tucson Police Department, and Customs is very important.

The police department frequently has to work with the Pima County Sheriff's Department, but there is no direct communications. There is poor coverage on their channels outside Pascua Pueblo.

There are a number of dead spots especially in buildings. There is virtually no talk-back west of Camino Verde. They frequently hear the Chandler Police Department.

Both the police and fire departments want the ability to communicate with surrounding departments.

2.1.2.9 Northwest, Three Points, Golder Ranch, Picture Rocks, and Avra Valley Fire Departments

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Emergency Access
- Operational Boundary Flexibility



- Commonality of Equipment
- Training

Coverage – Many of the departments expressed concern about poor coverage in their areas of responsibility. In general, the more remote areas of the county were the areas that experienced the poorest coverage.

Interference – Co-channel interference can be experienced at times from the Phoenix / Mesa area. Occasionally the audio can interfere with dispatch. The interference could be the result of crosstalk or misrouting through the system.

Better interoperability with other agencies is required.

2.1.2.10 Rincon Valley Fire Department, Mt. Lemmon Fire Department, Green Valley Fire Department, and Drexel Heights Fire Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Emergency Access
- Competitive Procurement Process
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Drexel Heights Fire Department cannot communicate directly with law enforcement. They operate on different frequencies.

Drexel Heights has in-building coverage problems in St. Mary's Hospital.



Rincon Valley has coverage problems north of I-10 in the valley.

Drexel Heights Fire Department would like to see UHF and VHF frequencies realigned for less interference. They would like to monitor the simplex frequencies.

2.1.2.11 Sahuarita Police Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Emergency Access
- Competitive Procurement Process
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Need to be able to directly communicate with the Federal agencies, particularly Border Patrol and DEA. The I-19 corridor is a primary trafficking route.

Radio coverage throughout the entire school district is not possible today. In-building school coverage is poor.

2.1.2.12 Tohono O'odham Police Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion



- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Encryption
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Poor in-building coverage in the casinos.

Portable coverage is poor or non-existent in the southwest, Alvarez Mountains, Santa Cruz Flats, Tat Momu MTN (northeast) Hikawan Valley, Copper City Hills, Florence, San Miguel, I19 South, Pan Tak, Pima Mine, the Hotel and Casinos.

Radio interoperability with Customs, Border Patrol, FBI, US Marshal, and ICE is needed.

Radio service takes a long time. If a radio can't be repaired in the field, it takes a minimum of two weeks.

There is no direct communication with officers working in the San Lucy District. Calls must be transferred to Maricopa County and then transferred again to the dispatch center serving the Gila Bend area.

2.1.2.13 Tohono O'odham Fire Department

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications



- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Competitive Procurement Process
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Radio coverage is not adequate and needs to be improved over the Nation.

There is a lack of standardized radio protocol.

There are numerous areas where radio coverage is limited especially from portable radios.

2.1.2.14 Marana Police Department Dispatch

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Encryption
- Operational Boundary Flexibility
- Commonality of Equipment
- Training



The police department is very dissatisfied with the consoles. The vendor has indicated that the consoles cannot be upgraded to resolve the issues.

There are some dead spots, particularly in the Ina Road and Orange Grove Road areas. These are high activity areas. In addition, transmissions are garbled at times.

The Marana Police Department removed their mobile data system because of problems. They will reassess how to provide mobile data services in the near future.

2.1.2.15 Pima Community College Department of Public Safety

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Because of the differences in the various facilities, there are different issues at the different campuses.

The Physical Plant Department uses UHF radios for the various campuses and has no communication with the Department of Public Safety.

Growth in region may increase the required coverage area.

The Qwest T1s can have reliability issues.



2.1.2.16 Tucson Airport Authority

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Console Features
- Emergency Access
- Encryption
- Operational Boundary Flexibility
- Commonality of Equipment
- Training

Gateway channel does not provide reliable communication.

Interoperability is an issue. For the most part, communications with other agencies is done by hot lines (dispatcher to dispatcher).

Interoperability is a problem with the Air National Guard Fire Department (no access to National Guard channels).

Cable management is an issue at each workstation.

Radios are older models with fairly poor sound quality in DES digital encrypted mode. Models MPA (circa 1992) and MRK (circa 1998) are currently being used.

Both the Police and Fire Departments have ability to communicate with each other, but do not have the same capability with the rest of the organization.

A significant amount of non-Public Safety traffic is monitored (without alias ID's) on select and unselect speaker(s).



Rest of airport departments are operating on UHF bands.

There are coverage issues in the baggage level of the Main Terminal.

2.2 Design Constraints and Solution Strategies

One of the key success factors for PCWIN was to choose between a large range of alternatives. CTA developed with the Community multiple approaches to a solution. The PCWIN community is unique and as such requires a unique solution. CTA explored each possible solution with PCWIN and identified the advantages and drawbacks inherent to each solution. The ultimate goal was to make informed and effective decisions for the community.

CTA identified the potential approaches that met the community's needs. From that list, we selected the most viable approaches, and performed sufficient analysis and design to enable us to rank these alternatives in order of applicability to PCWIN's operations. After a review process, CTA identified and analyzed alternative approaches in five major system areas to contribute to the overall system design:

1. Voice Radio Systems
2. Mobile Data Systems
3. Communications Center
4. AVL Systems
5. Connectivity Network System

Several alternatives for each of the major subsystems were identified. Then each alternative was described within the framework of PCWIN operations. We described how the technology would be applied in PCWIN along with the strengths and weaknesses of each approach.

Next, we evaluated the fit of each alternative to PCWIN operations using the CTA Impact Analysis process.

The PCWIN team selected the highest scoring alternatives in five major areas that became the basis for the overall conceptual design:



1. Voice Radio Systems

Construct the voice radio system using P25 trunked technology. Take advantage of simulcast technology in the metropolitan Tucson area to simplify wide area operations for the radio users and improve in-building coverage.

2. Mobile Data Systems

Construct the PCWIN mobile data system using stand-alone technology, separate from the voice system, in order to take advantage of the broad market offering in mobile data systems.

3. Communications Center

CTA recommended the following characteristics for PCWIN dispatch operations:

- Co-Location of the Pima County Sheriff's Department and Tucson Police Department; and Tucson Fire Department and the newly created County Fire dispatch organizations
- Upgraded 9-1-1 Systems
- IP Ready Equipment
- Continued Support by QWEST
- New Computer Based Consoles
- Maintain Four CAD Systems

4. AVL Systems

Construct an AVL system using GPS-based location technology. Implement location capabilities as an integrated function within the mobile data system.

5. Connectivity Network Systems

Construct a substantial network backbone as the foundation for the new PCWIN radio system. Utilize a mix of microwave and fiber optic construction maximizing re-use of newer parts of existing County and City network assets. Design for public safety grade reliability using loop topologies and path protection to ensure redundant routing to critical locations. Select an IP enabled design capable of carrying all voice, Mobile Data, AVL, and network



management traffic. Provision the necessary interoperability nodes including the gateways needed for regional interoperability.

Of course the largest constraint is funding. The community has enacted a bond program to purchase this project.

The cost estimate at this time is comprised of several items. Pima County is working within a budget of \$92 million for the PCWIN Project, which was established under the Bond Referendum. An additional \$1.125 million has been awarded from Federal grant sources creating a total budget of \$93.125 million. In order to produce a realistic budget for the project, CTA has budgeted in the current needs rather than reducing the initial cost estimate to meet the previously established \$92 million budget amount. The results have exceeded the bond referendum amounts. While there have most certainly been areas of general escalation of expected costs from the establishment of the bond amounts up to now; there have also been several specific changes in direction and project scope that have had direct impact on the costs estimates. Some of these are:

- The inclusion of Back-Up 9-1-1 center provisions.
- Non-Fixed equipment is estimated at the 2009 levels which may be higher than previously assumed.
- The inclusion of County Fire Dispatch as a new separate dispatch entity.
- The number of channels used in the Tucson Simulcast area is forty-two which will take the system through its expected lifetime until 2026.

2.3 Interoperable Voice Communications Conceptual Design

To accommodate the community's needs and requirements the PCWIN system is designed to provide many valuable features.

The system design considered a number of factors.

These included:

- Present and future requirements



- Coverage
- Interoperability
- Performance
- Capacity
- Systems reliability
- Maintainability
- Features
- Cost factors

Additional features are also designed into the system:

Voice Communications

- Robust system construction that results in very reliable operation
- Simplified user operation
- Radio interoperability with local and outside agencies
- Solid training coupled with advanced features such as an emergency function leading to a safe work environment
- In-building radio coverage
- Recorded on-scene incident and fire-ground channels

Mobile Data Communications

- Automatic vehicle location capabilities
- Increased capacity for mobile information access
- Added capacity for new mobile applications
- County-wide service
- High performance system available to all participants

The design meets the current needs and future requirements, based not only on the projected growth in the County, but also on the anticipated need for future system enhancements. These enhancements include the 800 MHz frequency band as the choice for the voice system with future addition of 700 MHz channels as needed for additional capacity.



Interoperability, the ability of users from one agency to communicate with users from other agencies, is designed both within the system coverage area and with the surrounding area. A combination of approaches is required to satisfy the interoperability requirements. These approaches include:

- A. Pima County's public safety users can switch their radios to work on neighboring systems. For example, it will be possible for Pima County agencies to use their radio equipment if called to work in the Phoenix/Mesa area or near Yuma in Yuma County. Both of these areas will use compatible 800 MHz P25 radio systems. This assumes that Pima's radios are programmed for these systems and access permissions are established on the outside systems.
- B. Pima County's fire departments can switch their radios to common 800 MHz fire-ground frequencies during mutual aid.
- C. Pima County Public Safety user's radio equipment is designed to be compatible with the planned new State of Arizona P25 system. Conversely, it will be possible for State agencies to operate on the new Pima County PCWIN system. Radios will also be compatible with the new radio system planned by Tucson Electric Power.
- D. Interoperability gateway devices in the proposed connectivity network provide access to State, Federal, and local channels in different bands, and other dispatch operations in the region. These connections are managed by dispatch.

The new system is designed to be available when and where needed. System coverage will be provided in buildings in the Tucson metropolitan area as well as throughout the entire county. The system will provide sufficient capacity so users can access channels when and where needed. It is designed so that the failure of any single module or piece of equipment will not perceptibly impact routine operations. System needs are configured so that they can be maintained in a consistent manner. In addition, the system must be designed to survive natural and manmade events. The special needs for in-building and tactical communications must be met as well. FIGURE 1 shows Portable Radio Coverage. The majority of the service area is covered with 95% reliability. Areas not colored do not necessarily mean there is no radio coverage; rather, that they are not rated at 95%.



Voice System Conceptual Design

The PCWIN voice radio system design is based on Project 25 standard-based digital technology. The system design incorporates an eight site, simulcast subsystem in the Tucson Metropolitan area. Users of the simulcast subsystem will be able to operate anywhere in the area without adjusting radio settings. In the populated areas outside of the Tucson service area there will be additional trunked tower sites with sufficient channels to handle the anticipated radio traffic. Users will generally rely on automatic site selection by the system to keep them affiliated with a strong site. In addition, we recommend that conventional repeaters be installed in two areas to boost coverage. Users will be required to manually switch to the conventional repeater when operating in the specific area. The repeaters will be linked via radio back into the trunked radio network.

The Tucson area simulcast design simplifies radio operations as compared to the current radio systems in the Tucson valley. Specifically, users will no longer need to switch radio settings based on their location over a large part of the valley. The simulcast design is intended to improve wide area operation for all agencies, especially for users concentrated in the central Tucson valley. Working within the constraints of simulcast technology, the coverage area is centered over the populous area and the core service area of the Tucson valley. Unlike the Sheriff's current high-site towers, the design uses an array of lower elevation sites designed to place more usable coverage closer to the service area. This will improve coverage density for better in-building penetration. As the user ranges out of the Tucson valley area, coverage is provided by additional radio towers. These trunked radio sites are identical in functionality to the Tucson simulcast system. These sites effectively expand the Tucson area coverage to a county-wide footprint. In some less populated areas of the County radio coverage is important, but high capacity trunked radio sites are not practical. Two of these sites have been identified, one at Ajo Mountain and the other at Three Peaks. FIGURE 2 shows Site Locations; on which the Users can see the locations of the sites designed for the PCWIN system.

The new Marana P25 800 MHz trunked radio system will be connected to PCWIN and receive additional channels. As mentioned previously regarding P25 standards progress, the capability to interlink different vendor's infrastructure is evolving. That interface, called the Inter Sub System Interface (ISSI), will enable Marana simulcast system to be directly connected to PCWIN making the Marana towers operate seamlessly with other towers in the network. This allows Marana's existing resources to contribute to a robust



communications network for overall Pima County. Operationally, users and dispatch operations can interact most conveniently with Marana integrated into PCWIN. This design addresses the characteristics of:

- Wide-Area Coverage
- Dispatch Operational Concept
- Survivability
- Capacity
- Future Expansion
- Intercommunications
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- System Operational Transparency
- Emergency Access
- Encryption
- Operational Boundary Flexibility

Site Reliability

Much of the reliability of the system is built into the condition of the sites themselves. Public safety communications systems must be highly reliable. They must function under all conditions. Assuring high reliability requires the right combination of facilities, equipment and systems, plans and trained personnel. The conceptual design uses 23 sites, plus 3 Marana sites. 14 of those sites are existing sites. The other 12 are new. There are a number of elements which must be addressed for the upgrade of any existing radio site, or when designing and developing new radio sites:

- A. In general, the site should be clean and properly cleared of vegetation. This includes grubbing and leveling of the area and providing a clearing of a 10-foot-wide path from any guyed towers to their guy anchor points.
- B. The site must be accessible to normal SUV-type vehicles on a regular basis. The road must be in passable condition or capable of being repaired without undue expense. We consider four inches of standard road paving gravel to be an acceptable covering material and recommend it for all sites. We do not recommend any extensive grading, culverts, etc. The road should be able to be



maintained free of washouts and dry, except possibly after heavy downpours. The area inside the equipment enclosure fencing should be covered with gravel. There should be ample room for parking and a turn-around area for two full-size pickup trucks.

- C. Foundations for the equipment building, emergency generator, and for the tower and guy anchors will be required when new shelters and/or towers are installed.
- D. The system vendor will be required to provide a structural and wind loading analysis of existing towers, antenna structures, and foundations with this equipment mounted on them to determine if they are acceptable. If the loading is not acceptable, the tower or antenna structure will have to be replaced or strengthened. All new towers will be specified with extra loading capability for future antennas.
- E. Fencing is needed to enclose the site and to enclose the guy anchor points individually where a guyed tower is utilized. Any existing fencing should be rust-free, in good repair, well grounded, and have a double gate. Access to the fenced radio site shall be regulated using locking devices.
- F. Geotechnical investigations, including borings for tower foundations, shall be performed before designing and building any new towers or other structures.
- G. The grounding system at a radio site must consist of the following:
 - Halo ground system inside building
 - Buried ground system for building and tower
 - Tower and fence grounding equipment
 - Ground rods and test wells
 - Surge suppression devices

Proper grounding and bonding of equipment is essential not only for system reliability but, more importantly, for personnel safety. The purpose of a grounding system is to provide a low resistance path for electrical surges and transient voltages. Lightning and electrostatic discharge (static electricity) are common causes of voltage spikes. The grounding system of all communications equipment installations must follow industry standard grounding specifications.



This design addresses the characteristics of:

- Survivability
- Future Expansion
- Intercommunications
- Maintainability
- Reliability/Failure Hierarchy

Consoles

Pima County Sheriff's dispatch and the City of Tucson Police and City of Tucson Fire will continue dispatch operations as separate organizations. The current plan is to locate these dispatch operations in two buildings. The 9-1-1/dispatch areas are set up as separate stand alone operations. In addition to these primary 9-1-1 centers, a number of other dispatch operations are included as part of the PCWIN design. The latest P25 infrastructure offerings feature IP based consoles. This technology facilitates placement of dispatch consoles at any "node" on the radio network. Bulky and expensive to replicate dispatch switching gear is replaced by less complex network routers and servers.

This design addresses the characteristics of:

- Wide-Area Coverage
- Dispatch Operational Concept
- Capacity
- Future Expansion
- Intercommunications
- System Operational Transparency
- Console Features
- Emergency Access
- Commonality of Equipment
- Training

Interoperability

Even using P25 technology, PCWIN interoperability is not complete without a means to communicate with agencies using different frequency bands and radio technologies.



In the Pima County region, some of these agencies include:

- All federal agencies
- All state agencies
- Santa Cruz County Public Safety – developing VHF P25 trunking
- Pinal County Public Safety – VHF
- Cochise County Public Safety – VHF
- Yuma County Public Safety – 800MHz

One solution is the Interoperability Gateway System (IGS). This system in concept is simply an enhancement of the “gateway channel” concept used as a cross band repeater in Tucson today. The existing gateway channel serves a useful purpose of interconnecting VHF and UHF radio users today. The interoperability gateway system included in our design improves upon this concept in several ways. First, the IGS is a network centric concept. Entry points for outside radio traffic are placed at strategic locations convenient to the source of the outside channels. The PCWIN IP based backbone may need deliberate routings to reach these locations. Once an outside radio channel is “gated” onto PCWIN, it is treated just like any other talkgroup in the system, available to be routed to any tower site or dispatch operation. Outside connections are normally disabled to prevent unnecessary traffic. When a connection is needed and agreed upon by both entity dispatchers, the link is simply enabled much the same as a patch. The IGS can handle all types of audio signals including radio, telephone, and P25 digital radio signals bridged from a VHF system to an 800 MHz system.

This design addresses the characteristics of:

- Dispatch Operational Concept
- Capacity
- Future Expansion
- Intercommunications
- System Operational Transparency
- Emergency Access
- Operational Boundary Flexibility
- Commonality of Equipment



2.4 Mobile Data System Conceptual Design

The PCWIN mobile data conceptual design provides a new higher performance 700 MHz “RF pipe” to replace legacy systems. PCWIN agencies, in their various locations using their various CAD systems, may migrate their applications over to the 700 MHz network. Overall, the design will provide an enhanced level of mobile information access to all participating agencies. The fixed mobile data transceivers are separate from the voice base stations, but share the same tower sites. This allows shared use of common facilities, towers, power systems, and network backbone. PCWIN requirements indicate that three different types of networks are needed for supporting mobile information needs:

1. **Dispatch Network:** The day-to-day workhorse for carrying Sheriff, Police, and Fire dispatch and information queries. This network provides county-wide service. Automatic Vehicle Location technology supports the asset location function over this network.
2. **Private Broadband Network:** Expansion of the County and City Wi-Fi networks at public service facilities and in other public spaces where public service experiences frequent activity.
3. **Commercial Network:** The design offers the option for selected units to connect to commercial cellular service which will enable the use of handheld computers, provide out-of-county service and service for special applications.

The mobile data fixed network also serves as the transport for AVL information. Some vehicles will be equipped with mobile data and others will not. Mobile data-equipped vehicles are outfitted with a GPS receiver as part of their radio modem. Vehicles without mobile data (and associated radio modem) are equipped with a GPS receiver and a more basic modem dedicated to transferring GPS data. The asset location function uses automatic vehicle location technology to deliver location data to the dispatch areas. The location data coupled with existing GIS information feeds the mapping functions that are part of the CAD systems.

This design addresses the mobile data characteristics of:

- Wide-Area Coverage
- Survivability



- Capacity
- Future Expansion
- Interference Reduction
- Maintainability
- Reliability/Failure Hierarchy
- Commonality of Equipment

2.5 Frequency Design

The use of the radio spectrum is a privilege made available in this country through the Federal Communications Commission (FCC). Of radio spectrum designated for use by public safety agencies, the 700 and 800 MHz portion of the spectrum offer the most available spectrum. Currently PCWIN agencies are licensed for 132 channels in the 800 MHz band. The system as defined in the conceptual design ultimately requires 119 total channels. While some reuse of existing channels may be feasible; due to transition and compatibility issues not all will be usable in the new design; additional channels may be required.

Frequency planning efforts are further complicated by the proximity to the Mexican border. A border zone has been established by both the United States and Mexico to minimize interference from users in the other country. The border zone extends 110 kilometers from the border. Any new channels or any channel relocation requires that the proposed use be coordinated not only within the United States, but also with Mexico. Because it is an international matter, the coordination is handled in this Country by the U.S. State Department. Currently the six channels licensed to Marana are assigned via a waiver. Marana's use of the channels is considered secondary and they must accept interference from Mexican users of the same channels. Restrictions have been placed on some of the channels licensed to the City of Tucson.

Pima County desires to maintain its existing 800 MHz system for a time because the system is used by a number of public service personnel who will not be migrating to the PCWIN system. Approximately one-half of the current channels will be retained by the existing system until that system reaches the end of its useful life.

All of these factors make frequency design for the PCWIN system a complex matter. A conceptual frequency design has been developed that will meet the channel requirements for the next 20 years.



This design addresses the characteristics of:

- Capacity
- Future Expansion
- Interference Reduction
- Emergency Access

3.0 CONCEPT OF OPERATIONS - DISPATCH

One of the adopted PCWIN project objectives is to “*design, construct, occupy and operate a regional communications center co-locating the 9-1-1 public safety answering points and dispatch functions of the Pima County Sheriff’s Department and the City of Tucson with the Pima County Emergency Operations Center.*” Initially the design concept involved creating one facility to be shared by the Pima County Sheriff’s Department and the City of Tucson. As the design concept evolved, it became evident that a single facility was not the best solution for Pima County and the City of Tucson. Among the factors contributing to this were the space requirements required and the need for adequate backup capability.

The conceptual design includes:

- Space Requirements
- Operational Police, Fire and EMS Consoles
- AVL Console Interfaces
- 9-1-1 Call Answering Architecture
- Administrative and Seven-Digit Telephone Systems
- Console and Dispatch Furniture Requirements
- ECC/EOC Functionality
- Power and HVAC Requirements
- Security Requirements
- Back Up facilities

PCWIN planning involved a programming effort to help planners visualize the functional and operational features being planned into the ECC/EOC. PCWIN users defined how the technology alternatives selected come together to provide a functional communications center configuration that meets the needs of the community as well as a functional emergency operations center.

Underlying the conceptual design is the need to assure that the selected designs facilitates the expeditious handling of emergency requests for assistance.

The scope of the project requires:

- Identification of potential sites for a new facility
- Define requirements for a new facility



- Evaluate need for back up facilities
- Determine suitability of facilities to meet needs for a back-up facility

3.1 Potential Facilities

A substantial effort has been ongoing within the community to identify possible space solutions for this project. It is well known that locating appropriate space and facilities can be one of the longest tasks in the project. After the review of several facilities based on initial concepts; two facilities stood out as solutions for this project – 3434 E. 22nd Street and the Thomas Price Center at 4004 S. Park Avenue.

3.1.1 3434 East 22nd Street

The 22nd Street facility has in excess of 50,000 square feet of useable space. It is 25-30 years old and is in apparent good condition. According to an evaluation report by JRCA Architects, some interior renovations will be required. In addition there may need to be upgrades to the building's mechanical, electrical and plumbing systems.

The building was originally built to function as a bank computer operations center. As a result, adaptation to function as a public safety communications center will be less difficult than if the building had been constructed for other purposes. The east wing of the building contains approximately 10,000 – 12,000 square feet of largely uninterrupted floor space. This is the most logical area for the location of the dispatch centers. The west wing of the building may be renovated to provide space for both the Emergency Operations Center and offices for the Pima County Office of Emergency Management and Homeland Security. The security system for the building will require upgrading to provide the level of security appropriate for a critical facility such as this.

The facility review indicated that while the existing mechanical, plumbing, and electrical systems were functional, upgrades will be required to make them suitable for use in a public safety communications facility. The HVAC system may not have sufficient capacity to function for the proposed use of the building. A separate HVAC system that serves only the communications centers will be required. Some upgrades to the plumbing system will be required in order to bring the restroom configuration into compliance with accessibility standards. More significant upgrades will be required to the electrical system. While there



are dual power feeds, there are questions about the functionality of the transfer switch. In addition, the building currently does not have an emergency generator or Uninterruptible Power Supply (UPS) system. It was noted that due to electrical system modifications, it is unclear what parts of the electrical system are actually still in service.

Even with the cautions noted above, the 22nd Street facility is a viable choice to house the primary dispatch centers, as well as the Pima County Emergency Operations Center.

3.1.2 Thomas Price Center at 4004 South Park Avenue

This facility is located and used as part of a large city service center which spans several city blocks. The Price Service Center was originally constructed in approximately 1977. A portion of the facility was later renovated along with a small building addition to form the current Communication Center for the City of Tucson. This took place in approximately 1984. The Communication Center is approximately 15,500 square feet on one level with an additional 2,000 square foot mezzanine.

This facility also houses major components of the City of Tucson microwave network and provides connectivity into their fiber network. The Communication Center currently houses 9-1-1 communications, police and fire dispatch and associated functions. The approximate age of the building is 23 - 30 years. The overall building condition is good for a structure of this age and type. The exterior shell of the building including exterior walls is in adequate condition and will not require modification at this point in time. The structure appears to be in good condition.

According to an additional evaluation report, some interior renovations will be required for the Price Center as well. There may need to be upgrades to the building's mechanical, electrical and plumbing systems.

3.2 Space Requirements

The PCWIN community is a large and complex environment. The dispatching and 9-1-1 operations that serve the community have developed over time into strong and efficient organizations. Four operations are the focus of this project. They are the Pima County



Sheriff's Department; the Tucson Police Department; Tucson General Services 9-1-1/Tucson Fire Department; and the Drexel Heights Fire Department Dispatch.

In reviewing and developing the number of operational positions and space required, the PCWIN agencies spent a great deal of time determining the actual requirements for five levels. The number of positions required in each condition or level is the basis for deciding the space required; the equipment required; and the estimate of costs.

These five levels are:

- Current Level – This level was the easiest to establish and contains the number of positions that are actually in use today.
- Immediate Level – This level reflects the number of positions needed either as currently unfulfilled needs or will be needed in the immediate future. This level is used to determine the initial purchase of equipment and furniture.
- Future Level – This level is the most difficult to determine as it expresses the expected number of positions that will be needed in the next twenty years. This level is used to create the space design and layouts, and the equipment capacity and routing. The goal is to be able to expand to this level without major overhauls or expansion of facilities.
- Training Level – This level is currently performed at normal operating positions, creating some conflicts. The desired goal is to have assigned training positions that will serve as effective training platforms. The number of staff required and the turn-over in employees creates this constant need for training of new employees and refresher training for existing employees.
- Back-up Level – Previously un-quantified, the number of positions required in a back-up scenario is now defined by the PCWIN community. These positions will be located at a PSAP away from the operation they are designed for; Pima County Sheriff's will not be at 22nd Street for example. Additionally, as much as possible, the training positions will be used as designated back-up positions.



3.2.1 Current Level

The Current Level for the four agencies is shown below:

Agency	Dispatch	Call -Takers	Supervisor
PCSD	5	8	1
Tucson 9-1-1/Fire PSAP	8	9	1
Tucson PD	6	17	4
Drexel Heights/County Fire	2		1
Total	21	34	7

These positions are processing the calls today however there is a pent up immediate demand for added positions.

3.2.2 Immediate Level

This Immediate Level is shown below:

Agency	Dispatch	Call-Takers	Supervisor
PCSD	7	8	2
Tucson 9-1-1/Fire PSAP	13	13	2
Tucson PD	10	22	4
Drexel Heights/County Fire	3		1
Total	33	43	9

3.2.3 20 Year Growth Level

As has been stated previously the community is experiencing rapid growth with added requirements. This produces a future need for even more operational positions. The Grand Total is shown below:

Agency	Dispatch	Call-Takers	Supervisor
PCSD	10	12	2
Tucson 9-1-1/Fire PSAP	16	15	2
Tucson PD	15	30	6
Drexel Heights/County Fire	3		1
Total	44	57	11

3.2.4 Training Level

Also identified in the project was the need for Training positions in order to maintain the proficiency of new and existing employees. This Training Level requirement is shown below:

Agency	Dispatch	Call-Takers	Supervisor
PCSD	2		
Tucson 9-1-1/Fire PSAP	4		
Tucson PD	6		
Drexel Heights/County Fire	1		
Total	13	0	0

3.2.5 Back Up Level

Another factor not previously quantified is the need for Back-Up positions. During the project these have been identified. The Back-Up Level requirement is shown below:

Agency	Dispatch	Call-Takers	Supervisor
PCSD	4	5	1
Tucson 9-1-1/Fire PSAP	8	7	1
Tucson PD	8	9	1
Drexel Heights/County Fire	2		
Total	22	21	3

3.3 Back Up Requirements

Emergency Communications Centers (ECC) need to have the highest degree of reliability feasible in order to ensure operations during all conditions. An important component of a reliable center is a functional back-up center. PCWIN planners desire to improve on current conditions and have stated that their requirements are for full call taking and dispatch capabilities in a back-up scenario with a capacity equivalent to or greater than 40% of regular operational capacity.

Two obvious options are available to meet the back-up requirements:

- Use of two fully operational manned facilities
- Equipping an unmanned facility that would be activated in time of need

An unmanned facility would not permit uninterrupted transfer of service to another 9-1-1 PSAP. Any other solution would be a reduction of services currently available today. When needed, staff would have to travel to the remote location and activate the center before calls could be received. The ideal solution therefore is to transfer 9-1-1 service to another 9-1-1 PSAP. None of the other 9-1-1 PSAPs in Pima County are sufficiently



sized or manned to handle the additional call load that would be transferred by the County or City of Tucson.

3.4 Two Facility Conceptual Design

As a result of the factors above, the PCWIN Executive Management Committee approved a revised conceptual design that calls for the Tucson Police Dispatch, the Pima County Sheriff's Dispatch and Primary PSAP, and the Emergency Operating Center to be located in the 22nd Street facility. The Tucson Primary Public Safety Answering Point (PSAP) and the Tucson Fire Dispatch Center would continue to be located at the Thomas Price Service Center, 4004 South Park Street. The facility would be renovated and reconfigured to not only serve as the Primary PSAP and Fire/EMS dispatch center, but also to function as the back-up for the 22nd Street facility.

In addition, the fire departments outside of the City of Tucson (Northwest Fire, Golder Ranch Fire, Avra Valley Fire, Three Points Fire and Picture Rocks Fire) currently dispatched by the City of Tucson and the departments currently dispatched by the Drexel Heights Fire Department have decided to form a joint dispatch operation that will be organizationally independent of the City of Tucson, but co-located in the Thomas Price facility.

Each operation will have separate dispatch areas, but equipment rooms and other support facilities will be shared.

The two centers are being designed to meet the needs of the participating agencies through the year 2026.

3.4.1 9-1-1 Customer Premise Equipment (CPE)

New 9-1-1 CPE was installed by the Pima County PSAPs beginning 2005. With the two center design concept, each center will consist of at least one primary PSAP and one secondary PSAP. The primary PSAP is the PSAP that initially answers the 9-1-1 calls. Secondary PSAPs are those PSAPs that only receive calls transferred from the primary PSAP. Based on the current design concept, the City of Tucson's primary PSAP will continue to be located at the Thomas Price Center and operated by the Department of General Services in conjunction with the dispatch for the Tucson Fire Department. The recently installed Plant/CML VESTA 9-1-1 CPE with Meridian and Option 61 originally intended



for the Tucson Police secondary PSAP will be used for the primary PSAP operation. Additional answering position units will be purchased as required. The Tucson Primary PSAP will continue to transfer 9-1-1 calls to either the Tucson Fire Dispatch, located at the Thomas Price Center, or the Tucson Police Dispatch, located at 22nd Street. They will also transfer calls to other area PSAPs as required.

The Pima County Sheriff's Tucson Dispatch Center will continue to be a primary PSAP. It will be located at the 22nd Street facility. It will transfer incoming 9-1-1 calls to the County Fire Dispatch at the Thomas Price Center and to Rural Metro's Tucson Dispatch as required. A new Plant/CML VESTA 9-1-1 CPE with Meridian and Option 61 9-1-1 switch will be required at the 22nd Street facility.

Both CPE switches will need to be sized for the extra call load experienced in a back-up scenario.

The selected voice equipment vendor will install a voice system manager, the alarm system, the system audio switch, if required, and console system server in the equipment area at the Thomas Price Center.

In the equipment room at both the 22nd Street facility and the Thomas Price Center, the console central electronics will be installed in racks or cabinets. The exact number of racks or cabinets needed at each facility is dependent on the vendor chosen.

3.4.2 Radio Operator Positions

The radio control equipment will be connected to each of the radio operator consoles via the console central electronics. Each radio operator position will be connected to the console central electronics by cabling as proscribed by the supplier. These central electronics will also be interconnected through the radio control network to the AVL location sub-system. This will provide location information to the dispatchers thru the CAD interfaces. Exact details will be provided by the selected Voice provider.

Each of the dispatch and supervisory positions will be equipped with a personal computer with vendor provided additional hardware and software. The workstations will be connected to the console server and central electronics.



In addition to the computer and monitor, each position will include an audio enclosure, speakers, and foot pedals to allow the operator to transmit on the selected channel in a hands free mode. Each position should also be equipped with dual headset jacks to facilitate training. The radio consoles and the telephone system should be interfaced to permit the use of the same headset for radio and telephone. Separate headset jacks should also be provided so that separate headsets may be used.

Each dispatch and supervisory position will be equipped with an additional desktop control station. The control station will allow the telecommunicator to continue to access the land mobile voice system in the event of a failure of either the console system or the links to the system. The actual control station radios may be located in the equipment room and a desktop remote will be located at the operating position.

The Tucson Fire, Tucson Police, the Pima County Sheriff's, and the Drexel Heights Fire Departments each operate their own, separate CAD systems.

All four agencies have used their individual systems for a number of years and have made a significant investment in their systems. Extensive modifications have been made to customize the systems to the department's needs. Each department will continue to use its existing CAD system in the new center.

3.4.3 Furnishings

As part of the building renovations, new dispatch workstation furniture should be purchased and installed. This furniture should be based on specifications that reflect the intense use that the workstations receive. The workstations should be articulated allowing the telecommunicators to operate in either a sitting or standing mode. The workstations should be equipped with personal environmental controls. The workstations should be sized based on the number of monitors that will be installed at the position. Typically call taker positions have fewer monitors and are not as big as a dispatch position. A supervisory workstation may be larger than a dispatch workstation because the supervisor may have additional monitors installed. Based on a person's normal turning radius, industry standards generally do not recommend installing more than six monitors horizontally at a workstation. If additional monitors are needed, they are stacked on top of the bottom row of monitors.



3.4.4 Logging Recorder

One new voice logging recorder system should be purchased for each facility. The current technology allows multiple agencies to share recording systems while still maintaining the necessary levels of security. For example, even though the Tucson Police Department and the Pima County Sheriff's Department will share the same logging recorder system, neither will be able to listen to the other's radio channels without permission. While the recording system will be larger than either of the agencies would need individually, the one system will be less costly than separate systems for each agency. It is also possible for both facilities to share the same recording system. However, because of the distance between the two buildings and the logistics that would be involved, we recommend a separate system for each building.

The recorder system provider will be the provider of the instant recall recording function.

The implementation of the new dispatch center and the renovation of the dispatch facilities and the renovation of the existing facilities at the Thomas Price Center, coupled with the implementation of the new Pima County Wireless Integrated Network is a complex process that will require careful planning.

The services delivered to the public and the public safety agencies are critical. Added to that, is the complexity and interdependence of the support systems involved, as well as the task of relocating three separate dispatch operations into the new emergency communications centers. Lastly, and possibly most important, is the large number of personnel involved with specific tasks to accomplish in this project. The overarching goal in the process is that there be no lost calls. The public should not notice the change when it occurs. User agency communications, except for the obvious change to the new Land Mobile Radio System, should not be interrupted.



4.0 CONCEPT OF OPERATIONS – EMERGENCY OPERATIONS CENTER

Anytime the response to an incident involves more than one responder, coordination is required. As incidents grow in size beyond the day-to-day emergencies that are routinely handled by public safety agencies, the need for coordination and communications increases. It is designed to be scalable, consistent, and integrated with day-to-day operations.

As the size of the incident increases or multiple incidents occur simultaneously, the need for a multi-agency command structure is required. The basic purpose of an Emergency Operations Center (EOC) is to provide a facility in which governmental entities can continue to function and provide interagency coordination and executive decision making during large scale disasters or emergencies.

Under the Pima County Emergency Response and Recovery Plan, the EOC has five primary functions:

- Direction, control, and coordination during emergency operations
- Situation Assessment - the ability to overview an incident and understand the broader implications
- Coordination between the various responders
- Collection, processing, and dissemination of public information
- Resource Management – ensuring the efficient use of resources

4.1 EOC Facility Requirements

The EOC must be sized to handle the maximum anticipated staff that will be called in. Pima County Emergency Management's Staffing Plan calls for a total of forty-eight people to fully staff the EOC. In addition to providing space for the Emergency Management Agency staff, adequate space is required for the following functions:

Operations Room
Communications Room



Conference/Breakout rooms

Kitchen/Break Area

- The Operations Room is where agency representatives assemble to coordinate their efforts. The Direction and Control Annex of the Pima County Emergency Response and Recovery Plan; groups the activities in the operations room into four sections:
- Policy Section: Responsible for the strategic direction of County level emergency operations, the policy section performs or supports the command function.
- Operations Section: Responsible for tactical command and coordination as well as incident response assets, the operations section provides tactical level liaison as well as coordination of mutual aid.
- Plans Section: Responsible for providing incident analysis; the plans section provides incident action plans and assists in the coordination of operations requirements.
- Logistics Section: Responsible for the coordination of personnel and other resources required to augment the initial response, the logistics section is responsible for the validation of requests for resources and for documenting the utilization of those resources and handling the financial aspects of the emergency.

Under the Pima County Plan, the Operations Room layout groups the members into separate areas by section. The operations room needs to be approximately 3,000 square feet. Telephone lines and multiple network connections are needed at each position. Additional status displays, including maps, charts, and logs are required.

4.2 EOC Equipment Requirements

In addition to the telephone and network connections noted above, multiple digital logic projectors will be required in the operations room and in the various breakout/conference rooms. A video switch is required in the operations room to permit the selection of video to be displayed from numerous sources. Access to video downlinks from the Pima County Sheriff's Department and Tucson Police Department, satellite feeds, broadcast



television, computer aided dispatch systems, computerized mapping, and so forth are required. Numerous specialized communications devices are also required.

These include satellite telephones with external antennas so that they can be used from the operations room, various amateur radio frequencies, as well as those channels used by agencies involved in the disaster response in Pima County. In addition, the operation will need an audio video feed to the Joint Information Center which will be located at the County Government complex downtown. Pima County uses a computerized crisis information management system (E-Team) to support the management of disasters and emergencies. All positions need access to the system which is network based.

4.3 ECC/EOC Interface

With 9-1-1 being the primary means by which the public accesses public safety agencies and those agencies usually being the initial responders, the public safety dispatch centers have a wealth of real-time information on developing situations. It is very important that the information be available in the EOC. This can be accomplished by providing the capability to monitor the radio channels and to view the CAD systems' screens. Access to all four CAD systems (view only) should be available in the EOC.

4.4 EOC Security Requirements

The EOC requires a safe and secure environment that will permit those involved to effectively carry out their responsibilities and missions. Access to the EOC must be limited to authorized personnel only. A separation is required between publicly accessible space and secure areas. An access control system will be required. It should be the same system used throughout the building.



5.0 CONCLUSIONS

The PCWIN public safety user community's vision has taken shape as a realizable system design. The design is developed on a concept that provides mobile coverage throughout the County, with in-building coverage provided in population centers. The City of Tucson will have primarily medium building coverage, with the denser urban areas meeting a heavy building classification. Channel requirements have been designed so that public safety personnel will have nearly immediate system access in almost all situations.

The preliminary design includes 8 radio sites for the Tucson simulcast module. Each of these sites will be provisioned with capacity for 42 voice channels. In addition to the Tucson module, there are two other simulcast cells – one in Marana, and one in the mountainous area of Mt. Bigelow and Mt. Lemmon. The Marana simulcast network is comprised of three sites and will need to be expanded from 4 to 6 channels. The Mt. Bigelow / Mt. Lemmon simulcast module will only require 4 channels. The balance of the County will be covered by eleven (11) other trunked sites with channel capacities varying from 3 to 8 channels each. Supplemental coverage in remote sections of the County will be provided by two solar-powered sites with conventional repeaters.

The dispatch operations will be performed at two primary locations – one at 22nd Street (for the Sheriff's Department co-located with Tucson Police Department) and the other at the Thomas Price Service Center (for the Tucson Fire Department co-located with the County Fire agencies). These two facilities will be constructed to current national standards for survivability and hardening against natural disasters and deliberate terrorist attacks. Each location will act as the back-up center for the other.

A subset of the voice system radio sites comprises the network for the Mobile Data System. The PCWIN design concept includes mobile data as an independent infrastructure operating on 700 MHz channels. The mobile data coverage footprint is nearly identical to that for the voice system. Twenty-two (22) channels in the 700 MHz band are required for county-wide operation. These channels will not require simulcast operation.

Automatic Vehicle Location (AVL) will be accommodated via Global Position System (GPS) receivers mounted in all trucks and automobiles that require this function. The infrastructure for this feature will be supplied through the Mobile Data System.



The coverage footprint for AVL should be nearly identical to that for the Mobile Data System.

The design for the Connectivity Network is envisioned as a combination of PCWIN-owned microwave links, County or City owned fiber-optic lines, and leased lines. The network is designed as an overlay of interconnecting rings with only a few spurs to remote sites. The interlocking rings will provide ultra-high reliability for quickly and efficiently routing voice and data calls to the proper sites.

We have also described the general requirements for the physical facilities to house the communications equipment. Particular attention must be paid to the structural, electrical and HVAC requirements at each location.

CTA recommends that the PCWIN users review the Conceptual Design looking to the systems ability to solve the majority of their communications problems.



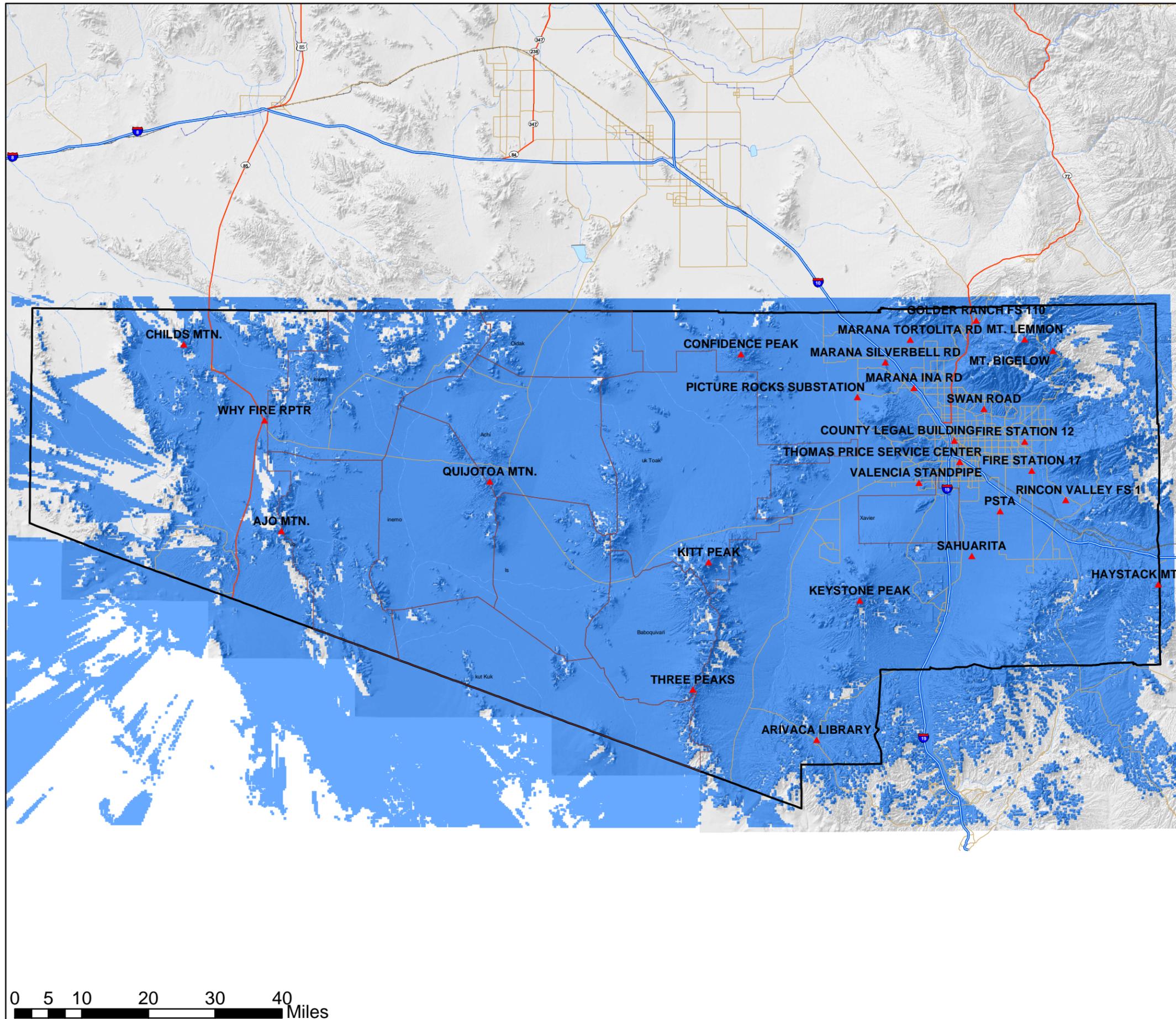


Figure 1 Portable Radio Coverage

Client: PCWIN

Commission No. 20099A

Voice System Coverage Prediction

700/800MHz Portable (Balanced)

Portable on the Street

- Sites:** Tucson Simulcast Cell
 Marana Simulcast Cell
 Childs Mountain
 Why Fire Repeater
 Ajo Mountain
 Quijotoa Mountain
 Kitt Peak
 Three Peaks
 Haystack Mountain
 Mount Lemmon
 Mount Bigelow
 Confidence Peak
 Keystone Peak
 Sahuarita
 Golder Ranch Fire Station 110
 Picture Rocks Substation
 Arivaca Library

MODEL: LONGLEY RICE 90/90 LULC - OFF

Coverage displayed on this document is the result of predictive statistical modeling based upon client provided parameters and USGS geographical data. Actual coverage as experienced by users in the field may vary due to interference, multi-path fading, and other random effects.

Design: DRA 12 July 2006

Drawn: TRM 30 January 2007

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 20099A - Business Architecture Planning\
 word-rpt\Concept of Operation\Portable Radio Coverage.pdf

Revised:

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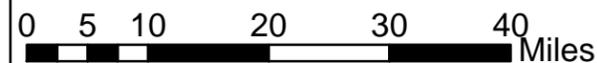


Figure 2 Sites Location

Client: PCWIN

Commission No. 20099A

Sites: County Legal Building
 Thomas Price Service Center
 Swan Road
 Fire Station 12
 Fire Station 17
 Valencia Standpipe
 Public Safety Training Academy
 Rincon Valley Fire Station 1
 Marana Ina Road
 Marana Silverbell Road
 Marana Tortolita Road
 Childs Mountain
 Why Fire Repeater
 Ajo Mountain
 Quijotoa Mountain
 Kitt Peak
 Three Peaks
 Haystack Mountain
 Mount Lemmon
 Mount Bigelow
 Confidence Peak
 Keystone Peak
 Sahuarita
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