

TRWC/RWC  
Reconfiguration Requirements,  
Alternatives, Recommendation and  
Project Timeline

## Executive Summary

The pending re-configuration of the PRWN/TOPAZ Trunked Radio System presents challenges in satisfying both day-to-day operability as well as interoperability requirements. This document defines those requirements, both operational and technical; and, offers several technical alternatives to fulfill the needs identified by the various user groups – Fire, Police, and Public Works.

Critical requirements identified by the Police Department include:

- Ability to communicate on a day-to-day basis with dispatch as well as between units.
- Ability to participate in undercover operations and joint task force activities throughout the Phoenix metro area.
- Ability to operate on interoperability talkgroups throughout the Phoenix metro area.
- Ability to backup other dispatch centers as well as have backup for Mesa dispatch.
- Air unit communications capability with all police agencies.

Critical requirements identified by the Fire Department include:

- Limited roaming capability throughout the PRWN/TOPAZ system.
- Adequate coverage throughout TOPAZ.
- Availability of tactical talkgroups.
- Medical channel support
- Support for Digital Vehicular Repeater Systems to improve in-building coverage.

Public Works requires:

- Effective communications for day-to-day activities.
- Communications capabilities to support mutual aid agreements with other utilities.

Several technical solutions are possible to provide communications capabilities that satisfy many of these stated requirements. These solutions include shared talkgroups, additional communication sites, back-to-back consoles and console patches as well as other variants. A multi-faceted approach is recommended to satisfy user needs in a re-configured TOPAZ radio system. This approach includes the following elements:

- Acquire the necessary core infrastructure to reconfigure TOPAZ as a standalone system;
- Develop an additional high elevation communications site in west Phoenix to support street-level coverage in the Phoenix area for TRWC operations; and
- Implement interoperability with the RWC using console attached control stations and shared interoperability talkgroups.

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# **Operational Requirements**

## **Police Department**

Operational public safety communications are critical to the mission of the Police Department. To be considered effective, they must be reliable, consistent and provide for functional interoperability. Listed below are three prioritized categories of separation needs for the Mesa Police Department Operations Bureau regarding the radio communications system. These categories range from basic capabilities required for day-to-day operational needs(Priority One) to additional, desirable capabilities (Priorities Two & Three) that would enhance the Police Department's communications capabilities.

### **Priority One (Required Operational Capabilities):**

1. Day to day patrol channels for Mesa Police to communicate with Mesa Dispatch and each other.
2. Unmarked units' ability to communicate with each other and Mesa Dispatch throughout work areas in the entire Phoenix-Mesa metro area. This would be up to one hundred fifty units.
3. Traffic units involved in interagency task force operations to communicate with each other and Mesa Dispatch throughout the Phoenix-Mesa metro area.
4. Air units' ability to communicate with all police agencies only if they are permitted to leave the City of Mesa in the future.
5. IGA for the use of another agencies' communications center to serve as a backup communications center in the event the Mesa Public Safety Communications (PSC) Center is not operational.
6. IGA allowing access to interoperability channels for joint agency use throughout the Phoenix-Mesa metro area.
7. Mesa Police Tactical Team units' ability to communicate with each other and Mesa Dispatch in the entire Phoenix-Mesa metro area.

### **Priority Two (Additional, Desirable Operational Capabilities):**

1. Jail transports' ability to communicate with each other and Mesa Dispatch.
2. Traffic units' common radio channel for Phoenix-Mesa metro task force operations.
3. Air units' ability to communicate with all police agencies in the Phoenix-Mesa metro area.

### **Priority Three (Ideal level of Operational Capability):**

1. All Mesa units' ability to talk on every Police and Fire radio channels in the Phoenix-Mesa metro area.

## **Public Safety Dispatch**

The Mesa Public Safety Dispatch Center has identified the following operational requirements:

### **1. Roaming**

Currently, Mesa Police Department(MPD) units are able to utilize a number of “Wide Area” talkgroups that roam into areas covered by the Phoenix PRWN Radio system. These units are able to communicate between each other and Dispatch, with similar reliability as they experience in Mesa. With the separation, roaming will no longer be allowed for day-to-day activities such as surveillances, pursuits, jail transports, officers attending court in Phoenix, etc. Additionally, any officers assigned to special details or task forces based outside of Mesa, such as ACTIC, will no longer be able to communicate with Mesa PD Dispatch or field units from the work assignments.

The inability to roam will also hinder participation in large-scale events taking place across and outside of the Valley. This will be further addressed in Interoperability.

The current limitation of the TOPAZ system is approximately 24<sup>th</sup> St. in Phoenix for Simulcast D, with Thompson Peak providing additional coverage west for talkgroups that are wide-area. Thompson Peak, while providing radio coverage for a good portion of Phoenix, is shadowed by numerous mountains as you go further west and north.

### **2. Programming**

With the re-configuration of the TOPAZ radio system, all radios currently in use by MPD will need to be re-programmed. With over 2000 radios, this will prove to be a time consuming proposal. Templates need to be developed allowing limited interoperability between Phoenix and Mesa (agreements not yet in place for post-separation), after which all portable and mobile radios will need to be programmed.

### **3. Interoperability**

Re-configuration of TOPAZ as a standalone radio system of the systems will have a severe impact on interoperability. Currently, any radio programmed for use on the TOPAZ or PRWN system has common decks/talkgroups that can be used by Public Safety for any events requiring multiple agencies to respond. These talkgroups have been used for demonstrations, DUI task forces, major events such as the New Years Block Party in Tempe, and most notably, the Super Bowl. The joint TOPAZ and

PRWN systems allowed for quick, convenient and reliable communications between all users.

Post-separation, Mesa will maintain Interoperability decks for use in the east valley (Mesa, Gilbert, Apache Junction, Queen Creek and any other municipalities that join the TOPAZ system) and Phoenix will maintain a separate set of Interoperability decks for use in areas covered by the PRWN system. Agreements will need to be reached by Mesa and Phoenix on the use of the Interoperability talkgroups, to include programming each radio issued into both systems. This solution will allow end users to communicate with each other, but will take the dispatch centers out of Communications if the event is not being worked in their city.

#### **4. Dispatch Center Back Up Functions**

Currently, the cities of Mesa and Phoenix have an agreement to act as reciprocal backup dispatch centers in the event of an emergency or failure of either center. Mesa ended a similar arrangement with Maricopa County Sheriff's Office in favor of the City of Phoenix for numerous reasons, including the fact that Mesa dispatchers could work in Phoenix and still dispatch units in Mesa through the combined TOPAZ/PRWN radio system. With the separation of the systems, we will no longer be able to fully utilize Phoenix as a backup center, as there will be no radio communications from the Phoenix center to the City of Mesa, and vice versa. 911 calls will still be answered in the backup center, but alternative radio communications will need to be developed.

### **Fire Department**

Fire services in the valley operate under an "Automatic Aid" agreement that eliminates jurisdictional boundaries for public safety emergency response. This response model assigns the closest emergency response unit to all 911 calls for assistance to greatly enhance service delivery and reduce response times. To realize maximum efficiency from the automatic aid response plan, effective interoperable communications are required.

Operational requirements for the Fire Department:

#### **1. Roaming**

Roaming is not a primary operating function within the operational structure of the fire automatic aid system. Typically fire units are dispatched and assigned an operational channel for each incident. This scenario covers the majority of the communication needs for the fire system. There will be opportunities and needs for roaming within the fire system. To cover this need, TOPAZ/PRWN will identify and

dedicate specific channels for wide area coverage across the TOPAZ/PRWN system through intergovernmental agreement.

## **2. Area Coverage**

TOPAZ will perform a coverage study to determine actual coverage capability for simulcast D. This study will identify the basic boundary for 12dB in building coverage and portable radio street coverage.

## **3. Tactical Incidents**

All single unit incidents and all multiple unit tactical incidents shall be assigned tactical channels as geographically located within either the TOPAZ or PRWN system. This will support operational consistency and reduce communication errors on emergency scenes.

## **4. Medical Channels**

TOPAZ will review system application and begin to transfer to 800MHz for hospital communications.

## **5. DVRS**

TOPAZ will review and consider a programming agreement with PRWN.

The Mesa Fire Department foresees the following challenges resulting from a re-configured, standalone TOPAZ radio system:

1. Firefighter training
2. Dispatch training
3. Unit I.D. monitoring across PRWN/TOPAZ
4. Radio reprogramming
5. Redesign of the talkgroup plan

## **Public Works**

The Mesa Public Works Departments have identified the following operational requirements that are needed to effectively perform their job functions in a post re-configuration environment:

### **1. Communications Capabilities to support Mutual Aid Agreements**

A valley-wide communications capability in support of existing and future mutual aid agreements will be necessary in a re-configured TOPAZ system. This capability has the potential to be critical in the event Public Service and/or Utilities are activated through a mutual aid agreement, whether officially activated or in good faith.

City of Mesa Utility gas crews have already experienced this in assisting Southwest Gas with a major gas outage in west Phoenix. Radio communications were patched through City of Phoenix to Mesa in order for Mesa staff to talk to each other and our Mesa Utility Control Center which greatly assisted the assignment, reporting and documenting of the work. In additional, all radio communications were monitored and recorded.

Mesa Utilities also has similar mutual assistance agreements with SRP and is in the early stages of creating agreements with other valley and state water agencies.

### **2. Interoperability**

The ability to communicate with mutual aid partners, as well as the Utility Control Center, will become even more important as additional mutual aid agreements are created.

## **Recommendations**

The Appendix of this document describes several alternatives that address operational needs expressed by the users of the TOPAZ radio system. These alternatives range from relatively simple methods to quite complex. As might be expected, the associated capabilities and costs for each alternative track the level of complexity as well.

The recommended approach to satisfying the TOPAZ radio system users' operational requirements is as follows:

- Acquire the necessary core infrastructure to allow the TOPAZ radio system to be reconfigured as a standalone radio system. This will provide the greatest level of autonomy and allow the TRWC to manage its own radio communications capabilities

and control the costs associated with the operation and maintenance of the radio system.

- Develop an additional high elevation site in west Phoenix to support street-level coverage in the Phoenix area for TRWC operations. This site would provide needed radio coverage without relying on the RWC.
- Implement interoperability with the RWC using console attached control stations with shared interoperability talkgroups.

(Note: Implementation of a control station interoperability solution would not preclude the use of an ISSI(Inter-SubSystem Interface) at some point in the future.)

### **Cost Estimate for Recommended Approach**

- Re-configuration as Standalone Radio System: **\$700,000**
  - Funding Source: Mesa Public Safety Bonds
- High Site development: **\$550,000**
  - Funding Source: TRWC
- Control Station Interoperability Solution: **\$10,000 per control station**
  - Funding Source: Each individual TRWC agency. Control stations installed at each TRWC member's dispatch center as needed.
- Subscriber Reprogramming: **\$95,000** (3800 radios \* \$75/hour \* 1/3 hour/radio)
  - Funding Source: Each individual TRWC agency

### **Implementation Timeline**

On January 16, 2009, Motorola provided a high-level schedule that covers the tasks associated with re-configuring TOPAZ to be a standalone system. According to their schedule, it would take approximately six months to complete this work. A six month timeframe would also be feasible for construction of a new high site **provided** all lease arrangements/co-location agreements are in place. Implementation of the control station interoperability solution is feasible in this timeframe as well. It will require identifying what interoperability talkgroups are desired and acquiring/installing the necessary hardware at the various dispatch centers.

## **Appendix**

### **Current Status:**

Currently, Mesa PD enjoys valley-wide roaming on specific wide-area talkgroups. This roaming capability allows officers to conduct police activities (investigations, surveillance, warrants, pursuits, etc.) anywhere in the Phoenix metropolitan area while still having communications capability back to Dispatch. This capability allows Mesa to participate in multi-jurisdictional talkgroups with seamless interoperability.

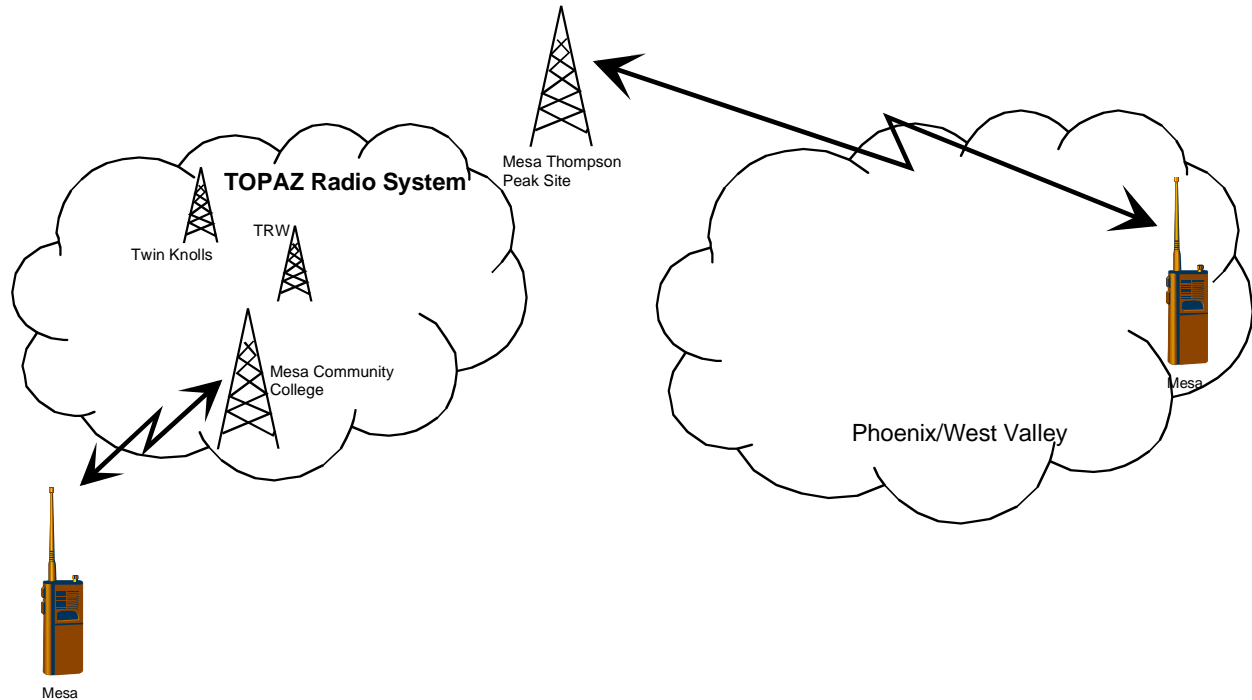
Mesa Fire and its dispatch partners (Town of Gilbert, City of Apache Junction, Apache Junction Fire District and the Town of Queen Creek) currently operate on a separate radio system (TOPAZ) from the rest of the valley automatic aid partners (those dispatched by Phoenix Fire). This requires switching to a different radio system when responding to an event in the other dispatch service area. Roaming capability has not been a major benefit for Mesa Fire.

### **Problem:**

Re-configuration of the PRWN/TOPAZ radio system will eliminate automatic, seamless, roaming capability by forming two separate systems. Alternatives will need to be evaluated and implemented to support the operability/interoperability requirements identified by the various user groups.

## **Day-to-day Operability Alternatives:**

There are several alternatives that could restore some of the wide area capability that would be lost by separating the existing radio system. These alternatives are outlined in the graphics that follow:



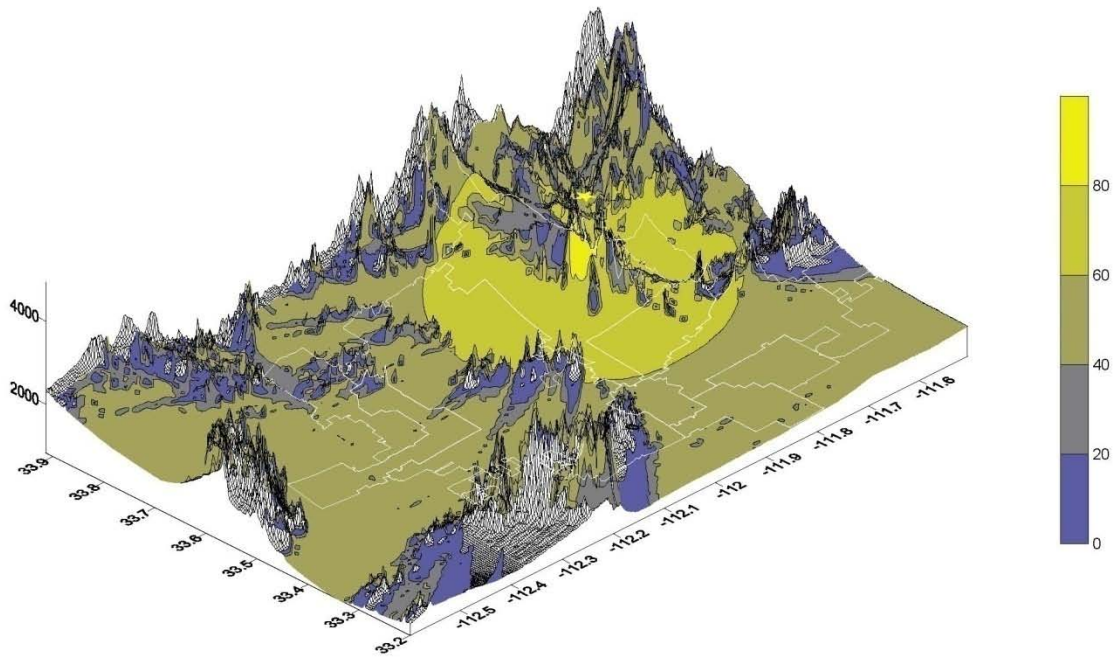
**Use existing TOPAZ high elevation Thompson Peak Site to provide Wide-area On-street Coverage.**

### **Requirements:**

- ❑ Configure wide-area talkgroups in system and subscriber programming to use Thompson Peak.
- ❑ No additional infrastructure required unless channel capacity at Thompson Peak becomes an issue. The Thompson Peak site is already part of the TOPAZ infrastructure.

### **Impact:**

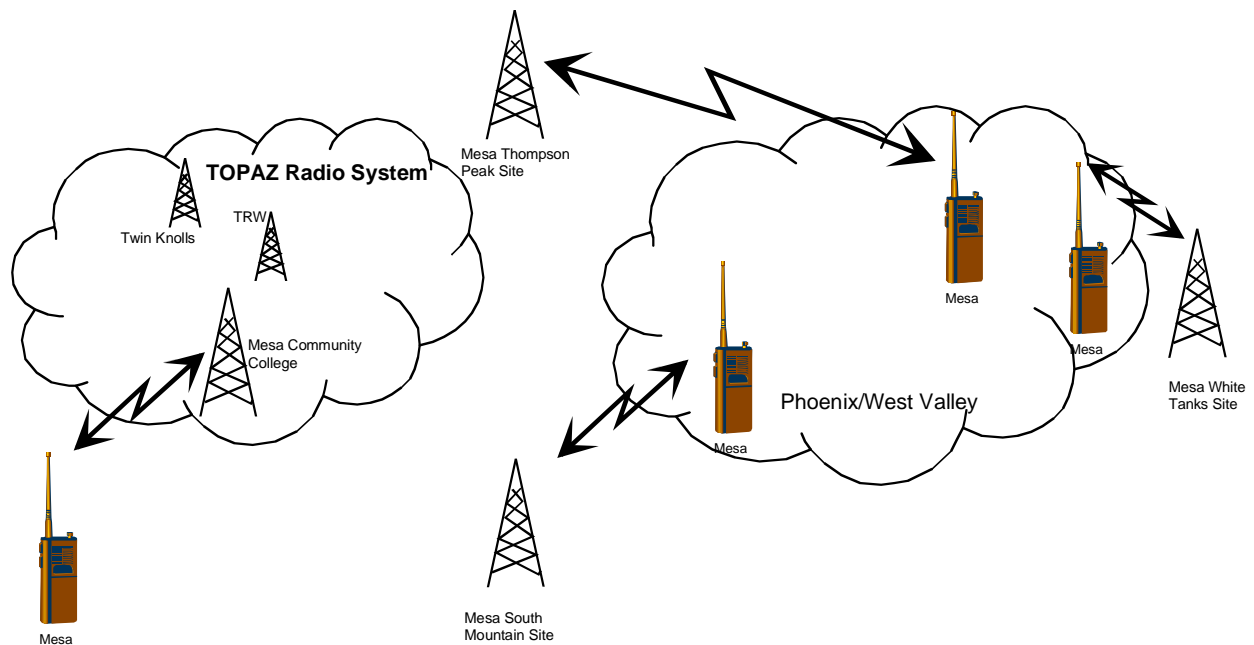
- ❑ There will be some areas that are shadowed and will not have coverage from Thompson Peak.
- ❑ Signal levels will be lower and will provide on-street coverage in lieu of in-building coverage.
- ❑ Communications back to Dispatch is maintained.



Thompson Peak 800 MHz Predicted Coverage  
 Longley-Rice Poor Conditions (LR 90/90) model  
 ERP=100W Antenna Elevation=50 ft

Thompson Peak 800 Cov Topo.srf

**Predicted Thompson Peak Coverage (Minimum Acceptable On-Street Mobile Coverage > 40 dBu)**



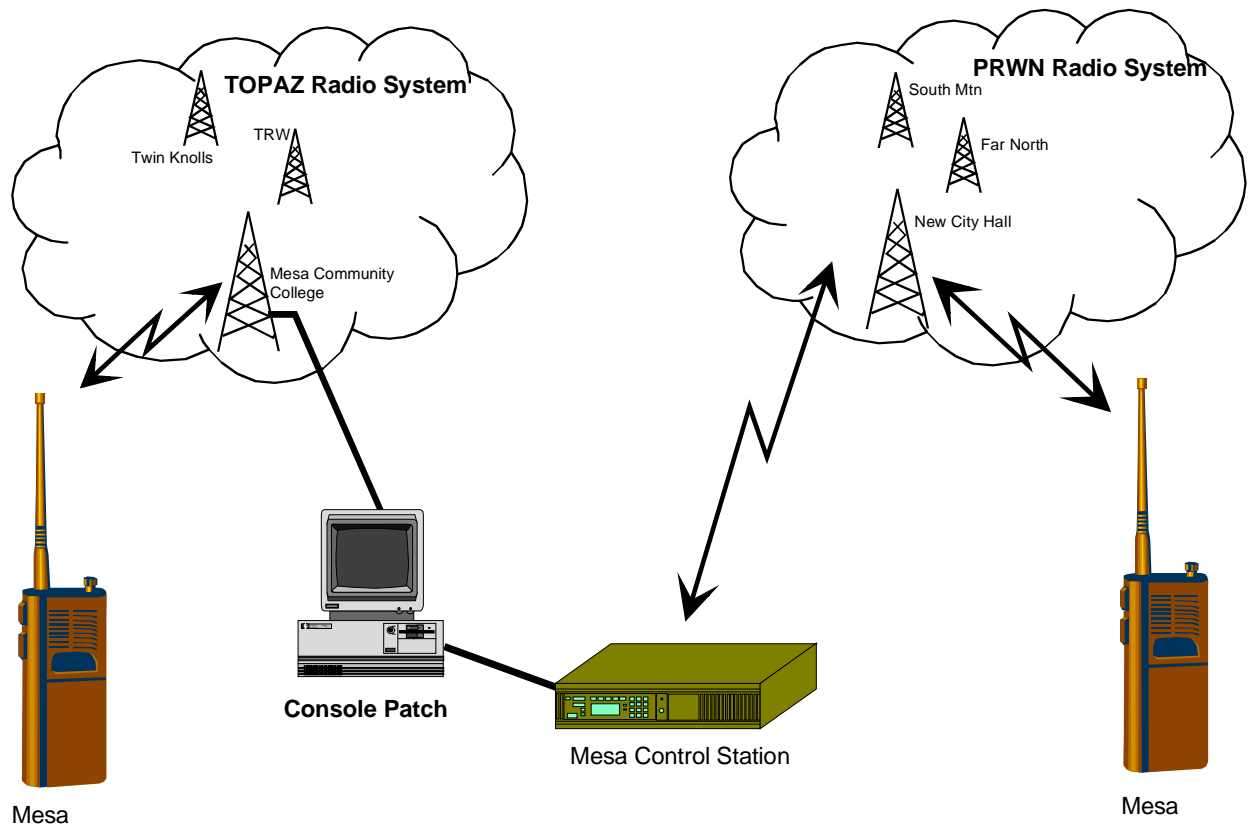
### Add Additional High-Elevation Transmitter Sites to the TOPAZ Infrastructure

#### Requirements:

- ❑ Develop additional high-elevation transmitter sites (e.g. South Mountain, White Tanks) and integrate them into the TOPAZ infrastructure.
- ❑ Acquire necessary frequencies for these sites.

#### Impact:

- ❑ Cost.
- ❑ Site availability.
- ❑ Frequency availability.
- ❑ Will provide on-street coverage, not in-building.
- ❑ Will provide communications back to dispatch.
- ❑ Will fill in coverage holes in Thompson Peak coverage.



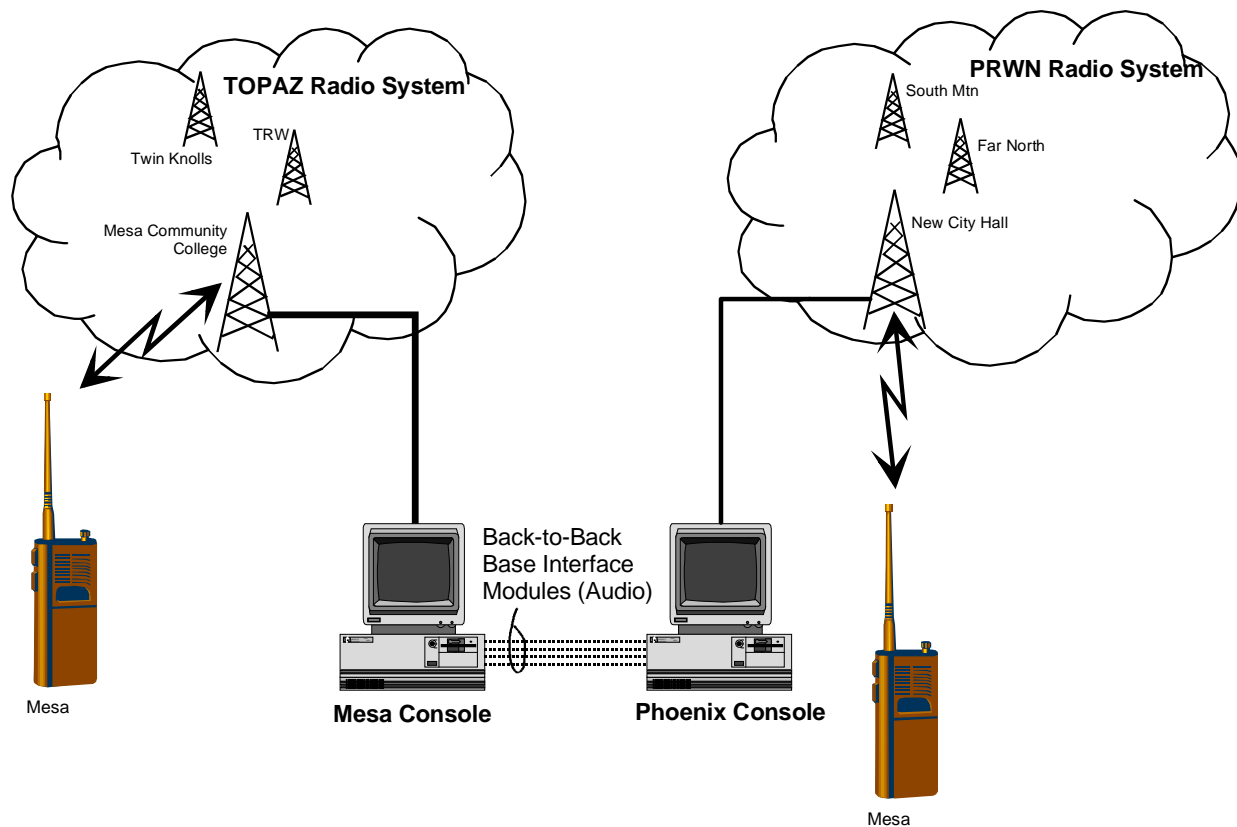
**Use PRWN provided talkgroup when in Phoenix**

**Requirements:**

- ❑ Acquire talkgroups from PRWN.
- ❑ Program both systems into subscriber unit.
- ❑ Acquire and install control station(s) programmed to PRWN talkgroups and use console patch to patch these talkgroups to TOPAZ talkgroups if desired.

**Impact:**

- ❑ Provides in-building coverage when in Phoenix/West Valley.
- ❑ Provides communications with dispatch.
- ❑ Would require a control station for every talkgroup that would operate concurrently which could impact console resources.
- ❑ User would need to manually switch to PRWN talkgroup when in Phoenix/West Valley.



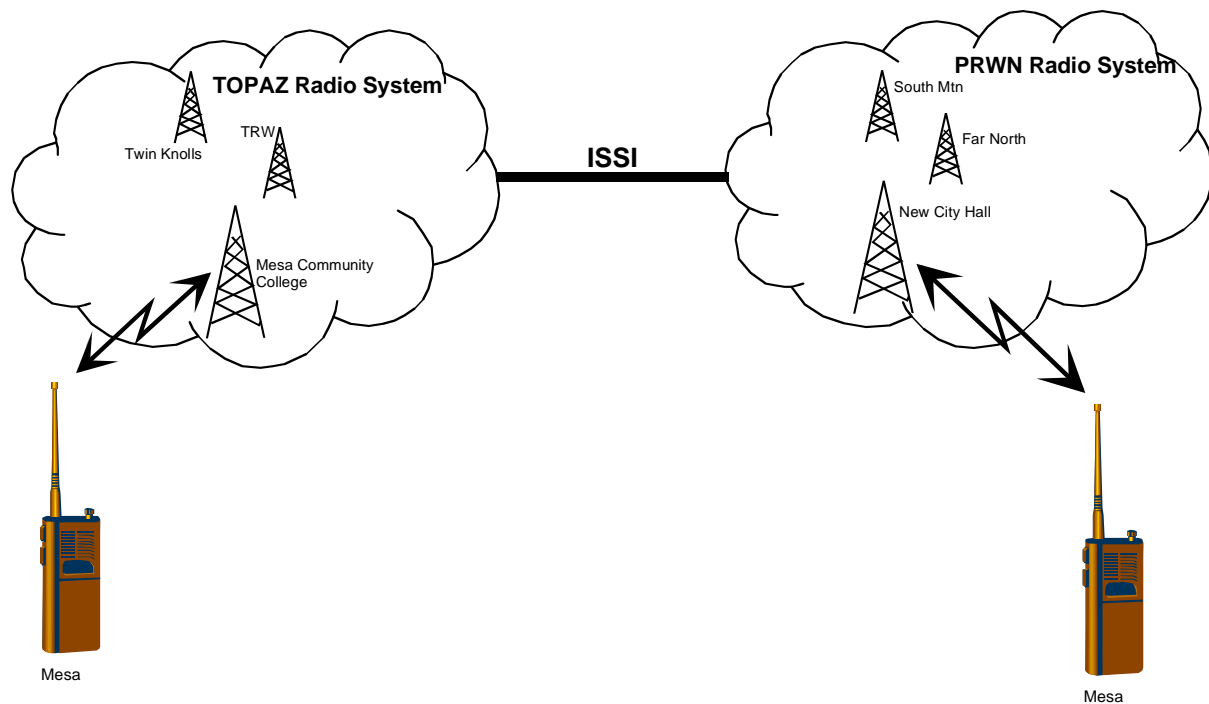
### Use Back-to-Back BIMS

#### Requirements:

- PRWN talkgroups required.
- Console resources (BIMS) required.

#### Impact:

- In-building coverage available when in Phoenix/West Valley.
- Communications back to dispatch available.
- Would require back-to-back BIMS for all concurrently used talkgroups. This could impact console resources.
- Subscriber would need to be programmed with both systems.
- User would need to manually switch to PRWN talkgroup when in Phoenix.



**Use the ISSI (Inter-Subsystem Interface) to link PRWN and TOPAZ**

**Requirements:**

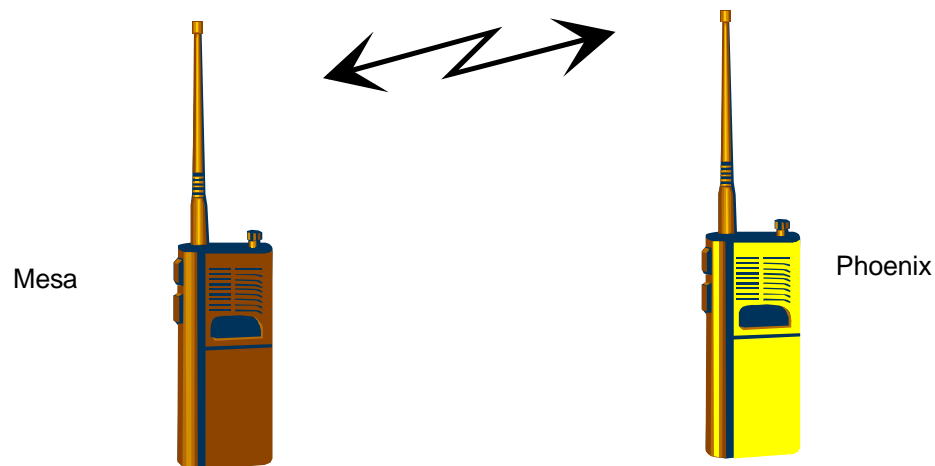
- ❑ Purchase the Inter-Subsystem Interface(ISSI) and install between PRWN and TOPAZ.
- ❑ Configure each system to allow roaming via the ISSI interface.

**Impact:**

- ❑ Provides in-building coverage when in Phoenix/West Valley.
- ❑ Provides communication back to dispatch.
- ❑ Requires upgrades to control channel and subscriber programming.
- ❑ Standardized solution. Allows disparate P25 systems to be inter-connected.

## **Interoperability Requirements:**

The need for interoperability with Phoenix and other agencies can be satisfied with the same alternatives that support Mesa's operational needs. In addition to these alternatives, there are additional options as described in the following pages:



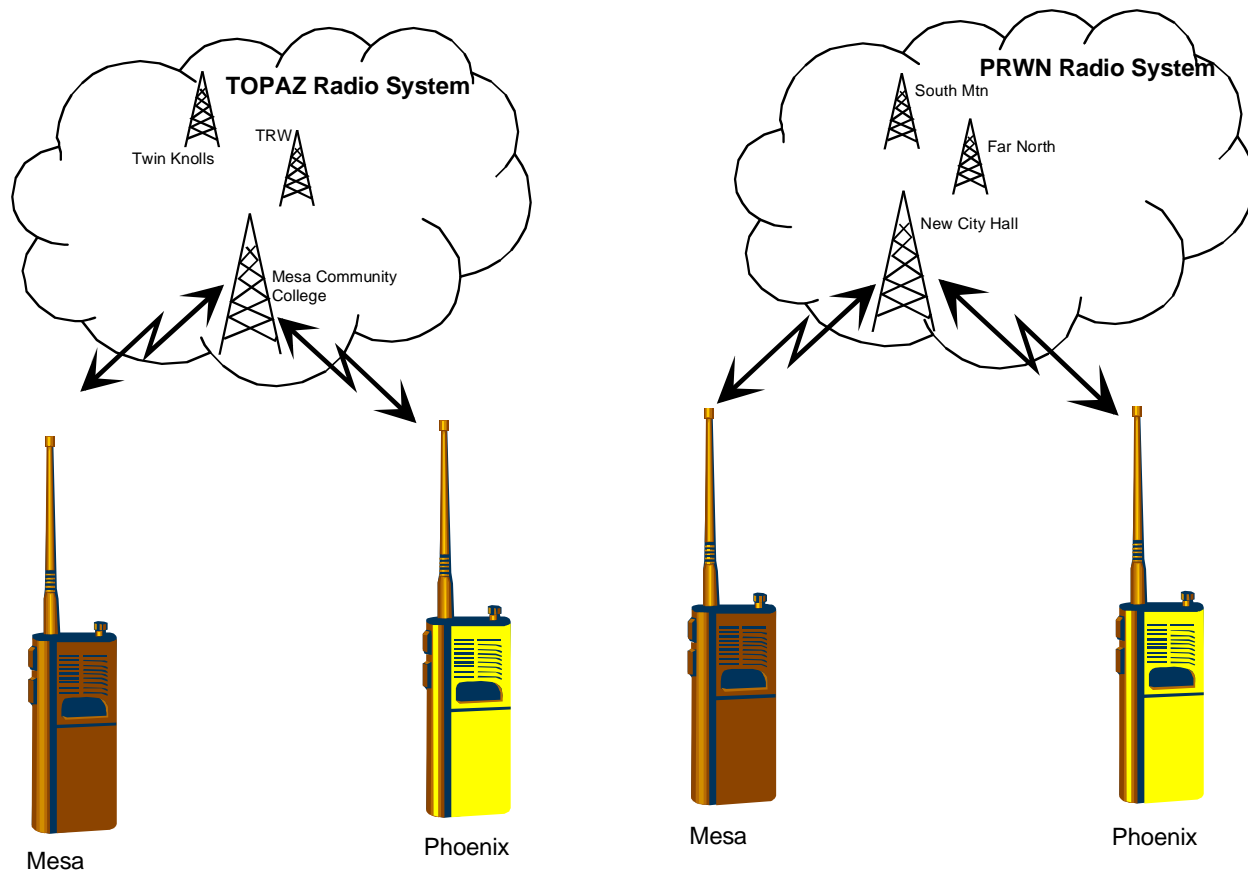
### **Basic Interoperability – Direct Radio-to-Radio**

#### **Requirements:**

- ❑ Compatible radios with the same RF channels in each radio.

#### **Impact:**

- ❑ Not physically or economically feasible to have every radio able to talk to every other radio (not like cell phones). This is what everyone has in mind when they think of “interoperability” but is not the reality today. This functionality does not exist.



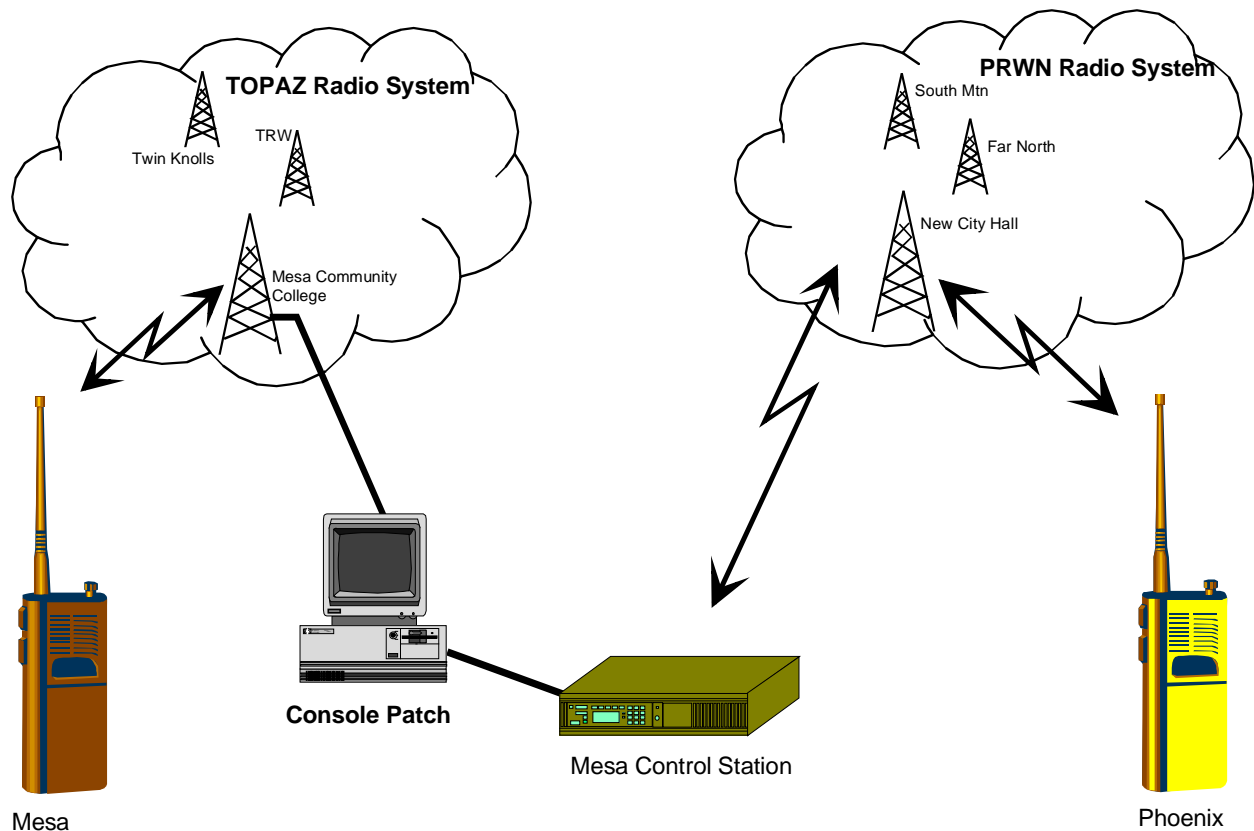
### Separate Radio System Interoperability – TOPAZ and PRWN separated

#### Requirements:

- ❑ Each agency must program its radios to allow operation on the other agency's system.
- ❑ Preplanned talkgroups (channels) must be programmed into the radios.

#### Impact:

- ❑ Loss of seamless roaming.
- ❑ Can't communicate with home dispatch center when operating in the other City's system. Can remedy with console patches.
- ❑ Can alleviate roaming loss with console patches. This method has been used in the past to support DUI taskforce, presidential debates, etc. Can also expand radio coverage by using existing high sites and/or installing additional sites in the other City's coverage area.



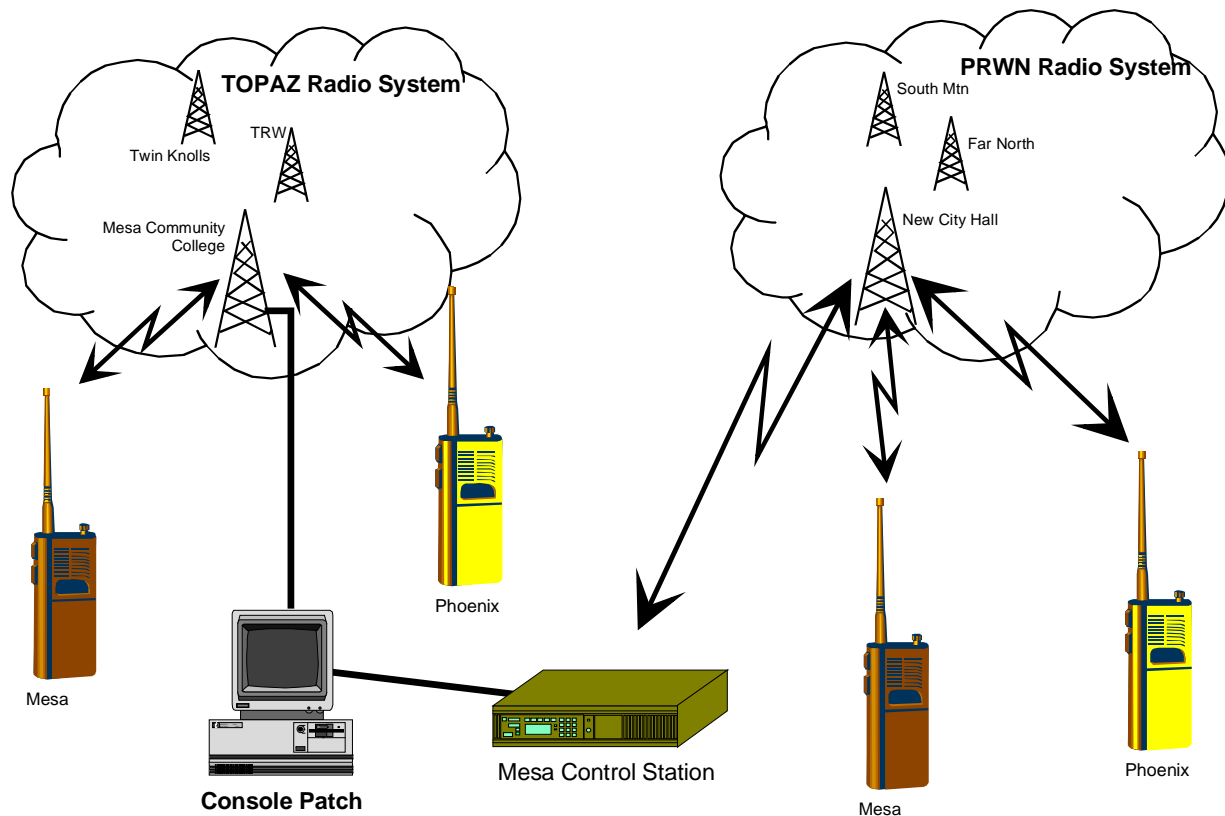
**Interoperability using a console patch** – A dispatcher can tie radios operating on different radio systems together using a “console patch”

**Requirements:**

- ❑ A radio must be programmed with an interop talkgroup (channel) on the other agency’s system. This radio will be used to “patch” the dispatcher’s agency to the other agency’s radio system.
- ❑ There must be overlapping radio coverage by both systems in the geographic area where interoperability is desired.

**Impact:**

- ❑ Have used this method on several occasions to tie Tempe radio system users to PRWN/TOPAZ radio system users (e.g. DUI task force, presidential debates, etc.).



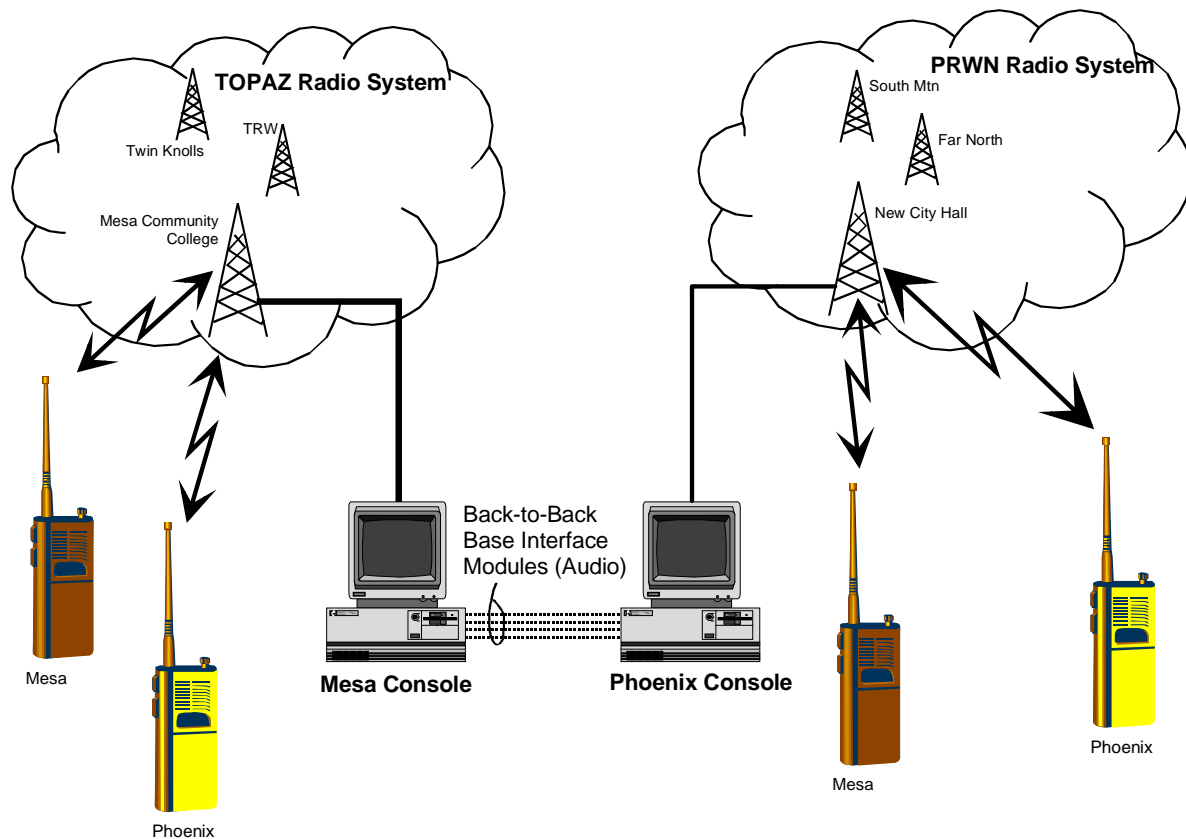
**Separate Radio System Interoperability - TOPAZ and PRWN maintain independence, console patches used to provide Dispatch Center connectivity.**

**Requirements:**

- ❑ Each agency must program its radios to allow operation on the other agency’s system.
- ❑ Preplanned interoperability talkgroups (channels) must be programmed into each agency’s radios.
- ❑ A radio must be programmed with an interop talkgroup (channel) on the other agency’s system. This radio will be used to “patch” the dispatcher’s agency to other agency’s radio system.
- ❑ There must be overlapping radio coverage by both systems in the geographic area where interoperability is desired.

**Impact:**

- ❑ Console patches must be used to communicate with Mesa Dispatch when the subscriber is operating on PRWN.
- ❑ This method has been used in the past to support the DUI taskforce, presidential debates, etc. Can also expand radio coverage by using high sites and/or installing additional sites in the other agency’s coverage area.
- ❑ Provides redundancy in Valley communications in the event of a major disaster.



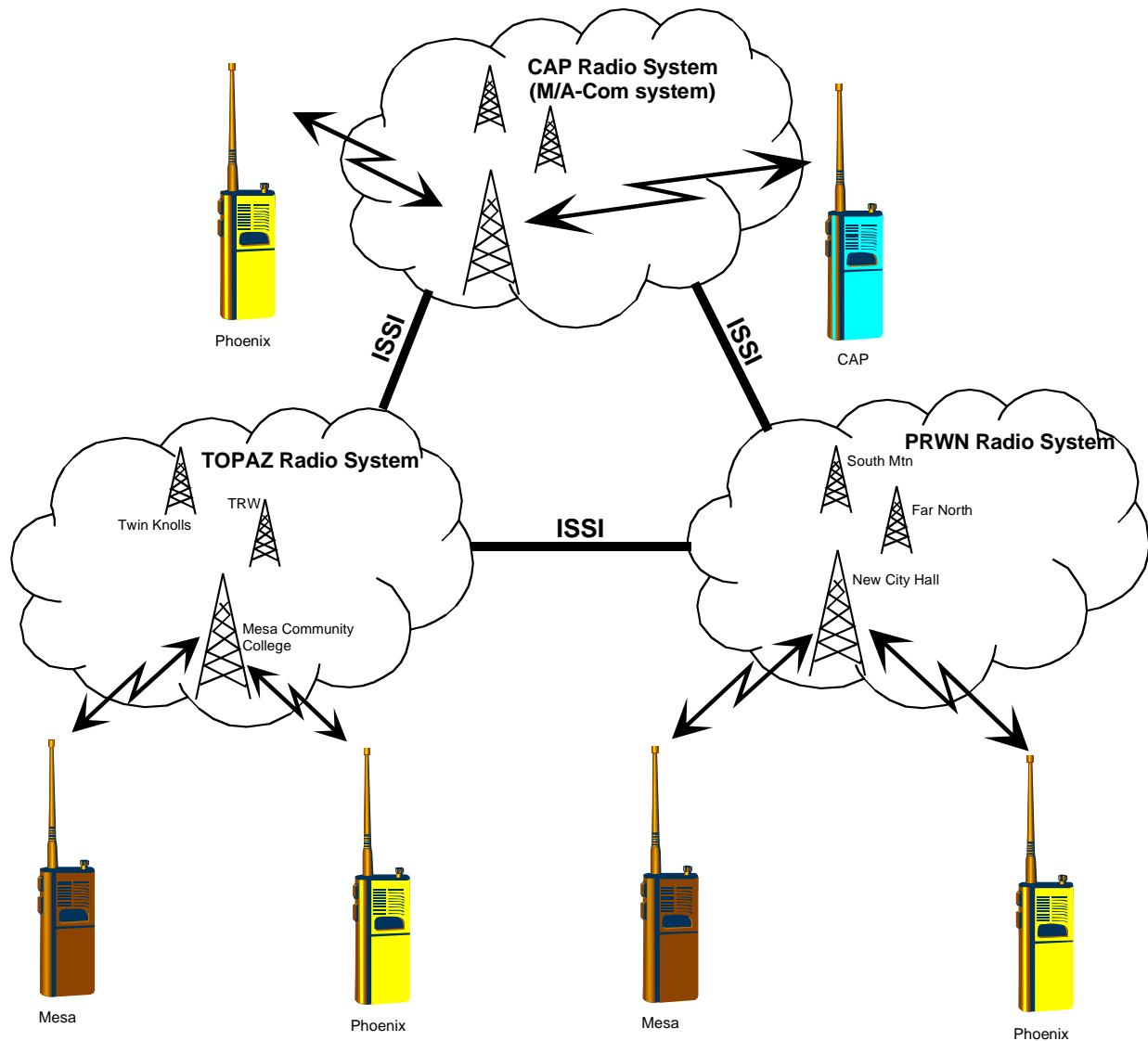
**Separate Radio System Interoperability** – TOPAZ and PRWN maintain independence, back-to-back base interface modules are used to provide Dispatch Center connectivity. This connectivity is at an audio level which is transported between the two systems via a microwave connection.

**Requirements:**

- ❑ Each agency must program its radios to allow operation on the other agency’s system.
- ❑ Preplanned interoperability talkgroups (channels) must be programmed into each agency’s radios.
- ❑ Each agency must dedicate one or more BIMS to be connected to the other agency’s BIMS. These BIMS will provide audio connectivity and can be patched to talkgroups on each system.
- ❑ There must be overlapping radio coverage by both systems in the geographic area where interoperability is desired.

**Impact:**

- ❑ Console patches must be used to communicate with Mesa Dispatch when the subscriber is operating on PRWN.
- ❑ Unit ID and emergency alert information is not carried over the back-to-back BIMS.



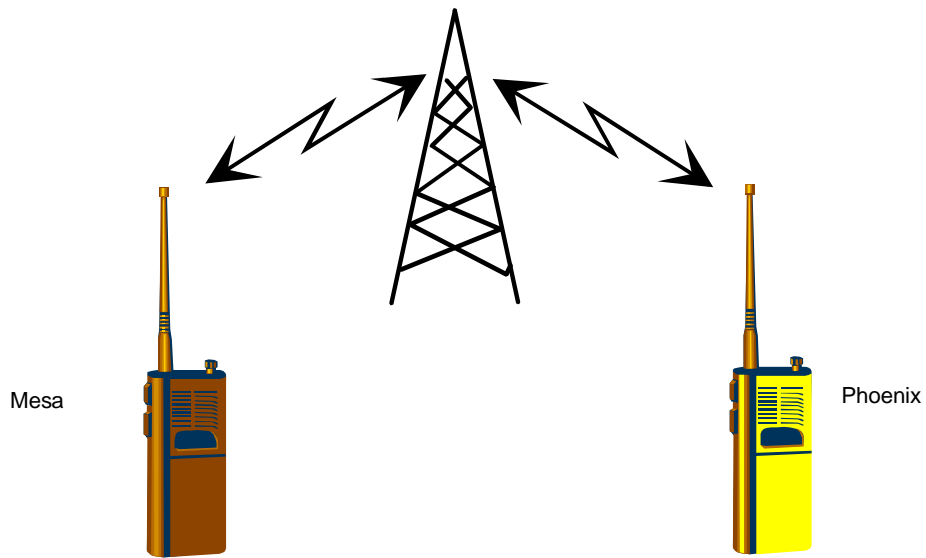
## Separate Radio System Interoperability using the Inter-Subsystem Interface (ISSI)

### Requirements:

- ❑ The ISSI must be in place and each system configured to use it.
- ❑ Pre-planned interop talkgroups (channels) must be programmed into the radios.

### Impact:

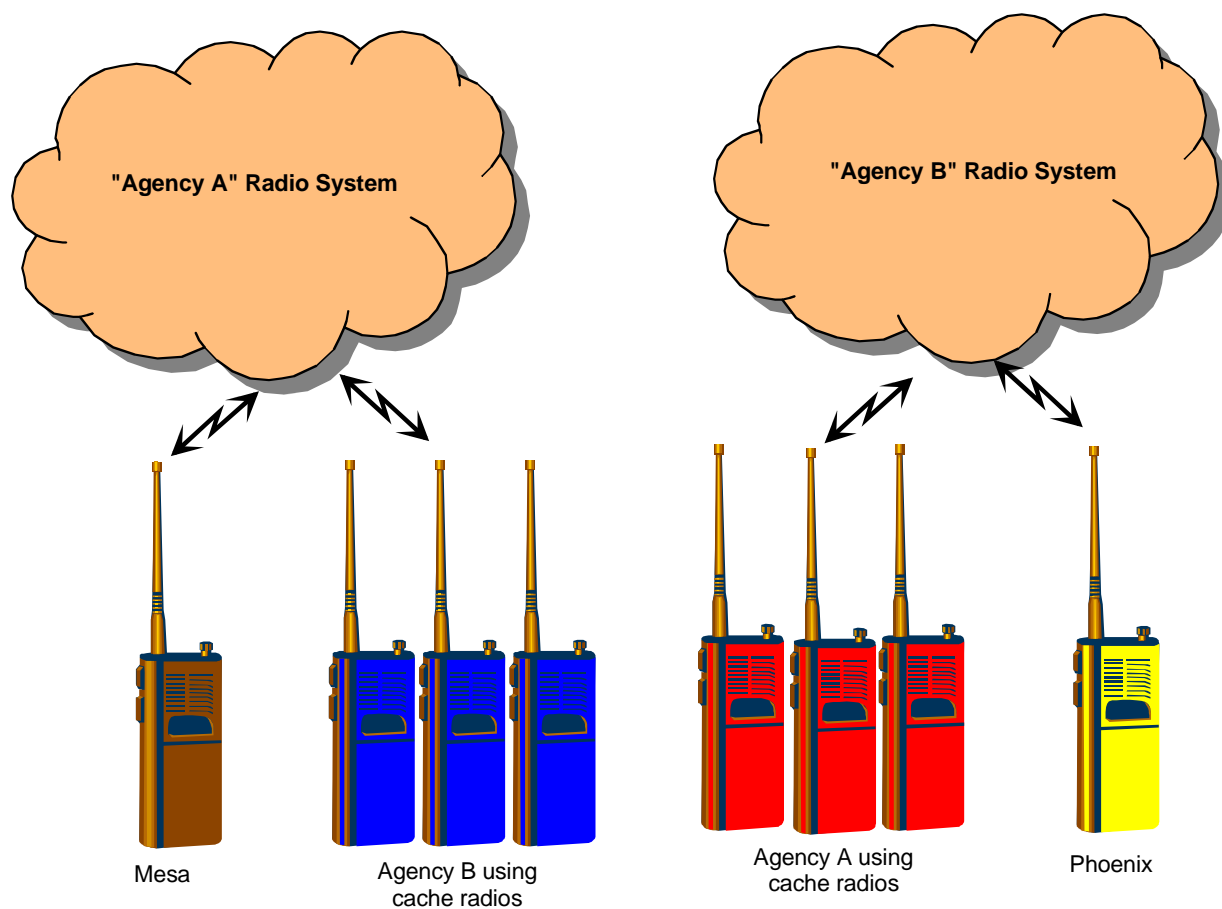
- ❑ Supports seamless roaming.
- ❑ Supports radio systems from multiple manufacturers.
- ❑ Standard P25 implementation
- ❑ Requires upgrades to the control channel and subscriber programming



### **Interoperability using Mutual Aid Channels**

#### **Requirements:**

- ❑ Mutual Aid channels must be programmed into radios (FCC requirement).
- ❑ Can use mutual aid repeaters that Mesa installed on South Mountain. This is a separate system that can be used by all agencies in the valley.



**Separate Radio System Interoperability using cache radios**

**Requirements:**

- Agencies maintain a cache of radios that can be used during emergencies. These radios would be distributed to visiting first responders assisting with the emergency. DOJ has funded three of these caches to date in the valley.