System Administrative Issues – One of the concerns, impacted by both technical and administrative issues, is the current capacity of both the Oakland and EBRCS networks. Some of the problems related to system dispatch management are self-inflicted, such as the number of dispatch position assigned on the night shift. RCC has commented on this and believes there are actions being taken.

Currently, we believe both the Oakland and EBRCS networks are provisioned to support existing traffic and in the case of EBRCS, the NW simulcast cell was designed and provisioned to support additional traffic from Oakland users. Given future growth and the potential of adding wireless call response in Oakland this could significantly add traffic to the Oakland system and would need to be addressed by EBRCS. At this time we see nothing that would prohibit Oakland from moving over to EBRCS based on system capacity.

Dispatch and Network Compatibility Issues – As discussed there are issues with the Harris P7200 both in condition and to some extent the digital application, but as outlined in this Report the P7200 could be used on the EBRCS network with minor operational issues that could be addressed.

The dispatch aspect of a move to EBRCS includes an offer from EBRCS to provide new consoles (Motorola) to integrate the Oakland dispatch into the EBRCS (Motorola based) network.

Fortunately, both EBRCS and Oakland use logging recorders manufactured by the same company (Nice Systems, Inc.). It has been stated that if Oakland moved to EBRCS that they would be able to maintain control and administrative authority over their logging records and support search and retrieval from the current Oakland facility. Oakland currently has dual redundant recorders at Police and Fire dispatch. To duplicate this on the EBRCS platform would require networking the City's logging recorder services with the EBRCS logging recorder service for parallel operations.

Interoperability is one category where EBRCS provides the preferred solution, according to the SAFECOM™ Continuum model. As defined, the best interoperability is provided over a common radio platform. However, APCO P-25 is supportive of different radio systems from different manufacturers interfacing with each other as long as they are compliant with the P-25 standard. Clearly this is possible with the Oakland and EBRCS platforms.

On the other hand, it should be noted that at present, only the Oakland system has an Inter-RF SubSystem Interface (ISSI) in place to allow Oakland users to operate on the P25 system that BART is installing in their tunnel system. EBRCS would need to establish an ISSI relationship with BART in order to preserve that functionality. (There are presently no active plans to setup an ISSI between EBCRS and BART.)

Other systems such as the Siren and Microwave systems are addressed. In the case of the Siren system there are options to support this system in the event the City elects to move to EBRCS, though those solutions still need to be tested. We address the Microwave system separately below.

Fiscal Considerations – the financial ledger for this potential move has to be considered both in terms of real cost and value. The initial perspective is that upgrading and addressing limitations in the current Oakland system are significant and would pose a significant upfront cost. The largest cost component in either scenario would be the portable radio replacement. This could be managed over time and through attrition over several years, though RCC recommends that if the City chooses to move to EBRCS, the City should replace their radios as part of the cutover process. Another major investment beyond the identified radio infrastructure improvement at the radio sites is the investment in the Oakland Radio Shop in terms of training and tools to maintain the radio system. The City of Oakland has budgeted to

support the radio system both in terms of staff, equipment and reserve, but those funds need to be spent on hiring, training, and equipping City staff. Otherwise City funds will need to be spent to outsource those maintenance responsibilities.

The offer from EBRCS provides a onetime cost to join and a monthly charge per radio for joining the JPA and EBRCS. They have offered to provide new dispatch consoles and will support the change out of the Oakland radio fleet to EBRCS. Moving to EBRCS is less expensive initially but more expensive over time due to the recurring monthly cost.

From an overall perspective the City has three options to consider;

Option A: Move all units to EBRCS
Option A: Total five-year cost: $24,288,500.00

Option B: Stay on Oakland System
Option B: Total five-year cost: $20,016,500.00

Option C: Move Public Safety to EBRCS; keep Oakland for Backup and Pub Works
Option C: Total five-year cost: $22,222,500.00

Microwave System Assessment – The 11 GHz Aviat Microwave System is a significant, underutilized resource for the City of Oakland. If the City elects to move its radio system to EBRCS, this resource will stand virtually empty. There are options, which RCC has brought to light, where existing city data traffic that is currently being supported over leased service could be migrated to this platform independent of moving the radio system to EBRCS. The creation of a City owned wireless and wireline voice and data network should also be explored.

Currently, the City is having Aviat manage and monitor the network viability from their Network Operations Center (NOC). This microwave asset of the City is a state of the art, loop-protected microwave ring that covers the City of Oakland, connecting to several sites downtown, to the Eastmont PD facility and to each of the Oakland Radio Sites.

There is also a site located at Fire Station 25 that is part of this ring. This site has become problematic in that it has received significant opposition from the residents in the area and was not vetted with the community prior to construction. RCC has visited this site and has made several observations and is in the process of identifying alternate locations for consideration once this site is decommissioned.

It should be noted that the current EBRCS microwave network is a Harris TRuepoint™ high capacity (OC-3) microwave which is now manufacture discontinued. For Oakland to migrate to the EBRCS network would mean migrating off of the current Oakland 9 hop Aviat Eclipse 11 GHz self healing ring and moving on to the manufactured discontinued Harris TRuepoint system. The EBRCS microwave as currently configured supporting the Oakland service area has 3 out of 4 sites as spurs[7] off of the larger EBRCS network. This would be a step backward in overall system reliability for Oakland and be addressed before the City moves. EBRCS has identified the need to eventually replace the TRuepoint™

[7] A spur refers to a network architecture, in this case microwave, that provides just one path to a site and there for cannot be self healing by definition.

microwave equipment and this is planned for the future. The resulting question is: Will this impact EBRCS users with increased monthly fees to pay for this? In any event this needs to be recognized and addressed as part of any consideration for Oakland to migrate to EBRCS.

The City needs to consider the microwave network as a valuable asset, as is the current P-25 radio system. Given the need to upgrade and provide some level of route/technology diversity and/or loop protection to the EBRCS network serving Oakland, some accommodation should be discussed between the City and EBRCSA to migrate to a comparable self loop-protected microwave solution for Oakland. The build out of a new microwave component to support Oakland will be time consuming (we have allocated time in the straw-man schedule for the migration defined in Section 7).

Summary and Conclusions – There are a variety of issues before the City of Oakland in deciding the direction to take to secure public safety radio service for the City into the future. These issues weigh differently from the perspective of Oakland management, stakeholders, and users of this System. RCC has attempted in this Report to lay out the issues and impacts and to allow the participants to draw their own conclusions. However, it is RCC's perspective that the decision to be made is based on a fundamental issue of operational sustainability and the City's commitment to providing and maintaining this resource. The fundamental question at hand is:

1. Is the City of Oakland committed to upgrading both the radio infrastructure and fleet of radios (both mobile and portables), and build a strong radio shop, in terms of management and processes, as well as technical competence and tools to do the job. This will require using the existing budget to meet the staffing and training needs of the radio shop, ongoing equipment needs, and an annual contribution to a dedicated fund to support the continued evolution of the radio system. The question is, is the City of Oakland prepared to follow up and make the same investments in improvements to its maintenance capabilities that it has made in its backbone system over the past year and a half?

2. If the City of Oakland prefers to not assume this burden and would rather manage radio communications as an outside service, it would be best for the City to move to the EBRCS network for both public safety and for public works radio services. This would require a reassessment of the IT Department's focus with radio services moving to EBRCS and outsourcing radio (mobile and portable) maintenance to a third party. This would leave the newly defined IT Department to focus on other City IT needs and manage radio and all other services for the City through outside providers that best meet the City's needs.

As outlined in the body of the Report there are specific issues that need to be addressed in any decommissioning of the Oakland radio system, and recognition that there are valuable resources that need to be leveraged in the process.

1. Introduction

This report is a follow up to a report prepared for the City of Oakland in May 2012, which provided an assessment of the City's P25 system. This report is intended to help Oakland City Management understand the key issues, pros, and cons, associated with a decision to either:

a. Continue to invest in the City's own P25 radio system, or
b. Invest in the transition to the Regional P25 system administered by the East Bay Regional Communications System Administration (EBRCSA)

This report includes:

- Side by side coverage testing results for the City of Oakland P25 system and the EBRCS P25 System.
- An assessment of how Oakland's Harris P7200 radios (the handheld radios currently used by the Oakland Police and Fire Departments) can be expected to operate on the EBRCS Motorola P25 infrastructure.
- An assessment of business issues associated with remaining on the Oakland system versus moving
- An assessment of the microwave systems used by the two radio systems

This report does NOT include a specific recommendation to pursue either of the above courses of action. Both systems remain viable alternatives, although each has its own pros and cons. The course of action preferred by any one individual will depend upon that individual's relative priorities in the categories of:

- Overall **Cost**
- Operational **Control**
- Radio System **Coverage**
- Radio System features and **Capabilities**

The City has several options available to it with respect to the future of the City's Radio System, but the two main choices are whether to continue to invest in its own radio system infrastructure, or to move to the EBRCS system.

2. Background

RCC Consultants, Inc. was retained by the City of Oakland in early 2012 to perform an assessment of the City's P25 digital public safety radio system. RCC's assessment of the current state of the City's system was delivered in May 2012.

In May of 2013, RCC performed a follow-up study to measure radio signal strength from both the Oakland and EBRCS systems inside a select list of Oakland buildings. The results of that study were provided in Supplement 1 to the P25 Assessment Report.

In August and September of 2013, RCC was asked to perform a "Side by Side Comparison" of the Oakland and EBRCS P25 systems. This document contains RCC's findings from that side by side comparison. The Side by Side comparison includes:

- Side by side coverage testing results for the City of Oakland P25 system and the EBRCS P25 System.
- An assessment of how Oakland's Harris P7200 radios (the handheld radios currently used by the Oakland Police and Fire Departments) can be expected to operate on the EBRCS Motorola P25 infrastructure.
- An assessment of business issues associated with remaining on the Oakland system versus moving
- An assessment of the microwave systems used by the two radio systems

RCC conducted interviews with or obtained information from more than 40 people during the course of their investigation. Entities represented include agencies that use the Oakland system, agencies that use or plan to use the EBRCS system, and contractors that support either system. Entities contacted include:

Oakland System Users:
Oakland IT Department
Oakland Radio Shop
Oakland Police Department
Oakland Fire Department
Oakland Housing Authority
Piedmont Police Department

EBRCS System Users
East Bay Regional Communications System Administration
Alameda County IT Department
City of Alameda Police Department
City of Berkeley Police Department
City of Berkeley Radio Shop
City of Hayward Police Department
City of Richmond Police Department

Other Radio System Users
BART
Oakland Port Authority

Contractors:
Motorola Inc.
Harris Inc.
Dailey-Wells Communications
Procomm Marketing

RCC personnel spent two weeks in September collecting signal level and Bit Error Rate readings throughout the Oakland service area.

RCC personnel made two trips to Oakland to work with Harris personnel and Alameda Radio Shop personnel to test the functional performance of HarrisP7200 radios (the model carried by Oakland Police and Fire personnel).

RCC personnel also visited Oakland to review available microwave system documentation and to inspect representative samples of the microwave sites in the Oakland area.

This report contains the findings and results of those investigations. This report contains the following sections:

Section 3 contains the results of the drive tests and a discussion of the key issues.

Section 4 contains the results of the Feature portability tests.

Section 5 contains the business case analysis of the two primary alternatives.

Section 6 contains the microwave system assessment.

Section 7 summarizes the key findings of this assessment, and highlights key issues associated with each alternative that the City must be aware of and must address if they choose that path.

3. Comparative Drive Test

This testing effort for the City of Oakland involved the measurement of both received signal strength and Bit Error Rate throughout the Oakland service area, along with spot testing of Delivered Audio Quality at scattered locations.

Received signal level is a good indication of how strong a signal is, but does not provide a complete picture of the effects of the environment. A signal may appear to be strong in a particular place, but users may find it unusable due to interference from other sources. By also looking at the BER measurement for the two systems, we can get an indication if either system suffers from any simulcast timing issues or outside interference which would produce a higher Bit Error Rate. As the Bit Error Rate increases, the signal becomes less usable (less intelligible).

3.1 Test Setup

Two identical sets of the following equipment were used during testing (one for each system):

- 800 MHz Mag Mount Antenna connected to the Anritsu S412D
- Anritsu S412D LMR Master interface to the Dell D810 using a (6') 9 pin serial cable
- Dell D810 Laptop Computer, Window 7 operating system, and Survey Technologies Inc. Field Test 7 software
- US Globalsat BU-353 USB GPS Receiver interfaced to the Dell D810 Laptop

Both the GPS and 800 MHz mag-mount antennas were located at approximately 6' AGL on the roof of a Ford Expedition.

P7200 voice radios supplied by the City were used for audio quality testing. The P7200s were used by both a team at a fixed location in Oakland Police Dispatch, and by the mobile team as the team traveled throughout the Oakland service area.

3.2 Test Procedure

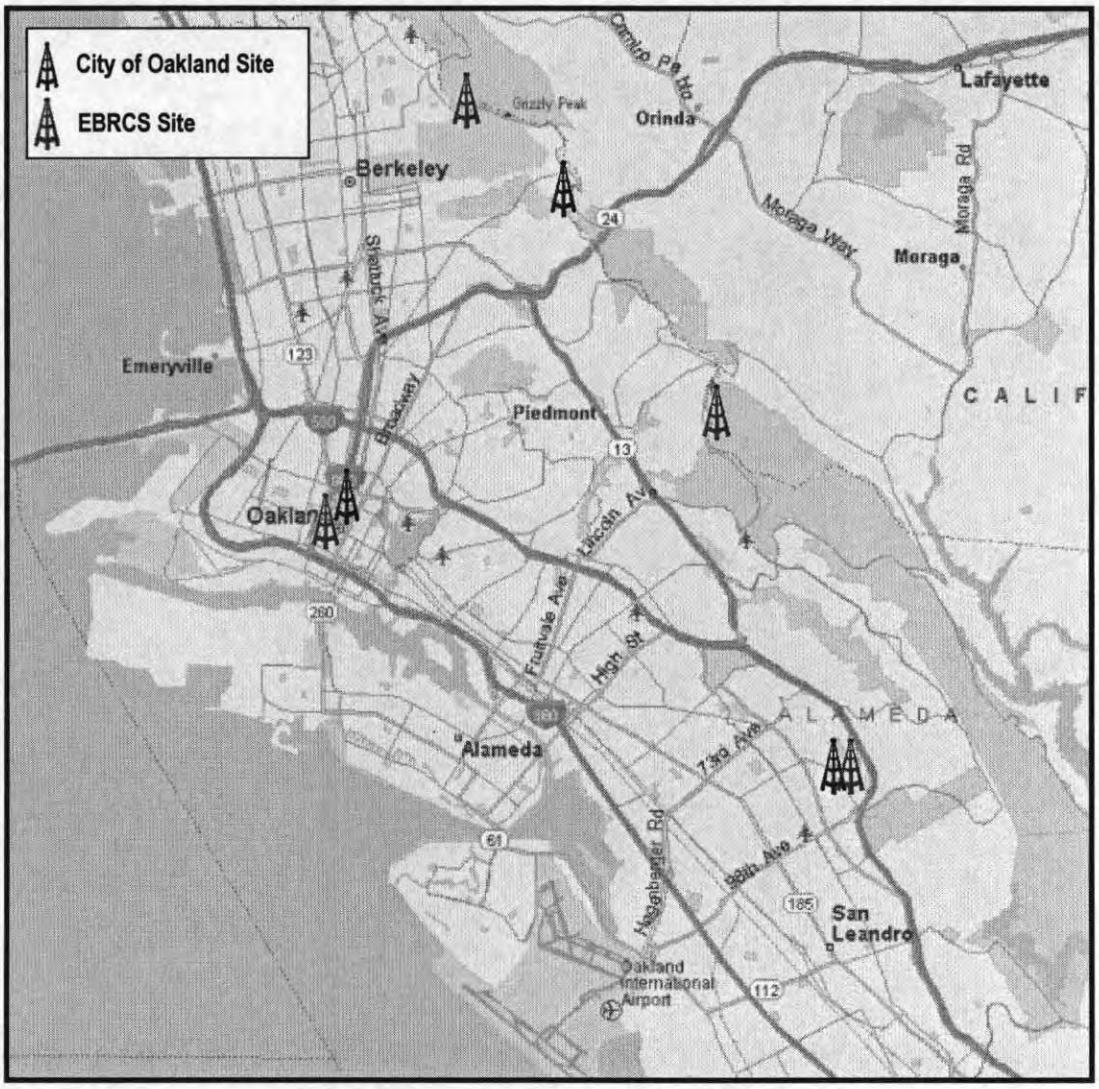
At the beginning of each test day, all equipment was powered up and verified to be operational. The field team verified that both systems were functioning properly, that the equipment was monitoring the correct control channel, and that the Bit Error Patterns were transmitting on the correct frequencies. The field team also checked to ensure that they were getting good readings from a known good location (at the Oakland Municipal Service Center) before beginning the day's drive route. The field team continued to monitor the results as they were collected to ensure that both systems and both test setups were operating properly.

Both test setups were automated to collect Bit Error Readings and Received Signal Strength readings continuously, every 4 seconds, as the test package traveled throughout the City.

3.3 Test Frequencies

Dedicated test frequencies were used to broadcast the Bit Error Rate pattern for each system. One frequency was dedicated to the City of Oakland, and the other was dedicated to EBRCS.

System	Base Transmit Frequency
City of Oakland	854.41250 MHz
EBRCS	771.79375 MHz



Oakland sites in Blue, EBRCS Sites in Red

3.4 Coverage Test Results

RCC collected more than 34,000 readings for each system over a two week period in September 2013.

Within the Oakland service area, the overall radio signal strength provided by the two systems was very similar, as shown in the summary table below:

Usage Type	Target Signal Level	Percentage of Area Covered by OAK	Percentage of Area Covered by EBRCS
Mobile at Trunk Level	-108 dBm	99.59%	99.64%
Portable at Head Level	-105 dBm	99.49%	99.14%
Portable on Belt	-95 dBm	97.77%	97.20%
Portable on Belt in 10dB Building	-85 dBm	90.91%	91.00%
Portable on Belt in 20dB Building	-75 dBm	67.58%	69.08%

The figures for each category are within 0.6% of each other in each category, with the exception of the 20 dB building category, where the EBRCS system was better by 1.5%.

(RCC's in-building coverage tests earlier in 2013 also indicated that the EBRCS sites slightly outperformed the Oakland sites inside large buildings, though the results for both systems were close overall.)

Oakland RSSI Results

RSSI Key:

Green:	**> -75 dBm**
Turquoise:	**-85 to -75 dBm**
Blue:	**-95 dBm to -85 dBm**
Violet:	**-105 to -95 dBm**
Yellow:	**-108 dBm to -105 dBm**
Red:	**< -108 dBm**

EBRCS NW Cell RSSI Results

RSSI Key:

Green:	**> -75 dBm**
Turquoise:	**-85 to -75 dBm**
Blue:	**-95 dBm to -85 dBm**
Violet:	**-105 to -95 dBm**
Yellow:	**-108 dBm to -105 dBm**
Red:	**< -108 dBm**

Radio signal strength is only part of the story. Bit Error Rate (BER) provides a better indication of how well the intended signal is received by the field user's radio. Bit errors can result from poor system timing control, from signal reflections or fluctuations, or from interference from other sources.

Since May 2012, when RCC's coverage test results revealed high BER readings in locations with otherwise sufficient signal strength, the City has spent a fair amount of effort in tracking down, identifying, and remedying sources of interference caused by cellular carriers. (Based on coverage data provided by RCC in 2012, the Oakland Radio Shop has been actively working with engineers from Pericle Communications Company, an interference mitigation company out of Colorado, to resolve problems with commercial carriers.) The City's efforts seem to have paid off, for while Oakland and EBRCS seem to provide very similar coverage footprints, Oakland's system has a slightly higher percentage of samples with less than a 1.0% Bit Error Rate (97.4% vs 95.4%), and a slightly lower percentage of samples with more than a 5% BER (.78% vs 1.35%), both of which suggest that during the test period, the Oakland signal most likely experienced less external interference than the EBRCS signal.

BER	Percentage of Area Covered by OAK	Percentage of Area Covered by EBRCS
0.0 to 1.00%	97.38%	95.40%
1.01 to 2.00%	1.19%	2.01%
2.01 to 2.60%	0.26%	0.52%
2.61 to 5.00%	0.40%	0.72%
5.01% to 8.00%	0.22%	0.65%
8.01% or greater	0.56%	0.70%

Two observations should be highlighted regarding the above data:

1. Fewer than 1% of the samples on either system showed higher than expected BER. (Less than 0.5% for Oakland; less than 1.0% for EBRCS.)

2. The difference between the two systems is not enough to steer the City in either direction, but the City and EBRCS should continue to monitor their frequency environment for potential sources of interference, particularly form commercial carriers.

Oakland BER Results

BER Key:

Green:	**0.00 to 2.00 % BER**
Blue:	**2.01 to 5.00 % BER**
Yellow:	**5.01 to 8.00 % BER**
Red:	**> 8.00 % BER**

EBRCS NW Cell BER Results

BER Key:

Green:	**0.00 to 2.00 % BER**
Blue:	**2.01 to 5.00 % BER**
Yellow:	**5.01 to 8.00 % BER**
Red:	**> 8.00 % BER**

In locations with strong signal and no interference, the Bit Error rate should be very low – ideally zero.

As the signal level drops or interference increases, the Bit Error Rate increases.

When the Bit Error rate unexpectedly increases relative to signal strength, this is an indication that something is interfering with or impacting the signal integrity. High BER in the presence of strong or adequate signal could be a symptom of a radio problem, a system timing problem, or an external source of interference.

If the problem existed consistently throughout the area, we might suspect the individual radio unit was at fault.

If the problem exists in broad areas of the City, we might suspect a problem with system timing

When we see scattered locations with a sufficient signal level (greater than -110 dBm for this test), but an unexpectedly high Bit Error Rate (equal to or greater than 5% for this test), the most likely culprit is a local source of external interference. If the source of interference is a local cellular carrier, then the interfering signal at any given point may fluctuate widely, as the carrier either gets busier throughout the day, or as the carrier modifies its network. This is what we observed with the data collected for the Oakland and EBRCS systems: scattered points where the BER is unexpectedly high relative to the received signal level at that location.

City staff note that many of the locations with high BER correspond to locations with commercial cell sites.

For both systems, fewer than 1% of the points sampled showed an unexpectedly high BER. The total count of points with a higher than expected BER (BER > 5%, signal > -110 dBm) was as follows:

Oakland

5 to 8 % BER:	66 points
> 8 % BER:	81 points

EBRCS

5 to 8 % BER:	203 points
> 8 % BER:	129 points

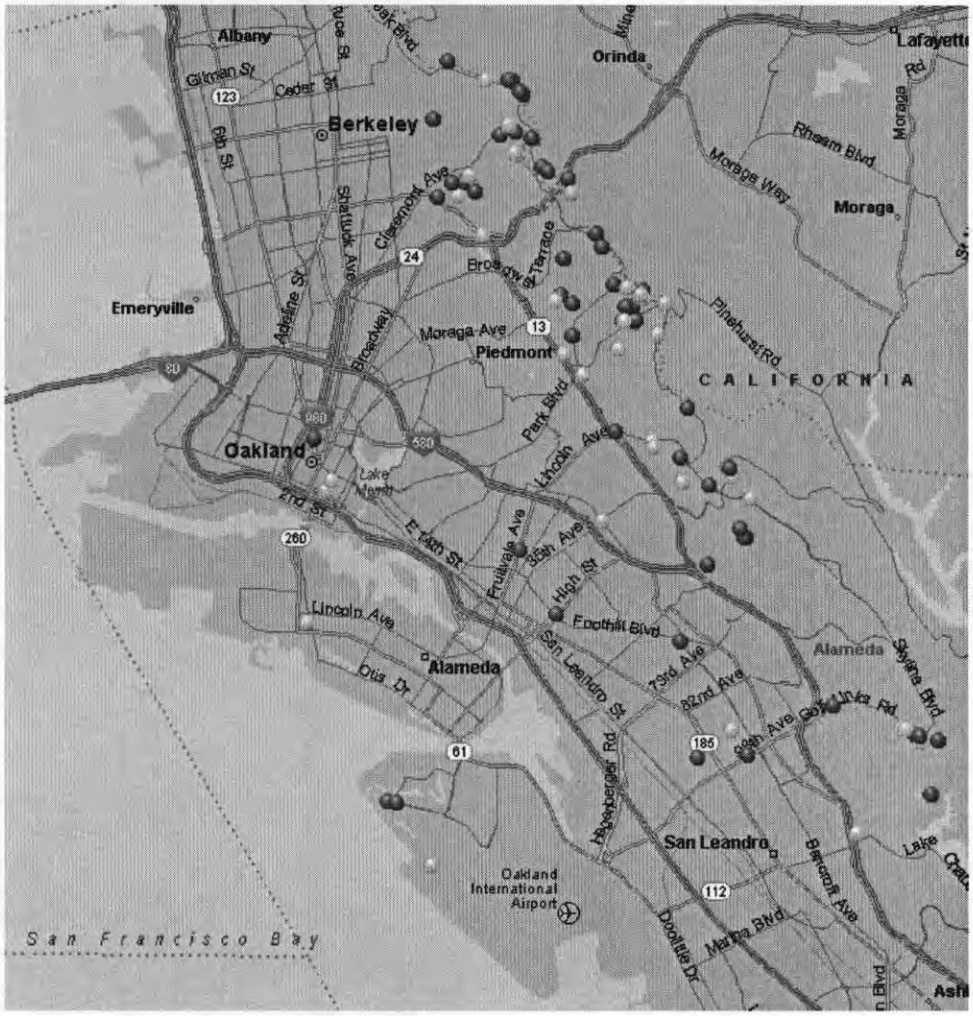
The most likely explanation for the difference between the two systems in the number of points with an elevated BER is that the City of Oakland has been actively engaged earlier this year in a process of identifying sources of external interference and mitigating those sources. Based on coverage data provided by RCC in 2012, the Oakland Radio Shop has been actively working with engineers from Pericle Communications Company, an interference mitigation company out of Colorado, to resolve problems with commercial carriers.

It is very important for a public safety radio system operator to watch for signs of interference from a third party source, and take aggressive action to mitigate the interference. This will be an ongoing operational requirement regardless of whether the City elects to stay on its own system or move to

EBRCS as its primary system. If the City stays on its own system then it must continue to monitor its own frequency environment. If the City moves to EBRCS, then it should make sure that either EBRCS adopts a similarly proactive program, or the City must be prepared to act on its own behalf.

It should be noted that only the licensee has standing to pursue action against outside interferers. If the City moves the EBRCS, then it must ensure that EBRCS will take action on Oakland's behalf or will allow Oakland to act in EBRCS name.

The graphics below and on the following page show only the test points where the measured signal strength was considered sufficiently high for a clean signal (> -110 dBm), but the Bit Error Rate was unexpectedly high (greater than 5%).

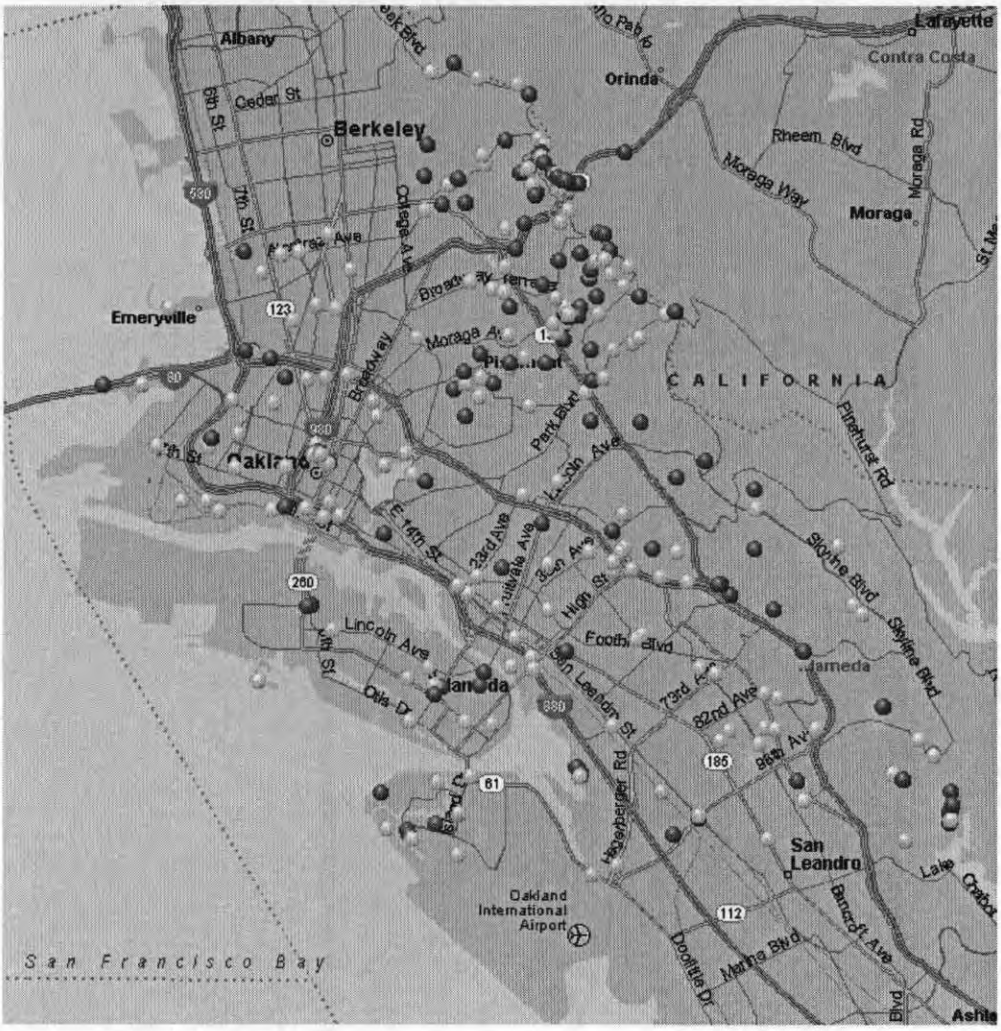


Oakland "High BER / High Signal" Results

<u>High BER Key (RSSI > -110 dBm):</u>

Yellow: 5.00 to 8.00 % BER

Red: **> 8.00 % BER**



Oakland "High BER / High Signal" Results

<u>High BER Key (RSSI > -110 dBm):</u>

Yellow: **5.00 to 8.00 % BER**

Red: **> 8.00 % BER**

3.5 Coverage Test Summary

In summary, both systems provided very similar levels of coverage within the Oakland service area. The EBRCS system had a slightly higher number of points in the highest signal strength category, while the Oakland system had a lower percentage of points that appear to have an unexpectedly high Bit Error Rate.

Outside the Oakland Area, only the EBRCS system can be expected to provide any usable coverage, as the EBRCS system is designed to cover both Alameda County and Contra Costa County, while the Oakland system is primarily limited to the area between the Bay and the ridge that defines Oakland's eastern border.

(It should be noted that the coverage area for Oakland's primary channels will be limited to the Oakland area on BOTH systems, as Oakland's operational channels will be limited to the EBRCS NW simulcast cell. Oakland users will have coverage beyond the Oakland area only when they manually switch to one of their neighbors' operational channels, or when they switch to one of the interoperability channels that are allowed to roam throughout the two-county area. It should also be noted that Standard Operating Procedures still need to be developed to govern the use of the interoperability channels, as no agency was as yet responsible for monitoring or coordinating those channels at the time of this report.)

Within the Oakland service area, there is very little material difference in coverage overall between the two systems.

Beyond Oakland, EBRCS can be expected to provide coverage throughout the majority of both counties.

Both systems require vigilant protection from sources of outside interference.

4. Feature Portability Test

4.1 Background

One of the options that the City of Oakland is considering as part of improving their radio communications is to keep their current Harris mobile and portable radios, but use them on the EBRCS Motorola Project 25 radio system. Task 2 of RCC's Oakland/EBRCS Side by Side Assessment and Impact Study required that RCC perform a comparative analysis to determine the impact to radio operation and features if the Harris P7200 portable radios were to be used on the EBRCS Motorola Project 25 system. During the week of August 26, and again during the week of September 16, RCC personal performed thorough testing of the Harris P7200 radios on the EBRCS Motorola P25 system. Prior to the EBRCS system testing, RCC performed and documented the same tests on the City of Oakland Harris system to establish a "baseline" from which to evaluate the EBRCS system tests.

To understand the purpose of this Radio Feature Portability test, it is helpful to know a little about the Project 25 standards. The goal of Project 25 is to create a set of standards by which radio systems and subscribers from multiple manufacturers can all operate together. It is important to note however that the Project 25 standards are not as comprehensively written as for example cellular standards. In the cellular industry you can buy an HTC, Samsung, Apple, etc. phone and be assured that the phone will operate properly on the network. This is because the cellular standards are very tightly written without any room for variances. The Project 25 standards on the other hand allow for some variance among manufacturers. They even allow for proprietary features by manufacturers. Thus, since the City of Oakland is considering using their current Harris subscribers on the Motorola EBRCS system, it is advisable to perform thorough testing to ensure that the radios operate properly and in a manner that is suitable to the City of Oakland.

4.2 Test Planning

Careful coordination, planning, and cooperation was required to accomplish the goals of this Radio Feature Portability test. RCC personnel worked closely with the radio system managers of both the City of Oakland Harris radio system and the Motorola EBRCS system to plan and execute the test. The test plan required that configuration changes be made to the Network Management and Console systems of both the Harris and the Motorola systems. Individuals from both systems were very cooperative and willingly assisted in any way necessary to facilitate the testing.

Three (3) Harris P7200 portable radios were supplied to RCC to perform the tests. These three radios were subsequently taken to the City of Oakland Radio Shop prior to testing and bench tested with an Aeroflex 2935 and an Aeroflex 3920 test units to ensure the radios were within spec. One radio did not pass the Sideband Suppression test and thus was removed from use. Two of the P7200 radios were found to be within spec and were used to perform all of the testing.

Testing was performed on the EBRCS Motorola P25 Phase 1 Simulcast system at the Alameda County Radio Shop. An MCC7500 Dispatch Console and a Network Management Terminal were both available at the Radio Shop with which to perform the testing. Two test talkgroups, OPD-1 and OPD-2, were added to the two Harris P7200 portable radios and to the Motorola MCC7500 Dispatch Consoles to facilitate testing without disrupting or involving dispatchers.

A customized set of tests was devised between the City of Oakland and RCC that were tailored to the way that the Oakland Police and Fire Departments use their radio system. In all, twenty-four feature tests were performed.

4.3 Test Results

Each individual test was performed multiple times to ensure accurate documented results. In the case of Emergency Call and Alarm, the test was performed approximately fifteen (15) times so that RCC could document precise operation. The detailed results of all tests are included in Appendix 2 to this document. A more condensed summary of the test results are provided in Table 1 below.

Table 1: Summary of Radio Feature Portability Test Results

✓ = Pass ✗ = Fail ✓ = Test notes differences in operation between Harris and EBRCS

Test Performed	Result	Comments
1. Talkgroup Call	✓	
2. Continuous Assignment Updating	✓	
3. Talkgroup Call to/from Console	✓	
4. PTT Unit ID/Alias Display	✓	
5. Emergency Alarm and Call	✗	Emergency Alarm and Call worked except could not clear Emergency display on P7200 portable from Dispatch Console.
6. Talkgroup Patch	✓	
7. Emergency Alarm and Call on Patched Talkgroup	✓	Operation was similar between Harris and EBRCS Dispatch Consoles. However, same as #5 above, could not clear Emergency display on P7200 portable from Dispatch Console.
8. Setup Patch During a Talkgroup Call	✓	**Harris:** Dispatch Console receive audio from portable mutes when patch is initiated. **EBRCS:** Dispatch Console receive audio from portable is still present when patch is initiated.
9. Simulselect	✓	
10. Emergency Alarm and Call on Simulselected Talkgroup	✓	Operation was similar between Harris and EBRCS Dispatch Consoles. However, same as #5 above, could not clear Emergency display on P7200 portable from Dispatch Console.
11. Setup Simulselect During a Talkgroup Call	✓	
12. Private Call	n/a	Not tested. This feature is disabled System-wide on the

✓ = Pass ✗ = Fail ✓ = Test notes differences in operation between Harris and EBRCS		
Test Performed	**Result**	**Comments**
		EBRCS system.
13. Call Alert	✓	
14. Alert Tones	✓	Two of the three Alert Tones are identical between Harris and EBRCS. One of the three Alert Tones is different.
15. Power On Affiliation	✓	
16. Power Off Deaffiliation	✓	
17. Talkgroup Change Affiliation	✓	
18. Radio Roaming	✓	There are two ways to program the P7200s to roam. RCC confirmed that roaming works but could not program the P7200's to use the "Enhanced" roaming methodology. Harris radios require an additional cost option to enable Enhanced Roaming. Enhanced Roaming makes use of Adjacent Site Control Channel download
19. Site Change Affiliation	✓	
20. Site Access Control/"Talkgroup Only" Site Access Denial	✓	
21. Adjacent Site Control Channel Info Utilization	Unknown	Unable to test but important to know.
22. Over the Air Programming	Unknown	Unable to test
23. Selective Radio Inhibit	✓	
24. Passing DTMF Tones Radio to Radio	✓	
25. Busy Queuing and Callback	Unknown	Unable to test but important to know.
26. P7200 Radio Reaction to Site Trunking	Unknown	Unable to test but important to know.
27. Radio Reaction to Motorola Master Controller Switch	Unknown	Unable to test but important to know.

4.4 Feature Test Conclusions

As can be seen from Table 1 above, the Harris P7200 radios generally worked well on the Motorola EBRCS system, with the exception of two functions:

1. The inability to clear an Emergency Call indication from the P7200 radio display from the Dispatch Console.
2. The City's Harris P25 radios used in the Feature Tests did not roam automatically from one cell to another.

At the time of this report, it was not clear whether the Harris P25 radios used for the feature tests had the advanced roaming software (an optional cost-added feature not required for use on the Oakland simulcast system) needed to roam smoothly from one simulcast cell to another. The radios did allow the user to program roaming parameters, which seemed to indicate that the radios had the required software.

RCC investigated and experimented with P7200 programming parameters in an attempt to resolve the Emergency Call issue, but found no remedy for this issue. Appendix 2 provides detail on how it was discovered that the Emergency display can ultimately be cleared. If the City of Oakland is considering using the Harris subscriber radios on the EBRCS system, it will have to be determined if this operation is acceptable.

RCC recommends repeating the full set of feature tests with any new radio model the City considers purchasing for Police or Fire.

Though tests #26 and #27 could not be performed because they involve a major failure of the EBRCS system, RCC recommends that the City of Oakland investigate further the impact of the EBRCS system entering Site Trunking prior to making a decision to use Harris subscribers on the EBRCS system. It is critical to know how the Harris subscribers would react to a Site Trunking event.

A spreadsheet containing more detailed notes on the feature portability test results can be found in Appendix 2.

5. Business Case Assessment

5.1 Issues Considered

RCC was asked to consider the following issues in their assessment of the Oakland vs EBRCS business case:

1. Level of Governance Participation
2. Dissolution Impacts
    a. Decommission Impacts and Mitigation Strategies
    b. MOU/MOA Dissolution Impacts
    c. Examination of External Public Safety Agency Service Contracts
3. System Administrative Issues
    a. Capacity and Future Scalability Issues
    b. System Configuration and Control
    c. System Features and Capabilities
    d. Redundancy and Fallback Issues
    e. Technology Refresh Issues
    f. Security and Encryption Issues
    g. Process, Procedures, and Performance
4. Remaining Dispatch and Network Compatibility Issues
    a. Radios
    b. Voice Logging
    c. Microwave Backbone
    d. Dispatch Consoles
    e. Computer Aided Dispatch (CAD)
    f. Next Generation 9-1-1
    g. Interoperability Issues
5. Fiscal Considerations
    a. Debt Management
    b. One Time Non-Recurring Costs to Join EBRCS
    c. Monthly Recurring Costs
    d. Summarized Cost Impacts
    e. Comparative Cost Impacts (Join EBRCS, Access EBRCS, New System)
    f. Cost Stability and Future Cost Management
6. Maintenance and Support Considerations

Those issues are addressed on the pages that follow in this Section 5.

5.2 Interview Process

RCC was asked to interview a large number of stakeholders that use either the Oakland radio system or the EBRCS radio system as part of RCC's assessment. A complete list of people consulted as part of this

process can be found in Appendix 1. RCC met with more than 40 individuals during the course of their investigation.

5.3 Level of Governance Participation

The Joint Powers Agreement that established the East Bay Regional Communications System Authority (EBRCSA) defines the voting members of the Governing Board in Section 6.a:

> Governing Board - Membership. The Authority shall be administered by a Board of Directors (the "Board") consisting of twenty-three (23) Directors and their respective alternates. Directors and alternates shall be appointed as follows and, at the time of such appointment and for the duration of such service, shall be employees or officers of Member agencies:
>
> (1) Alameda County Board of Supervisors
> (1) Contra Costa County Board of Supervisors
> ***(1) Alameda County Police Chiefs Association (to be selected by the Association)***
> (1) Contra Costa County Police Chiefs Association (to be selected by the Association)
> ***(1) Alameda County Fire Chiefs Association (to be selected by the Association)***
> (1) Contra Costa County Fire Chiefs Association (to be selected by the Association)
> (1) Special District (to be selected by the Association)
> (1) Alameda County, County Administrator
> (1) Contra Costa County, County Administrator
> (1) Alameda County Sheriff
> (1) Contra Costa County Sheriff
> (3) Contra Costa County City Managers (to be selected by the Association)
> ***(3) Alameda County City Managers (to be selected by the Association)***
> (3) Contra Costa County Elected Officials (to be selected by the Mayor's Conference)
> ***(3) Alameda County Elected Officials (to be selected by the Mayor's Conference)***

It is important to note that while the City of Oakland would be one of the largest users of the EBRCS system, the City does not have a permanent voice on the EBRCSA Board. City of Oakland representatives would be eligible for up to 8 seats on the Board (see bold italics above), but only if elected by their peers in the Alameda County Police Chiefs Association, the Alameda County Fire Chiefs Association, the Alameda County City Managers, and the Alameda County Elected Officials.

If the City joined the EBRCS system with 2700 users, they would have 17% of the users on the EBRCS system. To have a proportional number of seats on the EBRCSA Board, they would need 4 of the 23 seats.

The Alameda County Grand Jury recognized this as a significant hurdle to be overcome before the City was likely to join EBRCSA.

The City has inquired whether or not the JPA could be amended to give the City a permanent or guaranteed voice on the Board, but has been told that amending the JPA to include such a provision is unlikely to happen, and the EBRCSA Board does not intend to pursue such a change to the JPA.

Other strategies have been discussed, such as getting one of the organizations mentioned above to commit to giving their seat (or one of their seats) to the City of Oakland on permanent basis (via a binding Memorandum of Understanding), but to date no such agreement exists.

RCC strongly recommends that the City investigate the feasibility of this solution and obtain signed conditional MOUs BEFORE the City makes a policy decision to begin negotiating with EBRCS.

If the City chooses to keep its own system (whether as the primary system for all agencies, as the primary system for non-public safety agencies only, as a backup system only), **RCC recommends that the City establish an oversight board** for management and funding of its own system, with representation from Police, Fire, Information Technology, and Public Works. In other locations where this process is used, the Radio Shop manages the day to day operation of the system, but provides monthly status reports to the oversight board regarding:

- System maintenance activity
- System radio activity and remaining capacity
- System Alarms and resolution
- Subscriber issues and resolution
- Upgrades available, recommended or needed, along with budgetary estimates and timeframes for implementation
- Radio System Funding and financial management
- Vendor or contractor issues, if any

The monthly status report process helps to ensure that all stakeholders are kept in the loop on key issues affecting their radio system.

If the City chooses to keep its own system operational while moving some or all of its users to the EBRCS system, the City must be aware that the EBRCS Operating Agreement contains a non-compete clause:

"Section 4.04. Against Competitive Project.

To the extent permitted by law, the User covenants not to acquire, maintain or operate within the jurisdiction of the Authority any public safety radio system competitive with the Project without the prior written consent of the Authority, which consent shall not be unreasonably withheld. This covenant is not intended to, and does not, prohibit the User from acquiring, maintaining, or operating a public radio system within its jurisdiction if the Operating Agreement is terminated or when the User no longer participates in the Project or with the Authority."

The City simply needs to ensure that it obtains prior written consent from EBRCS allowing Oakland to continue to operate its own radios systems before any of its users join the EBRCS system or sign the Operating Agreement.

5.4 Dissolution Impacts

There are a number of relatively minor dissolution impacts that the City should be aware of, but that should not be a key decision factor when deciding to stay with its own system versus moving to the EBRCS system.

The chief impacts fall into the categories of:

a. Existing equipment that must be maintained or disposed of

b. Agencies that currently use the Oakland radios system as their primary system
c. Agencies that have a close interoperability relationship with Oakland

5.4.1 Existing equipment that must be maintained or disposed of

City personnel have indicated that they intend to keep the existing Oakland P25 system as an available backup system or as a transition system for non-public safety agencies even if they move their primary public safety operations to the EBRCS system. In that case, ALL of the backbone equipment must be preserved, so there are effectively no issues with disposition of microwave equipment or P25 radio backbone equipment. All of the P25 backbone equipment (microwave system, complete tower sites, and control point) must be maintained in a state of readiness.

One way to ensure readiness while slightly reducing costs would be to keep public works users operating on the Oakland P25 system. This would achieve three goals:

a. Save costs on subscriber equipment by allowing public safety agencies to "hand down" their equipment to the public works agencies
b. Save costs on subscriber fees if the public works agencies are not subscribers to the EBRCS system
c. Ensure that the system is exercised on a daily basis, and not mothballed and tested only a few times per year.

5.4.2 Agencies that use the Oakland system

Agencies that currently use the Oakland system for their primary operations include:

- City of Piedmont Police
- City of Piedmont Fire
- Oakland Housing Authority
- Oakland School Police
- Oakland Unified School District

These entities work in close cooperation with Oakland Police and Fire, and need to be kept in the loop regarding whatever decision the City makes regarding its own radio system. These agencies typically need at least one year of advance notice in order to budget for any new radio equipment or additional usage fees.

5.4.3 Interoperability agencies

Agencies that currently interoperate with the Oakland system for mutual aid purposes include

- Bay Area Rapid Transit (BART)
- Neighboring EBRCS agencies

(The Port of Oakland also seeks interoperability with Oakland, but is waiting for Oakland's decision to stay on its own system or move to EBRCS. The Port of Oakland has already decided that it will subscribe to the EBRCS system in either case, and is just waiting to learn whether they need to subscribe to the Oakland system in addition to the EBRCS system.)

BART currently has an Inter-RF Subsystem Interface in place for coordination with Oakland users. At the time of this report, that ISSI had not been enabled for operation between the two systems. If the City preserves its own system, either for primary or backup operations, then that ISSI should be configured and enabled.

BART has also constructed a P25 system to provide coverage in its tunnels. Oakland radios should be programmed to access this system regardless of whether the City stays on its own backbone or moves to the EBRCS system.

In general, the City of Oakland will need to ensure that the mutual aid talkgroups it currently has programmed into its radios are available on the EBRCS system, and will need to notify its neighbors if and when Oakland moves to the EBRCS system so that they can reprogram their radios with the new Oakland talkgroup IDs on the EBRCS system.

5.5 System Administrative Issues

5.5.1 Capacity and Future Scalability Issues

An important consideration when evaluating the City's two options is the available capacity on the two systems.

At present, the City of Oakland has approximately 2700 users (roughly 1500 Police, 700 Fire, 500 other).

The EBRCS system has approximately 13,180 users, as shown in the following table.

EBRCS Radio Users in 2013

Member	Cell	Current Radio Count 13,180
Dublin	ALCO East Cell	136
Livermore	ALCO East Cell	404
Pleasanton	ALCO East Cell	332
Alameda City	ALCO Northwest Cell	462
Albany	ALCO Northwest Cell	74

Berkeley	ALCO Northwest Cell	550
Emeryville	ALCO Northwest Cell	100
Oakland	ALCO Northwest Cell	0
Piedmont	ALCO Northwest Cell	0
University of California, Berkeley	ALCO Northwest Cell	220
Fremont	ALCO Southwest Cell	850
Hayward	ALCO Southwest Cell	82
Newark	ALCO Southwest Cell	121
San Leandro	ALCO Southwest Cell	250
Union City	ALCO Southwest Cell	259
California Department of Transportation (Caltrans)	All	600
East Bay Municipal Utility District (EBMUD)	All	0
East Bay Regional Park District (EBRPD)	All	100
Alameda County	All ALCO	2,800
Non County users (i.e Hopsitals,Zone7, etc)	All ALCO	250
Non County users (i.e Hopsitals,Zone7, etc)	All ALCO	150
Contra Costa County	All COCO	1,283
Contra Costa County Fire	All COCO	400
Livermore Amador Valley Transit Authority	ALCO East COCO Central	116
Concord	COCO Central Cells	421
Danville	COCO Central Cells	102
Lafayette	COCO Central Cells	45
Martinez	COCO Central Cells	83
Moraga	COCO Central Cells	50
Morage-Orinda Fire	COCO Central Cells	85
Orinda	COCO Central Cells	0
Pittsburg	COCO Central Cells	234
Pleasant Hill	COCO Central Cells	143
San Ramon	COCO Central Cells	232
San Ramon Valley Fire Protection District (SRVFPD)	COCO Central Cells	262
Walnut Creek	COCO Central Cells	198
Antioch	COCO Central/East Cells	300
Contra Costa College District	COCO Central/West	31
Brentwood	COCO East Cells	150
Clayton	COCO East Cells	38
East Contra Costa Fire Protection District	COCO East Cells	100
Oakley	COCO East Cells	50
El Cerrito	COCO West Cell	175
Hercules	COCO West Cell	70

Kensington	COCO West Cell	18
Pinole	COCO West Cell	97
Richmond	COCO West Cell	605
Rodeo-Hercules Fire Protection District (RHFPD)	COCO West Cell	36
San Pablo	COCO West Cell	116

Of those 13,180 users, 1,406 use primarily the NW simulcast Cell (the same one that Oakland would use), 3,200 have access to all of the systems in Alameda County, and 700 users have access to the full EBRCS system. Together, they add up to 5,306 users with normal access privileges that include the NW simulcast cell. If all of the City of Oakland's 2700 users moved to the EBRCS system, the combined total on the NW Cell would be approximately 8,000 users.

The City of Oakland's P25 system has 10 channels (9 voice channels and one control channel). The NW Cell of the EBRCS system has 16 channels (15 voice channels and 1 control channel).

During the busiest hours of the week, the Oakland systems currently handle a combined total of roughly 8,600 call-seconds. The EBRCS system reports that its peak busy hour on the NW Cell handles 12,724 call-seconds. If all of the Oakland users moved to the EBRCS system, AND if the busy hours for all of the agencies coincided, then the peak load would be close to 21,333 call-seconds.

Radio system loading is typically defined in terms of the amount of radio traffic that a system can accommodate during its busiest hour with 99% of channel requests (push-to-talks) going through on the first attempt. During normal operations, all calls go through on the first attempt. During the busiest hour, it is assumed that no more than 1% of attempts will be momentarily delayed before the channel assignment goes through. (It should be noted that today, the City reports that their system does not experience call blocking. The statistics discussed in this section are a measure of how much additional capacity the system should be able to handle before 1% of call requests are momentarily queued before they get a channel assigned.

At current peak traffic volumes, both systems are operating at substantially less volume than the amount of traffic that would result in 1% of calls being momentarily queued (also referred to as a "Grade of Service" of 1%).

The 10-channel Oakland system, with approximately 8,600 call-seconds of traffic, could accommodate roughly 58% more traffic before it reaches the 1% Grade of Service (GOS) threshold.

The 16-channel EBRCS NW Cell, with 12,724 call-seconds of traffic, could more than double that amount before it reaches a GOS of 1%. A 16 channel system (with 15 voice channels) should be able to handle approximately 29,000 call-seconds before reaching a 1.0% GOS.

When the peak traffic from both systems is combined for a total of 21,333 call-seconds), the system would have room for approximately 37% additional growth before reaching a 1.0% Grade of Service.

With the combined peak load, the combined system could *currently* expect a Grade of Service during the busiest hour of the week where fewer than 1 in 1000 call attempts (0.1% GOS) are momentarily delayed.

In summary, if the users from both systems are combined, the NW Cell will still have room for 37% more traffic before the system reaches a 1.0% GOS during the busiest hour of the week.

5.5.2 System Configuration and Control

System configuration and control of the EBRCS system are governed by the EBRCS Board, with the advice of a Technical Advisory Committee.

5.5.3 System Features and Capabilities, Technology Refresh Issues, Security and Encryption Issues, Process, Procedures, and Performance

EBRCS system features and capabilities today are very similar to the capabilities of the Oakland system. Control over when to add or expand features or when to upgrade technology on the EBRCS system will be subject to approval by the Board and availability of funds. This may have the benefit of moving Oakland users ahead before they would with their own system, or may have the effect of holding them back longer than they might have on their own.

5.5.4 Redundancy and Fallback Issues

At present, neither the Oakland system nor the EBRCS system has a true, geographically separate master control point that could take over control of the network in a "black, smoking hole" scenario that takes out the primary control point.

The sites in the Oakland system are currently connected by a loop-protected microwave system, which allows the rest of the system to keep operating even if one of the microwave sites is disabled.

Each of the sites in the NW Cell of the EBRCS system are connected by spurs to the rest of the network, which means they are connected by only one physical pathway to the rest of the system, which means that if the microwave site that connects to one of the radio sites is disabled, then that radio site will be isolated or disabled as well. (See the Microwave section of this report for further discussion.) If the City joined the EBRCS system, the City should consider sharing their microwave facilities with EBRCS in order to provide loop-protection for the EBRCS sites.

5.6 Dispatch and Network Compatibility Issues

It is important to understand the potential impact that a move to EBRCS will have upon the various components of the City of Oakland's Radio System.

5.6.1 Radios

The City of Oakland's P25 radios are manufactured by Harris. The EBRCS system backbone is manufactured by Motorola. P25 radios are designed to be compatible with systems manufactured by different companies, but in some cases proprietary features or subtle differences in the way that different manufacturers implement the P25 standards can affect the way that radios operate on one system or another.

RCC performed a series of feature compatibility tests using Oakland's Harris P7200 portable radios and both the Oakland and EBRCS radios systems. Those results are described in Section 4 of this report.

The current Oakland fleet of P7200 portable radios is aging, has not received any preventive maintenance until this year, and from a performance perspective has exhibited noticeable performance issues when used in a P-25 digital environment. It is RCC's assessment that these radios will need to be replaced whether used on the Oakland or EBRCS platforms.

Replacing all of the City's 2700 subscriber radios should cost between $15 and $20 million.

5.6.2 Voice Logging

The City of Oakland currently has a voice logging recorder manufactured by Nice Systems, Inc. Nice also makes the voice logging recorder system used by EBRCSA. Both recorders can be accessed by remote call-retrieval software with required user access permissions.

If the City of Oakland moves to EBRCS, it has two primary options regarding its existing recorder system:

1. The City can keep the existing system in place to record any traffic that may occur on the P25 system
2. The City can add its own recorder servers to the EBRCS network, to serve as backups to the EBRCS servers

Integration with the EBRCS system and network will require some reconfiguration time and expense on the part of the City, EBRCS, and Nice Systems.

5.6.3 Microwave Backbone

The City Oakland's microwave backbone is discussed separately in section 6.

5.6.4 Dispatch Consoles

EBRCSA has pledged to replace the City of Oakland's dispatch consoles if the City elects to join the EBRCS system (at a cost to EBRCS of approximately $1,540,000). The EBRCSA proposal to the City of Oakland states that "The EBRCSA system funding model includes the cost of consoles for member agencies. The EBRCSA will attempt to obtain additional grant funds and/or assume the cost of the consoles as part of the system financing. **It will not be the responsibility of the City to purchase, and\or maintain the consoles.**" The proposal does not indicate what the impact of assuming an additional $1,540,000 of system financing will be to the member agencies if EBRCS fails to obtain the additional grant funds.

For the most part, the City's dispatch consoles are simply a part of the City's radio system, and RCC is unaware of any unique interfaces to any other external systems.

The one exception that RCC noted during its investigation was a custom interface at the Fire Department dispatch consoles. The Harris system provides a special interface (called the Call Director), which allows a console operator to use a single headset to interface to both the radio system AND the 9-1-1 telephone system. When no call is active, the headset works as a normal radio console headset. When the operator picks up a 9-1-1 call, the phone caller audio appears in the right ear, and radio traffic appears in the left ear. Operator voice audio is connected to the phone caller until the operator presses the radio console transmit button or foot pedal, in which case the operator's audio goes out over the radio system. When the operator hangs up the 9-1-1 call, the headset reverts to normal radio operation again.

Since Oakland Fire Dispatch positions are combined call-taker and dispatchers, this function must be replicated on the new Motorola consoles when they are installed. If that functionality is not available as Motorola catalog option, then that function will have to be reproduced via integration with a third party device.

This function must be specifically called out and addressed in the City's agreement with EBRCS.

5.6.5 Computer Aided Dispatch (CAD)

RCC has not identified any known connections between the City's CAD system and the radio system.

5.6.6. Next Generation 9-1-1

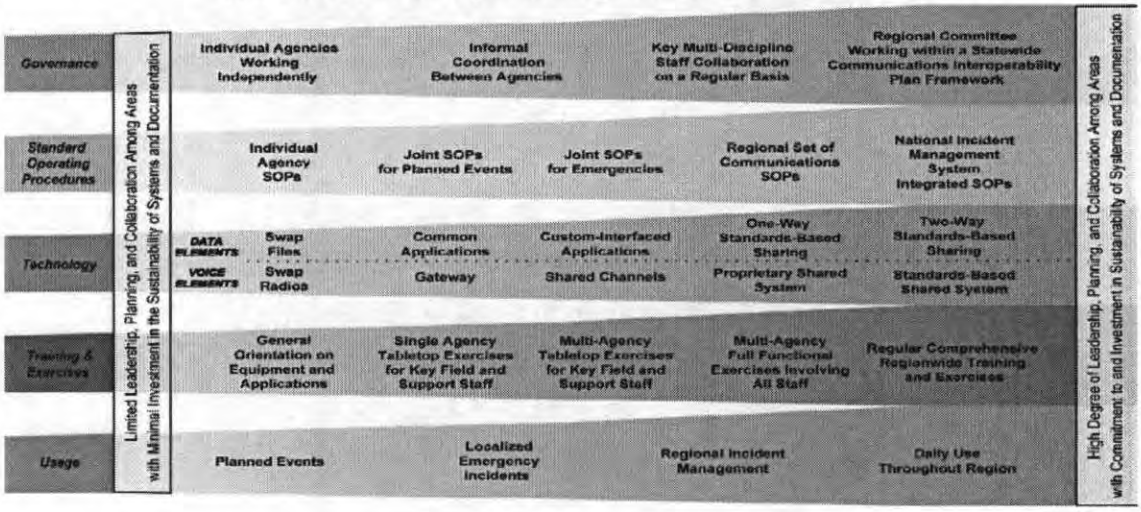
There are no physical interfaces between the City's 9-1-1 phone system and the radio system, other than the headset interface issue described above in 5.6.4. While the migration to Next Generation (NG) 9-1-1 would not impact radio operations the City of Oakland is the largest city in the State that does not currently receive and process wireless 9-1-1 calls. The City is in the process of evaluating and possibly will be upgrading the Oakland Police Dispatch to accept wireless 9-1-1 calls in the future. It should be noted that based on population the City of Oakland already receives an inordinate number of 9-1-1 calls and that the addition of wireless calls could impact this by a now

estimated 40%. Using a typical public safety model the impact on dispatch traffic for Oakland would increase between 4-6% which would be significant and needs to be considered.

5.6.7 Interoperability Issues

According to the SAFECOM Continuum, radios sharing a common system have the highest level of interoperability. This level of interoperability would be provided by moving Oakland's users over to the EBRCS system.

SAFECOM Interoperability Continuum Chart



This level of interoperability is technically (and technologically) available today to both Oakland and EBRCS agencies, since they both operate compatible P25 radio systems. In fact, Oakland is already providing access to its P25 system free of charge to outside agencies that request access to Oakland channels for Mutual Aid.

The only thing keeping Oakland and EBRCS from achieving this level of operability today is an administrative policy decision by EBRCS to allow access to its system only to paying users. To date, the City has not chosen to pay for EBRCS access for any of its users. It is very rare for a public safety radio system operator to charge access fees simply to allow access for Mutual Aid purposes (as opposed to daily operations).

In general, the City of Oakland will need to ensure that the mutual aid talkgroups it currently has programmed into its radios are available on the EBRCS system, and will need to notify its neighbors if and when Oakland moves to the EBRCS system so that they can reprogram their radios with the new Oakland talkgroup IDs on the EBRCS system.

One item that distinguishes the Oakland system from the EBRCS system in the interoperability category is that Oakland and BART have installed an Inter-RF SubSystem Interface (ISSI) between their two systems. At present, that ISSI system is not active. However, BART has indicated that they intend to activate that interface once they have completed their P25 tunnel system and worked out

an agreement with the City of Oakland regarding the allocation of radio and group IDs. (ID ranges must be worked out to avoid conflicts between the two systems.) BART intends to use the ISSI to manage radio permissions for users entering their tunnel system, and does not intend to assign IDs on their system or program individual radios to access their system. They intend to use the ISSI to manage those relationships with partner agencies.

At present, BART only has an ISSI relationship with Oakland, and does not have a similar connection or relationship with EBRCS.

(RCC notes that older versions of the ISSI may have a number of operational issues that the end user should be aware of, such as:

- handling of emergencies across systems
- handling of system busy /call queuing conditions on either side of the link
- handling of automatic roaming across linked systems
- limited number of talkgroups supported across systems
- No display of calling party Unit ID across the gateway

RCC simply recommends thorough testing of the ISSI whenever the City and BART are ready to activate the link between their two systems.)

5.6.8 Siren System

The City of Oakland currently operates an outdoor siren system for community alerting that is manufactured by Federal Signal Corporation. This system currently uses the City's older EDACS analog trunking system for connection from the alarm controller to each of the outdoor sirens. The older radios use Frequency Shift Keying (FSK) to communicate with and control their sirens. (FSK signaling is similar to modem tones.) FSK signaling does NOT work with P25 digital systems.

Federal reports that they now have the ability to use DTMF tones over P25 systems, and that they have worked out an interface to Harris P25 radios, but have NOT yet worked out or tested an interface involving Motorola P25 radios or systems.

During portable radio feature testing, RCC tested the ability of one P7200 radio to send DTMF tones to another radio over both the Oakland and the EBRCS P25 networks. The DTMF signaling appears to work as judged by the audio quality of the received tone, so the key requirements to allow the Federal controller to talk to the Federal siren remotes appear to be in place. City staff, however, have pointed out that two other Federal siren users in the East Bay area (San Leandro and UC Berkeley) have chosen to abandon their siren systems when they moved to the EBRCS P25 system. Until Federal demonstrates the ability to control their sirens in the field using DTMF tones on P25 radios, this will remain an item that belongs in an "at-risk" category. This operation needs to be verified by interfacing actual P25 radios to the sirens and ensuring that they work over the Oakland P25 system AND the EBRCS P25 system. Until the P25 test has been performed successfully with the

Federal siren system, the City must continue to maintain its older EDACS trunking system to support the siren system.

5.7 Fiscal Considerations

5.7.1 City of Oakland

The City of Oakland currently budgets $3,577,377 per year for its Radio Fund for FY 2013-14 and 2014-15. Those finds are derived from Internal Service revenues ($3,537,377) and Work Order Revenues ($40,000).

Those costs cover:

- Facilities and utilities
- Personnel and training
- Parts and equipment
- Contractor Services
- IT Department Personnel, including Radio Shop personnel and other administrative personnel
- Reserve or Contingency Fund

The projected budget for FY 2014-15 is shown on the following page:

Sum of Year Amount SUM Child Account And Description	FY14-15 Revenue	Expense
47111 - Internal Service Revenues	3,537,377	
47211 - Work Order Revenues	40,000	
51111 - Civilian: Regular		582,240
51212 - Civilian: Other Overtime		8,670
51313 - Allowance: Auto Flat (1, 2, Partially 3)		2,100
51413 - Standby Pay		10,836
51511 - Civilian: Paid Leave Charge		160,887
51611 - Civilian: Retirement Accrual		216,249
51613 - Civilian: Fringe Benefits Accrual		293,908
52211 - Stationery and Office Supplies		2,500
52213 - Minor Computer Hardware and Software (Not Capitalized)		1,525
52513 - Supplies: Telephone and Materials		535,700
52515 - Radio Material		85,749
53112 - Electricity (Except Street Lighting)		5,000
53116 – Telephone		21,600
53211 - Rental: Land and Building		167,970
54011 - Contract Contingencies (Budgetary Only)		1,200,010
54511 - Legal Fees		5,000
54612 - Service Contracts for Mach and Equipment		68,760
55112 - Commercial Transportation		-4,000
55212 - Registration and Tuition		-3,000
56113 - Facilities: General Support		165,240
56123 - City Accounting Services		939
56124 - City Contract Compliance-Purchasing Services		768
56411 - City Vehicle Rentals		28,131
58726 - Prior Year Adjustments: O & M		599
59314 - Operating Transfers Out: Contributions to Fund Balance (Budget Only)		19,996
Grand Total	**3,577,377**	**3,577,377**

For comparison, Actual Expenses for FY 2012-2013 were as follows:

Object	Object Description	FY 2012-13 Expenses
51100	Salary	578,719
51200	Overtime	65,546
51300	Allowances/Buybacks	1,803
51400	Premiums	57,734
51500	Paid and Unpaid Leaves	126,109
51600	Fringe Benefits and Retirement Contributions (City Paid Only)	423,025
51900	Miscellaneous Payroll Adjustments	2,836
52200	Stationery and Office Supplies	11,435
52500	Electrical, Plumbing and Construction Supplies	155,219
52900	Other Supplies and Commodities	442
53100	Utilities	79,030
53200	Rental of Real and Personal Property	134,245
53600	Postage and Mailing	2,206
53700	Other Services	3,575
54400	Architectural and Engineering Services	28,885
54500	Legal Services	17,973
54600	Repairs and Maintenance	66,193
54700	Printing and Duplicating Service	3,283
54900	Other Contract Services	242,184
55300	Memberships and Dues	-120
56100	Facilities Support	181,324
56400	Equipment Rentals	15,732
57100	Land	10,436
57200	Buildings	65,025
57300	Structures and Improvements (Other Than Buildings)	5,053
57500	Furniture and Equipment	55,515
57700	Other Fixed Assets / Computers and Software (Over $5,000)	181,133
57800	Other Non-Capital Traceable Assets (Under $5,000)	81,828
57900	Depreciation	5,169
58500	Burden and Overhead Allocations	12,948
Grand Total		**2,614,485**

Funds left over from the Contingency Fund carry forward year to year in a Reserve Fund. Oakland DIT reports that the current Reserve Fund balance is approximately $1.57 million.

Personnel costs funded out of the Radio Fund (4200) include the following:

Employee And Position Name	FTE (% Funded by 4200)	Amount
Accountant III	0.33	$38,100
Accountant II	1.00	$116,631
Administrative Services Manager	0.20	$24,007
Telephone Services Specialist	0.25	$32,657
Interim CIO	0.50	$133,102
Systems Programmer II	0.33	$39,312
Vacant - Telecommunication Systems Engineer	1.00	$131,015
Vacant - Electronics Technician	1.00	$105,371
Electronics Technician	1.00	$126,661
Microcomputer Systems Specialist II	1.00	$125,719
Electronics Technician	1.00	$122,928
Electronics Technician	1.00	$126,661
Electronics Technician	1.00	$114,331
Total	**9.61**	**$1,236,495**

The costs for the Radio Shop Supervisor (Information Systems Supervisor) are not currently included in the 4200 Radio Fund. The fully burdened costs for that position are $159,647 per year.

The last 7 positions on the personnel table (including the two currently vacant positions), plus the Information Services Supervisor, are the positions that comprise what most people think of as "The Radio Shop". The first 6 positions on the personnel table include other administrative positions or functions that are fully or partially funded out of the Radio Fund.

The personnel listed in the table above have other duties in addition to radio system duties, so their functions must be preserved (or consolidated) even if the City outsources all of its radio service and radio maintenance responsibilities.

The City's Radio Shop currently maintains the following systems:

- Post – warranty support of the P25 system
- EDACS Multicast Radio System
- Dispatch console system support for dispatch consoles
- Radio system logging recorder support
- Mobile radio installations for public safety departments
- User radio first echelon repairs for mobile and portable radios
- User programming and template development for all radio users
- Public Safety Mobile Data Systems
- VHF Interoperability Systems
- Wireless networks used to support City facilities
- Closed Circuit Television Systems for all City facilities
- 29-Site Outdoor Warning System
- Post – warranty 11 GHz microwave system

- 19 GHz Harris Farinon Microwave System

The Radio Shop costs will carry forward in some form regardless of whether Oakland chooses to move to the EBRCS system or to remain on its own system, as the functions performed by the personnel and departments included in that budget will still need to be performed In support of the City's radio subscriber fleet. And moving to EBRCS will not eliminate the City's need to have the IT Department and Radio Shop continue to take care of the City's other telecommunications electronics.

Further, the City Radio Shop is currently understaffed and is not sufficiently trained to take over maintenance of the City's P25 infrastructure from Harris and DWC, who are currently providing all of the backbone maintenance and much of the subscriber maintenance. In future budget years, the City will need to either hire and train additional staff, or make up for that deficiency by hiring outside personnel to make up the difference. As is discussed further in Section 5.8, whether the City maintains its own backbone infrastructure or gives that job to Alameda County, **the City will still need to do something about maintaining its own subscriber equipment**.

If the City elects to stay on its own radio system or preserve the existing Oakland P25 system as a backup system, then the City will incur additional costs associated with backbone maintenance that it is not currently paying today. Other costs that the City should incur as it enhances its own maintenance capabilities include remote network monitoring of the P25 backbone and a software FX agreement, both with Harris.

As budgetary estimates, the City should expect to add the following amounts to its annual radio system maintenance costs:

For Subscribers only:

Additional Bench Tech (Electronics Technician):		$210,000 / year if outsourced
	(or	$130,000 / year internally)

For Oakland P25 Backbone maintenance:

Network Engineer:		$102,000 / year if outsourced
	(or	$140,000 / year internally)
Software FX agreement with Harris:		$78,000 /year
Remote24x7 Network Monitoring and Support:		$55,000 /year

Further, the City has identified the following system improvements as necessary for the continued operation of the Oakland P25 backbone system (as approved in Oakland City Council resolution 84500):

Seneca Communications Facility – Buildings Shelter Replacement, Emergency Generator Replacement, Grounding & Power Upgrades. *Estimated Cost:* $500,000

GWIN Communications Facility – Emergency Generator Replacement, Power & Grounding Upgrades, Communications Shelter Replacement. *Estimated Cost:* $500,000

The City should also undertake further improvements to shore up the reliability of its backbone system and reduce the risk of single points of failure: $375,000

The City will incur the above costs whether it stays on its own system or preserves its system for backup operation.

If the City elects to shut down its own system entirely and move entirely to EBRCS, then the City can eliminate the additional annual expenses associated with the Network Engineer, the Software FX agreement, the Remote 24x7 monitoring, and the further improvements to the Seneca and Gwin sites.

5.7.2 EBRCS

Relocating to the EBRCS system will cost the City of Oakland $200 per radio to join, plus $31 to $33 per month per radio for ongoing usage fees. ($33 per month if just Police and Fire move to the EBRCS system; $31 per month if all radios move to the EBRCS system.

Given the City's current quantities of active radios, **if all Oakland users moved to the EBRCS radio system**, then the initial costs to join the EBRCS system would be:

Department:	Joining Cost:	
Oakland Police Department	$200/unit x 1500 units =	$300,000
Oakland Fire Department	$200/unit x 700 units =	$140,000
Oakland Public Works	$200/unit x 500 units =	$100,000
Oakland Total Up Front Joining Cost:		**$540,000**

And the ongoing costs would be:

Department:	Annual Cost:	
Oakland Police Department	$31/month/unit x 1500 units =	$46,500 /month
Oakland Fire Department	$31/month/unit x 700 units =	$21,700 /month
Oakland Public Works	$31/month/unit x 500 units =	$15,500 /month
Monthly Ongoing Cost:		$ 83,700 /month
Annual Ongoing Cost:		**$ 1,004,400 /year**

If Oakland moves only its Public Safety users to the EBRCS radio system (and keeps public service agencies on the Oakland system to ensure the Oakland system remains live and operational as a backup), then the initial costs to join the EBRCS system would be:

Department:	Joining Cost:	
Oakland Police Department	$200/unit x 1500 units =	$300,000
Oakland Fire Department	$200/unit x 700 units =	$140,000
Oakland Total Up Front Joining Cost:		**$440,000**

And the ongoing costs would be:

Department:	Annual Cost:	
Oakland Police Department	$33/month/unit x 1500 units =	$49,500 /month
Oakland Fire Department	$33/month/unit x 700 units =	$23,100 /month
Monthly Ongoing Cost:		$ 72,600 /month
Annual Ongoing Cost:		**$ 871,200 /year**

Keeping non-public safety agencies on the Oakland P25 system would save $100,000 in joining fees, and $133,000 per year in ongoing expenses versus moving them to the EBRCS system.

It is important to note that the ongoing costs in either scenario:

1. Include maintenance of the EBRCSA backbone, the OPD dispatch center consoles, and the OFD dispatch center consoles, but do NOT include maintenance of the City's end-user radios.

2. Can be adjusted at any point in the future by a vote of the EBRCSA Board as needed to keep the system operating.

The costs in this section address only the costs associated with Oakland radios, and do not include the costs associated with relocating other agencies that currently use Oakland as their primary system.

5.7.3 Cost Summary

So under Option A where Oakland would move all radio units over to EBRCS the summarized cost to the City for moving to EBRCSA would be as follows:

Option A: Move all units to EBRCS

EBRCSA Joining Fee:	$540,000.00
Backbone Improvements:	$0.00
Subscriber Replacement:	$15,120,000.00
Subscriber Programming:	$256,500.00

Subscriber Installation:	$250,000.00	
Misc. Program Management, Training, and other services	$1,000,000.00	
	$17,166,500.00	
Annual Fees:	$1,004,400.00	per year
Outsource Subscriber Radio Maintenance (2 techs equivalent):	$420,000.00	per year
Upgrade Oakland Maintenance Capabilities:	$0.00	per year
	$1,424,400.00	**Per year**

Option A: Total five-year cost: $24,288,500.00

Under Option B if Oakland chose to stay on and maintain its own radio system, including the defined upgrades to the System, the cost would be as follow:

Option B: Stay on Oakland System

EBRCSA Joining Fee:	$0.00	
Backbone Improvements:	$1,375,000.00	
Subscriber Replacement:	$15,120,000.00	over 3-5 years
Subscriber Programming:	$256,500.00	over 3-5 years
Subscriber Installation:	$250,000.00	over 3-5 years
Misc. Program Management, Training, and other services	$1,000,000.00	over 3-5 years
	$18,001,500.00	
EBRCSA Annual Fees:	$0.00	per year
Outsource Subscriber Radio Maintenance:	$0.00	per year
Upgrade Oakland Maintenance Capabilities:	$403,000.00	per year
	$403,000.00	**per year**

Option B: Total five-year cost: $20,016,500.00

Finally, if the City elected to move public safety only to EBRCS and keep the Oakland system to support public works and as a back up the cost would be as follows:

Option C: Move Public Safety to EBRCS; keep Oakland for Backup and Pub Works

EBRCSA Joining Fee:	$440,000.00	
Backbone Improvements:	$1,375,000.00	
Subscriber Replacement:	$12,320,000.00	
Subscriber Programming:	$256,500.00	
Subscriber Installation:	$250,000.00	
Misc. Program Management, Training, and other services:	$1,000,000.00	
	$15,641,500.00	
EBRCSA Annual Fees:	$871,200.00	per year
Outsource Subscriber Radio Maintenance:	$445,000.00	per year
Upgrade Oakland Maintenance Capabilities:	$0.00	per year
	$1,316,200.00	**per year**
Option C: Total five-year cost:	**$22,222,500.00**	

6. Microwave System Assessment

6.1 Overview

A major City asset is the recently installed 11 GHz Aviat Microwave System that interconnects various City sites including the three P25 radio sites. Any impact to the Harris P25 radio system will concurrently impact the City's Microwave network. This section will provide a brief description of the city owned microwave system and EBRCS microwave system and outline the advantages and disadvantages of both.

6.1.1 Oakland microwave network.

The microwave system consist of nine (9) hops of Aviat Eclipse 11 GHz high capacity (112 DS1 (176 Mbit/s)) microwave radios.

Aviat installed the new microwave radio equipment in older, preexisting shelters.

The microwave radios, for the most part, are split architecture, meaning the circuit interface part indoor unit (IDU) of the radio sits in the shelter and the radio frequency part, outdoor unit, (ODU) sits behind the antenna or on the tower.

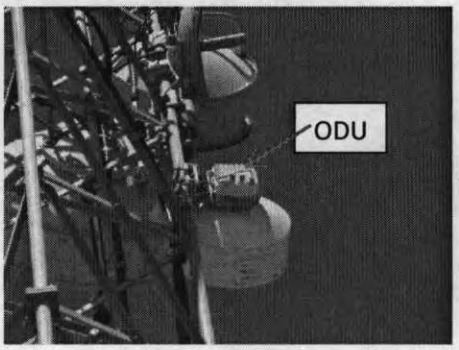
The fact that part of the microwave radio equipment is mounted up on the tower where it is not reachable by a technician on the ground impacts network reliability. In short network reliability is calculated in part by Path reliability, equipment failure rate, and meantime to restore. The Oakland system consists of non-standby equipment in a ring configuration. If there is a failure the ring protection will counter the effects of the failure, however if there are multiple failures and/or a path fade at the same time as a failure, traffic will be lost between the outage points until the condition is corrected.

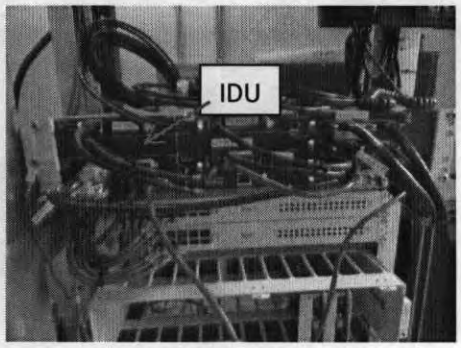
Therefore, meantime to restore will be greater with the ODU on towers requiring certified climbers to access. That is partly due to the need for a knowledgeable technician, someone with a climbing certification, and a spotter to complete the ODU repair under OSHA requirements, albeit this could be two people with the combined three skills. And the time it takes to deploy the "crew".

If the ODU was accessible on the ground any knowledgeable technician could make repairs without assistance. As it typically takes longer to deploy a "crew" than a single knowledgeable technician the network reliability will suffer.

Some of this may be covered in Oakland's maintenance contract. However many such contracts only specify response times for a first responder but not specifically for the people required to fix the problem. Bottom line, reality dictates that it will take longer to repair an ODU on a tower than equipment located on the ground and therefore the network reliability is reduced.

Oakland should review their maintenance contract to make sure ODU replacement times are covered otherwise they could be waiting days if not weeks for a tower crew to show up. E.g. in the early 2000s It took two weeks for ATT Wireless to get a tower climber deployed to replace an ODU in the Midwest.





Aviat designed the microwave paths for 99.9999% or better availability. The microwave hops are configured in a ring. Ring architecture allows for alternate routing of traffic in case of a radio failure, thereby improving network reliability.

Aviat provides remote 24 X 7 monitoring of the microwave system. The sites are alarmed and closely monitored for intruders. Some of the sites have recently received new security fencing and portable generator upgrades. Lightning protection and grounding are in need of upgrades to bring them up to the latest lightning and grounding specifications.

The network has a large amount of unused circuit capacity that could be used for Oakland city telephone and Ethernet IT traffic.

City staff needs to be properly trained and equipped to service and support the new Aviat microwave system.

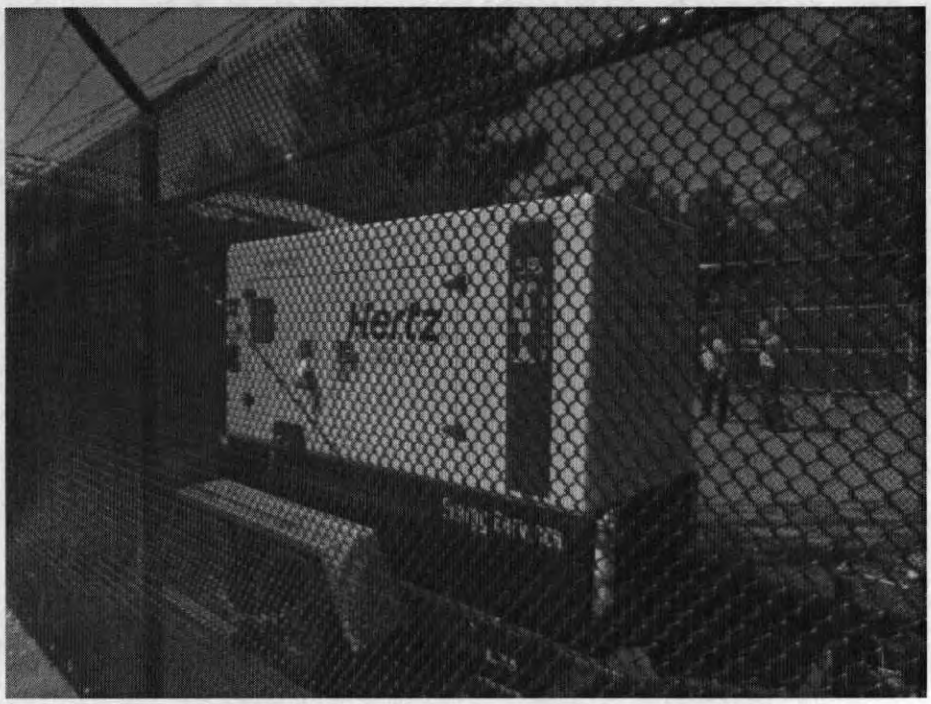
Of noteworthy concern is the Station 25 site mandatory tower removal. This means the microwave network must be reconfigured with at least one new site to replace station 25. The EBRCS Skyline site is a candidate site. The new paths would be MSC to Skyline and Eastmont to Skyline but the path engineering, path survey, leasing, zoning, permitting, etc. must be completed before it can be confirmed that the Skyline site could indeed replace station 25.

According to the path profile an approximate antenna centerline of 180' is needed at Skyline from Eastmont that would require a 200' tower. In addition the antenna centerline at Eastmont would need to be 50' above ground. So it is critical that a path survey be conducted to establish the true centerlines before a firm budget is in place. That said, the cost depends on how seamless the City want to make the transition. Moving the microwave equipment will result in a substantial period of time the network traffic would be unprotected. That could cause an unwanted traffic outage if a failure were to occur somewhere else on the network. It would be safer to install two new radio hops, cutover traffic and then remove the FS25 equipment.

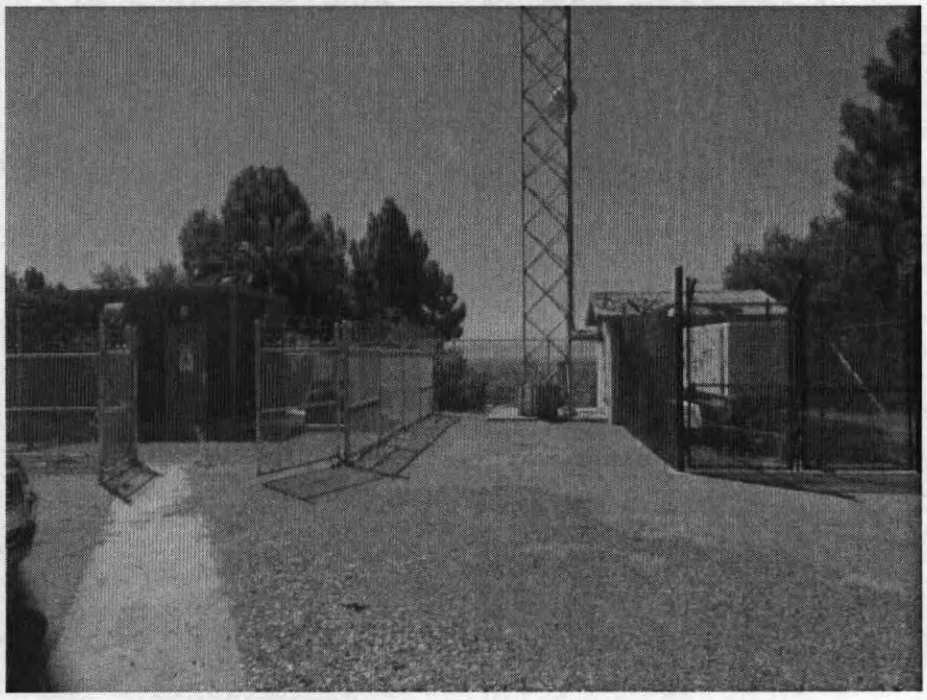
RCC has provided a budgetary cost estimate for the 2 hop replacement for Station 25 below. The pricing is strictly budgetary and is based on past experience with microwave system installations. It also assumes the 50' centerline at Eastmont will require no special antenna mast.

Oakland budgetary cost 2 hop replacement for FS25

		Cost per ea.	System	150 FOP	Skyline	Eastmont	FS25	Total
1.	**Engineering design**							
a.	Site survey	$ 2,200.00		1	1	1		$ 6,600.00
b.	Path survey	$ 4,000.00	2					$ 8,000.00
c.	Path calculations	$ 500.00	2					$ 1,000.00
d.	Frequency coordination	$ 1,200.00	2					$ 2,400.00
e.	Structural analysis	$ 6,500.00		1		1		$ 13,000.00
2.	**Equipment cost.**							$ -
a.	Microwave radio	$ 30,000.00		1	2	1		$ 120,000.00
b.	Antennas	$ 3,500.00		1	2	1		$ 14,000.00
c.	Transmission lines	$ 2,500.00		1	2	1		$ 10,000.00
d.	Jackfields	$ 3,500.00		1	2	1		$ 14,000.00
e.	Miscellaneous	$ 5,000.00		1	2	1		$ 20,000.00
3.	**Tower and construction**							$ -
a.	200' Self-support tower	$ 250,000.00			1			$ 250,000.00
b.	Tower construction	$ 75,000.00			1			$ 75,000.00
4.	**Outdoor cabinet and construction**							$ -
a.	Outdoor cabinet	$ 3,500.00			1			$ 3,500.00
b.	Cabinet installation	$ 1,500.00			1			$ 1,500.00
5.	**Installation and test**							$ -
a.	Equipment installation	$ 8,500.00		1	2	1		$ 34,000.00
b.	Antenna installation	$ 10,000.00		1	2	1		$ 40,000.00
c.	Antenna alignment	$ 1,500.00		1	2	1		$ 6,000.00
d.	Hop and System test	$ 6,500.00		1	2	1		$ 26,000.00
e.	Alarm and control integration	$ 1,500.00	1					$ 1,500.00
6.	**Decommissioning**							$ -
a. Equipment removal		$ 2,500.00					1	$ 2,500.00
b. Monopole removal		$ 15,000.00					1	$ 15,000.00
c. Site reclamation		$ 6,000.00					1	$ 6,000.00
d. Antenna and transmission line removal		$ 3,500.00		1		1	2	$ 14,000.00
							Grand total	**$ 684,000.00**



Oakland Fence and portable generator at Seneca site



EBRCS shelter on left Oakland shelter on right at Seneca

6.1.2 EBRCS microwave network.

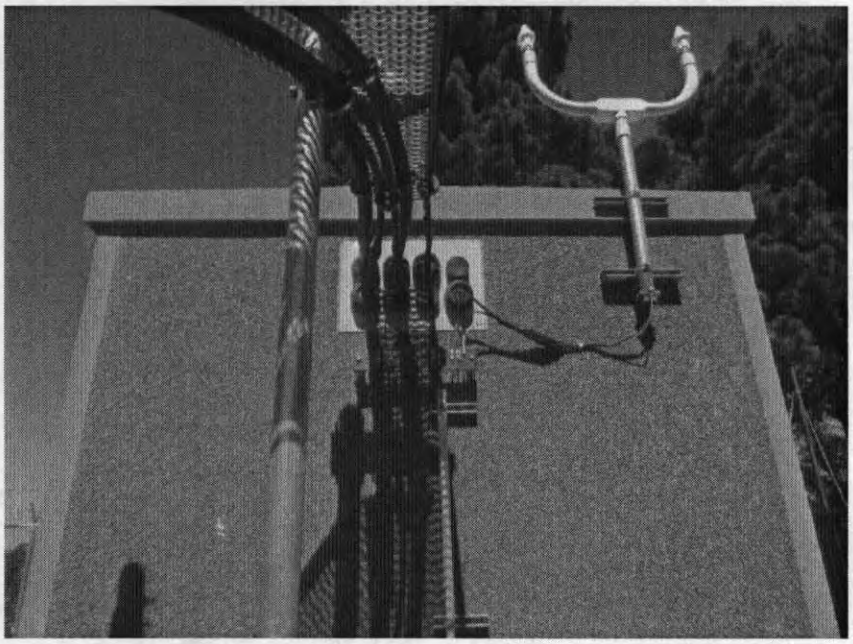
The EBRCS microwave system consist of twenty three (23) hops of Harris TRuepoint™ high capacity (OC-3) microwave radios, twenty one (21) hops of Harris TRuepoint™ low capacity (16T) microwave radios and eight (8) hops of Aviat Eclipse low capacity (16T) microwave radios.

Harris installed the microwave radio equipment in mostly new shelters. The shelters are up to date on the latest lightning and grounding specifications and have all new ancillary equipment e.g. batteries, rectifiers HVAC, etc.

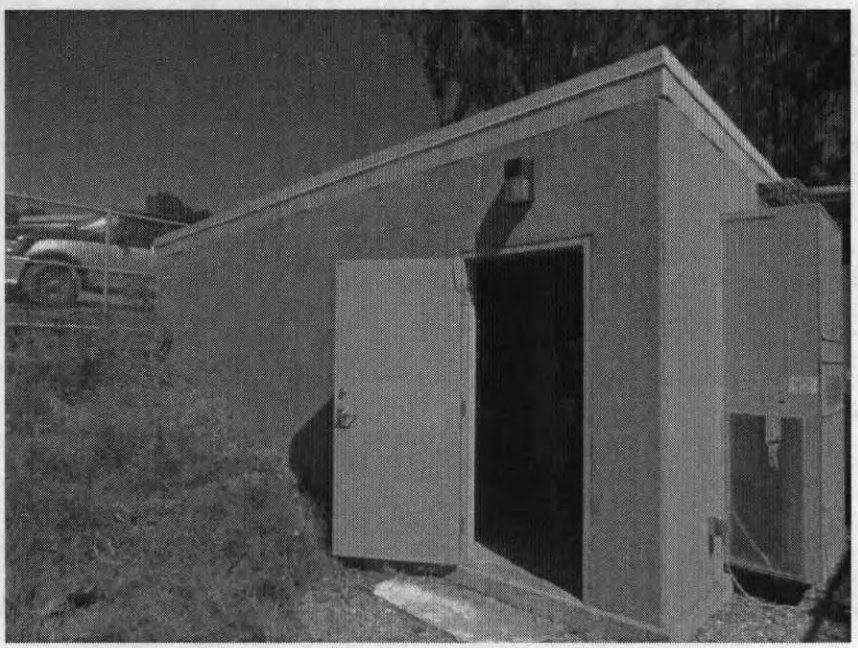
The TRuepoint™ microwave radios, for the most part, are all indoor architecture, meaning all radio electronics sits inside the shelter and waveguide connects to the antenna on the tower. When RCC visited the EBRCS sites door alarms were noted, however there was no communication made by the person opening the door that it was indeed someone that should be there, in return there was no sign that the party monitoring the alarms challenged the door alarm. It is unknown at this time who EBRCS uses to monitor radio and station alarms. **It should be noted that the Harris TRuepoint radio is manufacturer discontinued.** The estimated meantime to repair for the TRuepoint™ radios is 5 years. This will result in repair and spare restocking issues in the near future.

Harris TRuepoint™ radios were very popular in the industry. Making manufacture spares in high demand. RCC contacted Aviat and inquired about TRuepoint™ spare parts availability, and learned that some parts are already depleted and will not be produced. There is a market of used parts to pick from, but the economics of used parts is always a question. At the time RCC departed the survey EBRCS was to have a meeting with Aviat to discuss TRuepoint™ replacement. The results of that meeting and the future plans for remediation are unknown to RCC at this time. Costs to eventually replace the outdated equipment will need to be addressed by EBRCSA.

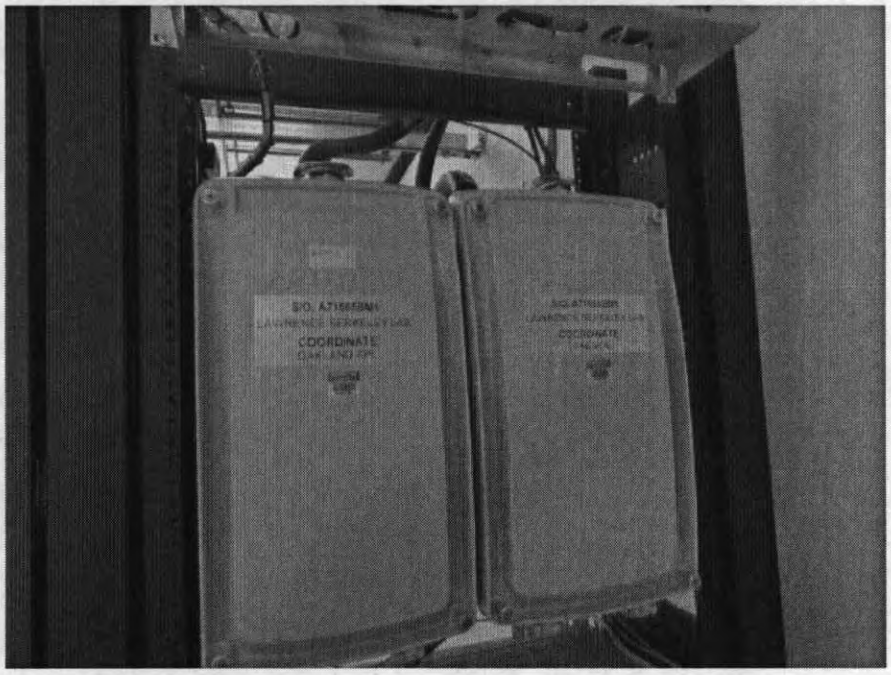
EBRCS Generator at Seneca Reservoir



EBRCS Shelter at Seneca Reservoir



EBRCS shelter at Berkeley Labs



Manufacturer discontinued TRuepoint radios

6.2 Comparison: Oakland vs EBRCS Advantages and Disadvantages

category	Oakland	Oakland issues	EBRCS	EBRCS issues
Network Ownership	Self-controlled	May require additional manpower and station improvements to realize full potential.	Oakland dependent on EBRCS	Oakland leases EBRCS facilities. Recurring cost for microwave usage (other than P25 radio system) TBD.
Circuit capacity	Avait build documentation shows 6 T1s are utilized for Public safety traffic throughout the network. The radio network is capable of 112 T1s. One T1 equals 28 telephone circuits	May require additional manpower and station improvements to realize full potential.	Limited amount of circuit capacity available	Many radio hops are only 16 T1
Network reliability	Ring architecture, alternate route capability	Split architecture (IDU/ODU) has a longer mean time to restore failed outdoor (ODU) units.	Ring, and spur architecture	Spurs sites have no alternate route in case of a failure. Microwave radios are out of production, which may lead to an extended outage due to dwindling spares in the future.
Traffic Flexibility	Can be used for all types of Oakland city circuits, e.g. voice, video, Ethernet etc.	May require additional manpower and station improvements to realize full potential.	Relegated to public safety traffic	Limited amount of circuit capacity available EBRCSA TRANSPORT PLAN for ALCO Loop Updated 6-28-2013.xls show 79 out 0f 84 T1s provisioned.
Shelter condition	Need updates	HVAC, Grounding, batteries etc.	New shelters	minimal upgrades needed

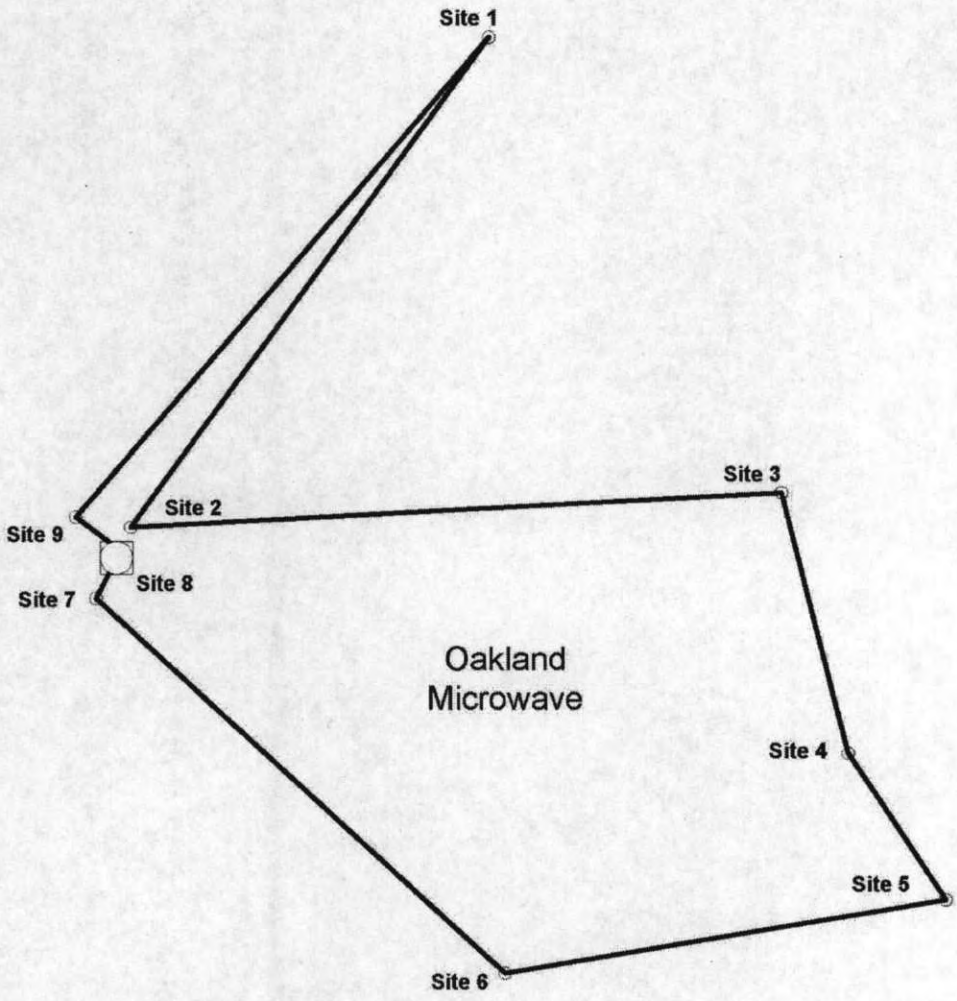
Microwave radios	Still in production	None known	Harris name changed to Aviat	TRuepoint radios are out production. Depending on cutover and test procedures: Traffic outages may be expected during radio replacement.
Generators	Currently rented at Seneca site.	Recurring cost	Owned	None known
Site security	Alarms actively monitored and challenged when remote entering sites	None	Passive alarmed	No indication of personnel being questioned when entering remote sites
Site signs	None posted	No contact information in case of an emergency	None posted	No contact information in case of an emergency
FCC Licensing	All Microwave paths licensed	It is highly advisable that Oakland contract frequency protection	All Microwave paths licensed	Licensed to Alameda County, Radio Services Group

6.2.1 Opportunities for consolidation or sharing with EBRCS

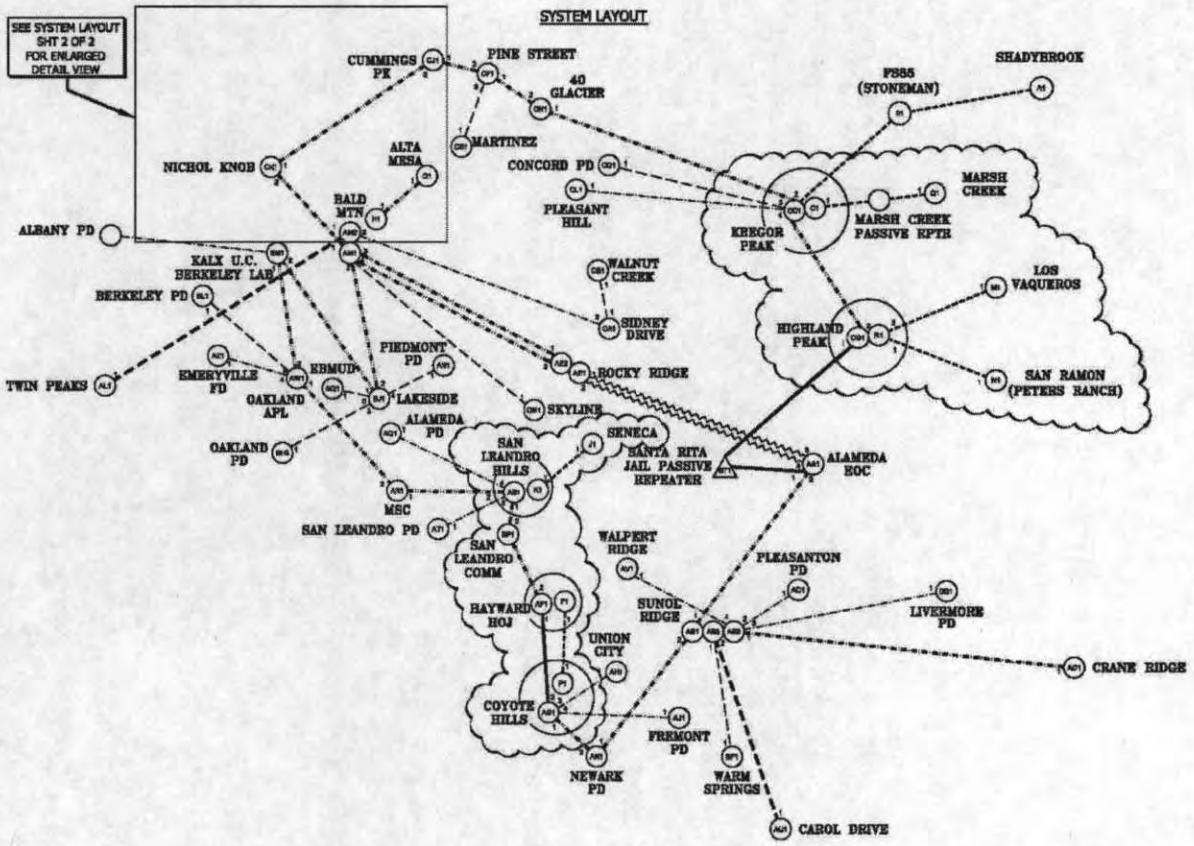
EBRCS could benefit from incorporating Oakland's microwave network into their network design for the NW cell.

The Oakland microwave system would provide EBRCS needed additional capacity, and a redundant backhaul route for their Seneca spur. The City should consider the potential of the Oakland network for city use before giving into sharing or including it in any contract agreements.

6.2.2 Oakland system diagram



6.2.3 EBRCS system diagram



6.3 FS 25 Site

RCC has learned that the microwave site at Fire Station 25 is very unpopular with the surrounding neighborhood. RCC was asked if an alternative path could be found to allow the removal of the tower at FS25.

Preliminary path profiles indicate that the tower at the EBRCS Skyline site could be used as a replacement for the tower at FS25, as there appear to be no terrain obstructions between Frank Ogawa Plaza and Skyline, or between Eastmont PD and Skyline. Both paths would need to be checked visually for other obstructions, such as tall buildings, billboards, or tall tress blocking the path. The path between Skyline and Eastmont is particularly at risk, as the actual tree height .4 miles from the Skyline site will prove critical.

If the path to Eastmont does not work, then a path between the Police Dispatch Center tower at the Municipal Service Center (MSC) could be explored. That path would also clear terrain obstructions, but would also need to be checked for tree and building obstructions, particularly at the MSC end of the path, where local trees are tall relative to the height of the MSC tower.

Using the Skyline tower would require:

- two physical path surveys (typically $4,000 for the two paths) to verify path obstructions and required antenna height at each end
- Frequency coordination for the two paths (typically $1200 for the pair)
- a structural analysis (typically $3,500 to $5,000) by a structural engineering firm to ensure that the tower could safely hold the two microwave dishes that would need to be added,
- a usage agreement with the tower owner (FAA)
- a shelter space agreement with EBRCSA.

RCC recommends proceeding with the path verification, regardless of which long-term decision the City makes regarding their radio system.

6.4 Additional Loop Protection for EBRCS Skyline and Seneca Sites

The current EBRCS microwave system layout currently includes a spur to the Seneca site from San Leandro Hills and a spur to the Skyline site from Bald Mountain. A "spur" means that the site is connected to the rest of the system via only one path, and not by two separate paths as sites on a "ring" are protected.

Since the EBRCS Seneca site is currently co-located with the Oakland Seneca site, an opportunity exists to provide loop protection for the Seneca site using paths of the Oakland ring to connect back to another site where EBRCS microwave equipment is collocated with Oakland equipment, such as at the MSC or at APL.

Similarly, if Oakland installs a path between Eastmont and Skyline (or any other location and Skyline), the Skyline site could benefit from loop protection to a common point with Oakland.

6.5 Microwave Summary

Primary observations from RCC's visit include

- The Oakland microwave network is well designed from an equipment standpoint.
- The shelters at Seneca and Gwin need updates in grounding, HVAC, and ancillary equipment such as batteries.
- The shelters are small compared to EBRCS shelters but may be adequate for Oakland's needs.
- Additional emphasis should be placed on promoting utilization of the network's available circuit capacity to reduce recurring costs in other areas.

- **The City of Oakland must plan on continuing to maintain its microwave network,** regardless of whether it decides to stay on its own radio system or move to EBRCS.

- The City of Oakland should retain frequency protection services to protect its microwave system from encroachment by other licensees.

The Oakland microwave network is obviously essential if the City stays on its own system, and is equally essential if the City chooses to maintain the system as a backup to the EBRCS network. The Oakland system also provides the City the ability to relocate some of its leased services off of commercial facilities, as originally intended when the City constructed the microwave system. (Before other City IT priorities diverted resources away from that effort.)

The Oakland system also provides some opportunity to provide an alternate path to connect the EBRCS Skyline and Seneca sites to the rest of the ring.

RCC strongly suggests that Oakland retain a frequency coordination house (e.g., ComSearch, Micronet, etc.) to provide frequency protection services for their system. This is needed to protect the City's microwave system from interference from other microwave licensees, who may be able to get their licenses approved even though they cause harmful interference to the Oakland system. A frequency coordination house can be retained to watch for potential interference from other license applications, and take action to protect Oakland's interests.

Frequency protection services typically cost $100 to $300 per month.

7. Summary

The findings of this Report have focused on where the City is at this point in time operationally with the operational perception of the Oakland P-25 Harris System and comparing and assessing the viability of migrating over to the EBRCS Motorola P-25 regional radio system.

At the commencement of this analysis, and taking into consideration the findings from the In-Building Tests performed earlier this year, it is clear that there has been a significant improvement in the perception of the Oakland Public Safety Radio System among the Oakland staff members interviewed for this report. Two years ago there was great anxiety and dissatisfaction with the Oakland System. The line officers and the Oakland Police Officer's Association (OPOA) that speaks for the officers were concerned, and rightfully so. This perception was definitely not helped by the media that continually reported negatively about the Oakland System. There were real problems which presented significant safety issues for the citizens of Oakland and public safety officers.

One issue that still stands out is the performance of the aging Harris P7200 radios. There was a significant misfire when the City's analog system was cutover to the current Harris digital P-25 system in 2010. This was compounded by the lack of preparation and training provided to the users, particularly the OPD officers on the street. The result was that the cutover was set up to fail; problems and technology misfires resulted in a complete mistrust of the radio system from the start. Part of the initial disappointment with the P25 system stemmed from the fact that the officers had been led to believe that this was a new system, and not simply a partial upgrade to an older system with aging infrastructure.

Driven by the initial RCC Report and Recommendations in 2012, the City set about addressing three key issues:

1. Interference issues that were identified in the Report that seemed to be uniform over the Oakland service area.
2. Shoring up key deficiencies in the infrastructure that had been identified in the report.
3. Providing preventive maintenance to the fleet of user radios

These issues have been addressed to a significant extent and have resulted in measurable improvements in the perception of the Radio System, demonstrated by the response of Police and Fire staff members interviewed as part of this current analysis. Generally, the improvement in performance is recognized as a result of an aggressive taskforce put in place by the City's new radio supervisor and a taskforce that he pulled together with Harris, Dailey Wells, and an interference mitigating consultant. The net result is a significant improvement in eliminating the interference issue and significant improvements to the overall performance and reliability of the Oakland radio system.

A concern with the current radio system is that while the taskforce has solved the problems with interference and system performance, the City still needs to make a similar investment in hiring, training, and equipping radio shop personnel. The City needs to either commit to moving forward with Radio Shop improvements, or outsource these services entirely by joining EBRCS, hiring an outside agency to maintain the fleet of user radios, and in RCC's perspective get out of the radio business.

RCC's evaluation of both the current Oakland Harris System and the EBRCS systems finds both of these platforms technically and operationally viable alternatives for the City, although each has its own strengths and weaknesses. The course of action preferred by any one individual will depend upon that individual's relative priorities in the categories of:

- Overall **Cost**
- Operational **Control**
- Radio System **Coverage**
- Radio System features and **Capabilities**
- **Interoperability** with surrounding agencies

The two main alternatives provide very similar radio coverage within the Oakland service area, and both systems provide similar capabilities.

The EBRCS system offers an advantage in coverage beyond the Oakland service area, and offers the highest level of interoperability with other agencies in Alameda County and Contra Costa County outside of Oakland's city limits.

Staying with its own radios system gives the City the greatest level of control over both its own operations and its own expenses.

Both systems provide interoperability with outside agencies that have moved to the P25 platform. Indeed, the City of Oakland already allows outside users, including some EBRCS users, to operate on its system, and is not currently charging their interoperability partners for system access.

Two significant issues must be addressed by the City regardless of which decision they make:

1. The City should upgrade its current subscriber radio fleet (even if it stays on its own system)
2. The City must focus on upgrading (or outsourcing) its subscriber maintenance capabilities

Oakland personnel report that their biggest remaining issue with the Oakland system involves their P7200 portable radios, and user feedback from officer testing indicates that newer models of Harris portable radios perform better than the P7200s. Portable radios for public safety personnel should be replaced as soon as possible. RCC recommends that the City obtain samples of current models of public safety radios from Harris, Motorola, and other P25 manufacturers, and evaluate them on the Oakland system, the EBRCS system, and the BART P25 system. It is possible that the City could carry out this migration over several years through attrition and replacement if the City remains on the Oakland System, or the City could manage this process in as part of its cutover to EBRCS. Public safety radios in particular should be replaced if the City decides to move to the EBRCS system. In either case, the City needs to plan on and budget for replacing its subscriber fleet.

Replacing the entire subscriber fleet is likely to cost the City $15 million to $20 million, regardless of whether the City stays on its own system or moves to the EBRCS system. (Competitive pressures and bulk procurement may both be managed to help the City achieve greater discounts. Both are best managed though a competitive bidding process involving large numbers of subscribers.)

As noted in Section 5.8, the City of Oakland needs to take active steps to upgrade the ability of its Radio Shop to maintain the Oakland system and the Oakland fleet of radios, if Oakland intends to remain in the radio business. If the City elects not to make that investment in its own personnel, then the City must formalize an agreement with a third party (contractor or other governmental agency) to supplement or take over that role from the City. At present, the City relies heavily upon Dailey-Wells and Harris for that assistance, but does not have a formal maintenance agreement or network monitoring agreement in place.

At a minimum, supervisory staff should be trained in management and diagnostics of the Oakland system, so that they will be prepared to oversee the work done by outside contractors.

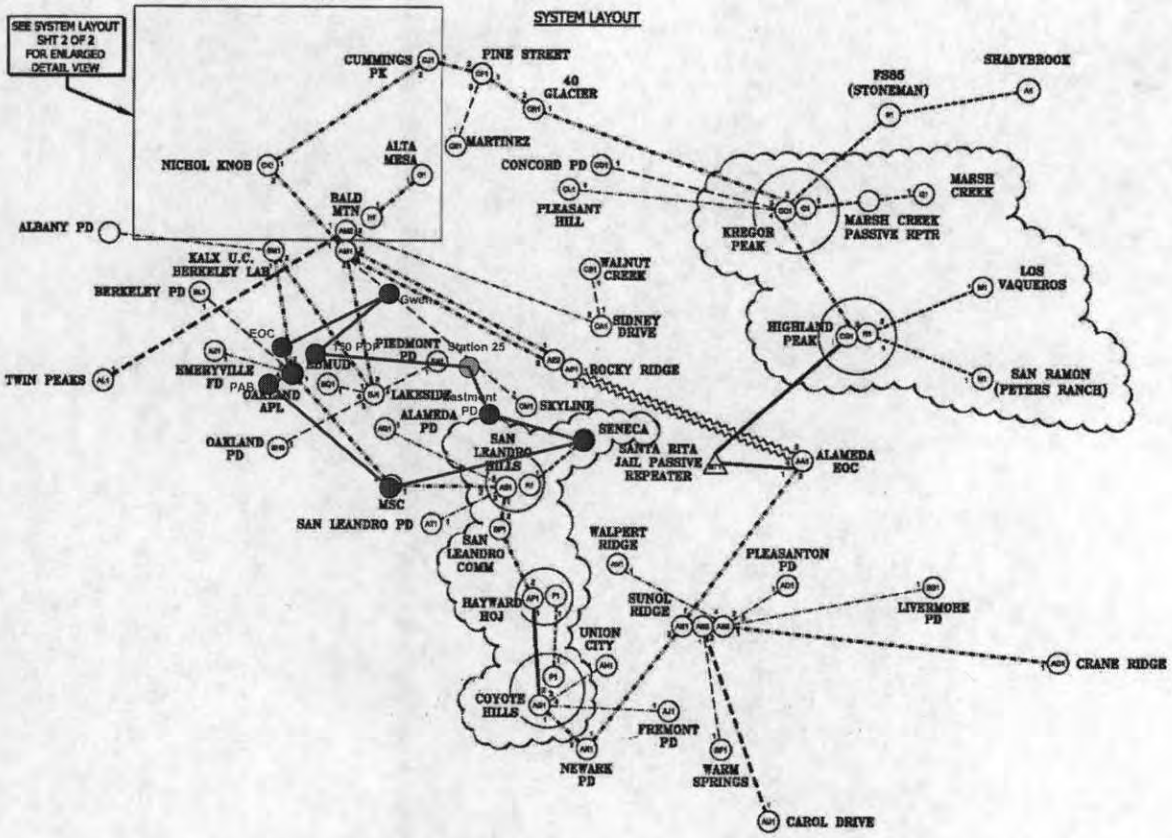
From a business case perspective, there are several key considerations.

- The City has significant investments in radio infrastructure (both the public safety radio and the supporting new microwave network). As discussed in this report, the use of these resources needs to be considered as part of the ultimate decision.

- For the City to remain with its Radio System, it will require a commitment to finish the upgrades to radio sites and build a sustainable radio solution consisting of budgeted operational expenses, technical staff, and set aside funding for the future. To create this **sustainable** solution will be initially more expensive but over time should be less expensive and would give the City real control over this service.

- Moving to EBRCS will provide interoperability throughout Alameda County and Contra Costa County. Moving to EBRCS will be less expensive than finishing proposed improvements to the Oakland system, but is expected to be more expensive over time due to higher annual expenses. Moving to EBRCS will relieve the City of the burden of radio system backbone maintenance. If the City moves to EBRCS, it must still upgrade its subscriber maintenance capabilities or outsource the radio fleet maintenance and have the City manage radios as a service.

- The issue of control and Oakland's position on the EBRCS JPA Board still needs to be addressed. Negotiations with EBRCS needs to include the issues of valuable resources, specifically the microwave system, that could be used to support the portions of the EBRCS network that serve Oakland.



The above diagram overlays the Oakland microwave network (in red) over the existing EBRCS microwave network. With minor site realignment the Oakland microwave network Could provide the City with a loop protected ring architecture. However, the EBRCS network that Oakland would migrate to has 3 of the 4 sites as spurs off of the larger system rings. This deficiency should be addressed prior to Oakland moving to EBRCS. EBRCS recognizes that their microwave system is aging and that it needs to be upgraded, this needs to be clarified to Oakland as part of the decision process.

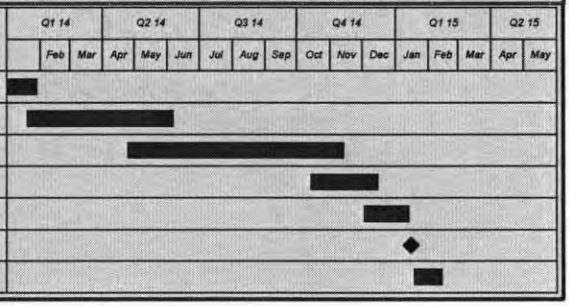
If the City decides to move to the EBRCS system, the transition to the EBRCS system would need to be done in such a way as to not repeat problems that brought about the lack of confidence in the Oakland P-25 system. Specifically, careful attention needs to be given Transition Management, which includes proper expectation setting and thorough training as part of the cutover process.

RCC expects this full conversion process would take just over a year from the completion of negotiations with EBRCS as identified in the schedule below. The schedule below assumes that the City will procure new subscriber radios for its public safety agencies to facilitate the cutover process, and that user radios will be programmed before user training begins. The schedule also assumes that radios will initially be programmed with both the new EBRCS system and the old (or backup) Oakland system.

Task 2 involves the configuration issues associated with improving the microwave connectivity on EBRCS to be comparable to what Oakland currently has in terms of equipment and architecture to provide the same level of reliability, and to address the integration of the logging recorders into the EBRCS platform with the same level of access, reliability and control that Oakland currently has.

Oakland to EBRCS Migration Schedule

ID	Task Name	Start	Finish	Duration
1	Start up and Coordination	1/1/2014	1/28/2014	20d
2	Network Configuration (Site Work)	1/20/2014	6/6/2014	100d
3	Mobile and Portable Reprogramming	4/25/2014	11/13/2014	145d
4	Dispatch Work	10/14/2014	12/15/2014	45d
5	Cutover Preparation (Training)	12/3/2014	1/13/2015	30d
6	Oakland Cutover	1/16/2015	1/16/2015	0d
7	Testing and Commissioning	1/19/2015	2/13/2015	20d



The table below provides a condensed summary of the key advantages associated with either staying on the Oakland system or moving to the EBRCS system:

Issue	Advantage	Brief Synopsis
Cost	Oakland	Relative cost is not a significant factor in choosing whether to stay on the Oakland system or move to EBRCS. If Oakland gives up its system and moves to EBRCS, then long term costs of joining the EBRCS system can be expected to be somewhat higher than the costs of maintaining its own system. If Oakland continues to maintain its own system in addition to moving public safety agencies to EBRCS, then the combined costs of moving and maintaining its own system will be even greater.
Control	Oakland	Oakland currently is not guaranteed a vote on the EBRCS Board. Even with a vote (or votes), Oakland will be part of a 23 member board, and will no longer have sole decision making authority over its own budget and operational issues.
Coverage - Oakland	Neutral	Coverage tests performed in 2013 indicate that both systems provide very similar coverage within Oakland's service area. EBRCS appears to provide slightly better coverage inside large buildings, while Oakland has been more active in combating local sources of interference.
Coverage – 2 Counties	EBRCS	The EBRCS system covers two counties, which would give Oakland users the ability to operate in a larger area when using interoperability channels. (Oakland's primary channels would be limited to a little more than the Oakland service area.
Capabilities	Neutral	Both systems are built to the P25 standard; both systems currently have similar capabilities.
Interoperability	Neutral	Both systems give Oakland users the ability to interoperate with other P25 agencies. EBRCS policy currently allows interoperability with users on its system only to paying users of the EBRCS system. Oakland currently allows outside agencies interoperability access to its channels free of charge. Oakland currently has an ISSI ready to interface the Oakland system to the BART P25 tunnel system, when completed.
Backbone	EBRCS	Oakland has some issues that must be addressed in the near term

Maintenance		in order to ensure effective long-term maintenance of its own system. EBCRS has a plan in place, a budget, and an oversight board to ensure that EBRCS continues to maintain its system.
Subscriber Maintenance	Neutral	Oakland must address the same fleet maintenance issues either way it goes, with similar overall costs

Appendix 1 - Interviewees and Information Sources

Agency	Name
Alameda County ITD	Randy Hagar
Alameda County ITD Director	Tobin Broadhurst
Alameda PD	Lt Rob Frankland
BART	Tom Herold
Berkeley PD	Capt. Lynne Ohlson
Berkeley Radio Shop	Greg Marwick
Compliance Director	Tom Frazier
Dailey-Wells Communications	Shane McFadyen
Dailey-Wells Communications	CJ Hijazi
Dailey-Wells Communications	David Sweet
Dailey-Wells Communications	Thomas Parkinson
EBRCSA	Bill McCammon
Federal Signal Corporation	Chris Lopez
Harris	Thomas DeWitt-Rickards
Hayward	Desi Calzada
Motorola	Gary Durbin
Oakland DIT Accounting	Annie To
Oakland DIT Director	Ahsan Baig
Oakland Housing Authority	Jackie Mesterhazy
Oakland Port Authority	Ron Puccinelli
Oakland Radio Shop	David Cruise
Oakland Radio Shop	Andrew Norleen
Oakland Radio Shop	Louis Sirias
Oakland Radio Shop	Cherelyn Garcia
Oakland Radio Shop	Chung Phang
Oakland Radio Shop	Mohamad Rahnama
OFD Asst Emergency Mgmnt Coord	Cathey Eide
OFD Dispatch	Annette Fountaine
OFD Operations	BC Melinda Drayton
OFD Operations	Tracey Chin
OFD Operations	Cynthia Chimonyo
OFD Operations	Nick Luby
OPD Dispatch	Regina Harris
OPD Operations	Lt Carlos Gonzalez
OPD Tech Unit	Irabe Taylor
OPD Tech Unit	Dave Burke
OPOA	Barry Donelan

OPOA	Daniel Tirapelli
Piedmont Dispatch	Scott Wyatt
Procomm	Ron Seitz
Richmond	Byron Baptiste

City of Oakland Feature Portability Test 10-3-13

		City of Oakland Harris Infrastructure		EBRCS Motorola Infrastructure	
		P/F	Comments	P/F	Comments
Test Setup					
			Testing was performed on the City of Oakland Harris P25 Phase 1 Simulcast system at the downtown Fire Department Dispatch facility. Two C3 Maestro IP Dispatch Consoles were available on the second floor with which to perform the testing. Two test talkgroups, Group D and Group E were added to the two Harris P7200 portable radios and to the C3 Maestro Dispatch Consoles to facilitate testing without disrupting or involving dispatchers.		Testing was performed on the EBRCS Motorola P25 Phase 1 Simulcast system at the Alameda County Radio Shop. An MCC7500 Dispatch Console and a Network Management Terminal were both available at the Radio Shop with which to perform the testing. Two test talkgroups, OPD-1 and OPD-2, were added to the two Harris P7200 portable radios and to the Motorola MCC7500 Dispatch Consoles to facilitate testing without disrupting or involving dispatchers. Note that at the Alameda County Radio Shop, only the EBRCS ALCO Southwest simulcast system can be received inside the Shop by the Harris P7200 portable radio, while outside of the shop in the parking lot both the EBRCS ALCO Southwest and EBRCS ALCO Northwest simulcast systems can be received by the P7200 portable radio.
Tests Involving Only Harris Portable Radios					
1	Talkgroup Call	Pass	Talkgroup calls were successfully placed to and from P7200 Radio 1 and P7200 Radio 2.	Pass	Talkgroup calls were successfully placed to and from P7200 Radio 1 and P7200 Radio 2 with both radios registered onto the EBRCS ALCO Northwest simulcast system. A wide-area talkgroup call was also successfully placed across two simulcast subsystems by using a Motorola APX7000 portable with OPD-1 programmed into it, and registered on the EBRCS ALCO Southwest simulcast system, and by placing talkgroup calls to and from the Harris Radio 1 registered on the EBRCS ALCO Northwest simulcast system.
2	Continuous Assignment Updating	Pass	With both P7200 Radio 1 and Radio 2 on Talkgroup D, Radio 2 was powered down. A talkgroup call was initiated on Radio 1. With the call still in process, Radio 2 was powered up, and via Continuous Assignment Updating, Radio 2 joined the call in process.	Pass	With both P7200 Radio 1 and Radio 2 on Talkgroup D, Radio 2 was powered down. A talkgroup call was initiated on Radio 1. With the call still in process, Radio 2 was powered up, and via Continuous Assignment Updating, Radio 2 joined the call in process.
Tests Involving C3 Maestro Dispatch Console					
3	Talkgroup Call to/from Console	Pass	Talkgroup Calls were successfully performed to and from P7200 Radio 1 to the C3 Maestro Dispatch Console.	Pass	Talkgroup Calls were successfully performed to and from P7200 Radio 1 to the Motorola MCC7500 Dispatch Console.
4	PTT Unit ID/Alias Display	Pass	The PTT ID and Alias displayed properly on the C3 Maestro console talkgroup control window each time a talkgroup call was initiated.	Pass	The PTT ID and Alias displayed properly on the MCC7500 console talkgroup control window each time a talkgroup call was initiated.
5	Emergency Alarm and Call	Pass	The Emergency Button was activated on P7200 Radio 1 while on Group D. The Emergency Alarm appeared properly at the C3 Maestro Dispatch Console on Group D. The Harris P7200 portable radios properly displayed "TxEmerg." Talkgroup Calls were then placed to and from P7200 Radio 1 to the C3 Maestro Dispatch Console while in the Emergency mode. The Dispatch Console was then used to clear the Emergency on the console and clear the TxEmerg from the P7200 radios.	Fail	The Emergency Button was activated on P7200 Radio 1 while on OPD-1. The Emergency Alarm appeared properly at the MCC7500 Dispatch Console on OPD-1. The Harris P7200 portable radios properly displayed "TxEmerg." Talkgroup Calls were then placed to and from P7200 Radio 1 to the MCC7500 Dispatch Console while in the Emergency mode. The MCC7500 Dispatch Console then attempted to clear the Emergency. The Emergency did clear on the MCC7500 Dispatch Console. However, the display on the Harris P7200 portables did not clear, but remained flashing "TxEmerg." A Motorola APX portable radio on the same talkgroup DID have its Emergency display cleared. This test was repeated about 15 times. Only two ways were found to clear the "TxEmerg" on the Harris portable display. 1. The TxEmerg display could be cleared by powering the radio off then back on. 2. The TxEmerg display could be cleared when first the MCC7500 console cleared the Emergency AND then the P7200 portable radio received audio from the talkgroup on which the Emergency took place. Upon receiving this talkgroup audio from another radio or from the MCC7500 console, the TxEmerg was cleared from the P7200 display.
6	Talkgroup Patch	Pass	Set P7200 Radio 1 to Group D and P7200 Radio 2 to Group E. A Patch was then set up between Groups D and E using the C3 Maestro Dispatch Console. Calls were placed to and from the consoles to the radios. The Patch was confirmed to be working properly.	Pass	Set P7200 Radio 1 to talkgroup OPD-1 and P7200 Radio 2 to OPD-2. A Patch was then set up between talkgroups OPD-1 and OPD-2 using the MCC7500 Dispatch Console. Calls were placed to and from the consoles to the radios. The Patch was confirmed to be working properly.

City of Oakland Feature Portability Test 10-3-13

		City of Oakland Harris Infrastructure		EBRCS Motorola Infrastructure	
		P/F	Comments	P/F	Comments
7	Emergency Alarm and Call on Patched Talkgroup	n/a	Note: There is a C3 Maestro console configuration setting (system wide) to specify how the Harris console operates when an Emergency is activated on a "patched" talkgroup. 1. Harris Mode (tested and confirmed) - When an Emergency was declared on a talkgroup included in the patch, the patch remained intact and the Emergency lit up both talkgroup control windows on console. The P7200 radios on all patched talkgroups displayed the Emergency. The C3 Maestro audio could be heard on all patched talkgroups, including the talkgroup on which the Emergency was declared. Audio from talkgroups involved remain patched. 2. Proprietary Mode (tested and confirmed) - When an Emergency was declared on a talkgroup included in the patch, the Emergency talkgroup was separated from the patch and its audio went to unselect speaker. Other talkgroups remained patched. Only the P7200 radios on the Emergency talkgroup displayed the Emergency. The C3 Maestro console talks back only to Emergency talkgroup members when keying the Emergency talkgroup. When Emergency was cleared by the C3 Maestro console, the system automatically re-patched all talkgroups.	n/a	**Note:** There was no known configuration setting on the Motorola MCC7500 console similar to the Harris Mode vs. Proprietary Mode setting on the Harris C3 Maestro console. Results of this test were similar to the **"Harris Mode"** results on the City of Oakland system. When an Emergency was declared on a talkgroup included in the patch, the patch remained intact and the Emergency lit up both talkgroup control windows on console. The P7200 radios on all patched talkgroups displayed the Emergency. The MCC7500 audio could be heard on all patched talkgroups, including the talkgroup on which the Emergency was declared. Audio from talkgroups involved remain patched.
8	Setup Patch During a Talkgroup Call	n/a	Tested the ability to set up a console patch between talkgroups D and E with talkgroup D keyed on Radio 1. The patch did get setup. However, while listening constantly to dispatch console receive audio from Radio 1 during the patch setup process, the audio stopped when the patch was initiated. Radio 1 had to be dekeyed to activate the patch. Subsequent talkgroup calls were fully patched and audio heard properly at the console. The same test was repeated a second time with both talkgroups D and E keyed, with the same results. The same test was repeated a third time with the dispatcher keyed on talkgroup D. The patch CANNOT be setup with the dispatch console keyed.	n/a	Tested the ability to set up a console patch between talkgroups OPD-1 and OPD-2 with talkgroup OPD-1 keyed on Radio 1. The patch did get setup. While listening constantly to dispatch console receive audio from Radio 1 during the patch setup process, the audio could still be heard when the patch was initiated. Radio 1 had to be dekeyed to activate the patch. Subsequent talkgroup calls were fully patched. The same test was repeated a second time with both talkgroups OPD-1 and OPD 2 keyed, with the same results. Could not perform this test with the dispatch console keyed because there was only one test dispatch console.
9	Simulselect	Pass	Set P7200 Radio 1 to Group D and P7200 Radio 2 to Group E. A Simulselect was then set up between Groups D and E using the C3 Maestro Dispatch Console. Calls were placed to and from the consoles to the radios. The Simulselect was confirmed to be working properly. Both portable radios could hear console audio, but one portable could not hear transmission from other portable.	Pass	Set P7200 Radio 1 to talkgroup OPD-1 and P7200 Radio 2 to OPD-2. A Simulselect was then set up between OPD-1 and OPD-2 using the MCC7500 Dispatch Console. Calls were placed to and from the console to the radios. The Simulselect was confirmed to be working properly. Both portable radios could hear console audio, but one portable could not hear transmission from other portable.
10	Emergency Alarm and Call on Simulselected Talkgroup	n/a	Note: There is a C3 Maestro console configuration setting (system wide) to specify how the Harris console operates when an Emergency is activated on a "Simulselect" talkgroup. 1. Harris Mode (tested and confirmed) - When an Emergency was declared on a talkgroup included in the Simulselect, the Simulselect remained intact and the Emergency lit up both talkgroup control windows on console. The P7200 radios on all Simulselected talkgroups displayed the Emergency. The C3 Maestro audio could be heard on all Simulselected talkgroups, including the talkgroup on which the Emergency was declared. Audio from talkgroups involved remain Simulselected. 2. Proprietary Mode (tested and confirmed) - When an Emergency was declared on a talkgroup included in the Simulselect, the Emergency talkgroup was separated from the patch and its audio went to unselect speaker. Other talkgroups remained engaged in the Simulselect. Only the P7200 radios on the Emergency talkgroup displayed the Emergency. The C3 Maestro console talks back only to Emergency talkgroup members when keying the Emergency talkgroup. When Emergency was cleared by the C3 Maestro console, the system automatically re-engages all talkgroups.	n/a	**Note:** There was no known configuration setting on the Motorola MCC7500 console similar to the Harris Mode vs. Proprietary Mode setting on the Harris C3 Maestro console. Results of this test were similar to the "Harris Mode" results on the City of Oakland system. When an Emergency was declared on a talkgroup included in the Simulselect, the Simulselect remained intact and the Emergency lit up both talkgroup control windows on console. The P7200 radios on the Simulselected talkgroups displayed the Emergency. The MCC7500 audio could be heard on all Simulselected talkgroups, including the talkgroup on which the Emergency was declared.

City of Oakland Feature Portability Test 10-3-13

		City of Oakland Harris Infrastructure		EBRCS Motorola Infrastructure	
		P/F	Comments	P/F	Comments
11	Setup Simulselect During a Talkgroup Call	n/a	Tested the ability to setup a console Simulselect between talkgroups D and E with talkgroup D keyed on Radio 1. The Simulselect did get setup. While listening constantly to dispatch console receive audio from Radio 1 during the Simulselect setup process, the audio did not stop. The same test was repeated a second time with both talkgroups D and E keyed, with the same results. The same test was repeated a third time with the dispatcher keyed on talkgroup D. The Simulselect CANNOT be setup with the dispatch console keyed.	n/a	Tested the ability to set up a console Simulselect between talkgroups OPD-1 and OPD-2 with talkgroup OPD-1 keyed on Radio 1. The Simulselect did get setup. While listening constantly to dispatch console receive audio from Radio 1 during the Simulselect setup process, the audio could still be heard when the Simulselect was initiated. Radio 1 had to be dekeyed to activate the Simulselect. Subsequent talkgroup calls were Simulselected. The same test was repeated a second time with both talkgroups OPD-1 and OPD-2 keyed, with the same results. Could not perform this test with the dispatch console keyed because there was only one test dispatch console.
12	Private Call	n/a	Private Call is not allowed on the Oakland system so it was not tested.	n/a	Private Call is disabled System Wide on the EBRCS system so Private Call was not tested.
13	Call Alert	n/a	Not tested	Pass	A Call Alert was initiated from the MCC7500 console to the Harris P7200 Radio 1. The Harris Radio 1 got an immediate "Rx Page" and an audible notification. The MCC7500 console received an immediate acknowledgement from the Harris radio.
14	Alert Tones	n/a	Three Alert Tones are available on the Harris C3 Maestro dispatch console. All three tones were tested over Group D and properly received on the P7200 radio. 1. Solid 1000Hz tone 2. Pulsed 1000Hz tone 3. Warble tone alternaing between 1600Hz and 2000Hz	n/a	Three Alert Tones are available on the Motorola MCC7500 dispatch console. The tones are slightly different than the C3 Maestro Alert Tones, as described below. All three tones were tested over OPD-1 and properly received on the P7200 radio. 1. Solid 1000Hz tone 2. Warble tone alternaing between 1500Hz and 800Hz 3. Pulsed 1000Hz tone
Tests Related to Roaming and Requiring Motorola Network Manager Terminal					
15	Power On Affiliation	n/a	Not tested. City of Oakland Harris System is not a Roaming system	Pass	Harris Radio 1 was powered up on talkgroup OPD-1. Proper Affiliation was confirmed on the Motorola ZoneWatch Affiliation Display.
16	Power Off Deaffiliation	n/a	Not tested. City of Oakland Harris System is not a Roaming system	Pass	Harris Radio 1 was powered down on talkgroup OPD-1. Proper Deaffiliation was confirmed on the Motorola ZoneWatch Affiliation Display.
17	Talkgroup Change Affiliation	n/a	Not tested. City of Oakland Harris System is not a Roaming system	Pass	Harris Radio 1 was changed from talkgroup OPD-1 to OPD-2. Proper Talkgroup Change Affiliation was confirmed on the Motorola ZoneWatch Affiliation Display.
18	Radio Roaming	n/a	Not tested. City of Oakland Harris System is not a Roaming system	Pass	According to Harris engineers, there are two ways to program a Harris P7200 radio to automatically roam among multiple simulcast subsystems within the EBRCS system. These are described below: **1. Fixed ProScan Roaming** - This method requires that each EBRCS simulcast subsystem within which the radio must roam be entered as a unique system in the P7200 programming software. Each will have a unique "Site ID" and unique Control Channels. Each is chen listed in the "Systems Being Scanned" list. This is the method that was successfully used by RCC to test P7200 roaming on the EBRCS system. **2. Enhanced CC** - This is the optimal method of roaming. According to Harris engineers, this method utilizes the Adjacent Control Channel information that is downloaded regularly from a P25 site to build and continuously update a dynamic list of control channels (and thus sites) within the radio to facilitate roaming. Despite significant efforts, RCC, Harris, and DWC could not get this Enhanced CC method to work on the EBRCS system. In all attempts the radio would display "INV SYS NO ROAM." It is possible that this type of roaming is a cost option requiring a flash upgrde to the radio to activate the feature.

City of Oakland Feature Portability Test 10-3-13

		City of Oakland Harris Infrastructure		EBRCS Motorola Infrastructure	
		P/F	Comments	P/F	Comments
					Roaming was successfully demonstrated using the Fixed ProScan programming option. First, Site Access Control was modified by going into Motorola's ASTRO 25 User Configuration Server (UCS) and specifying that talkgroup OPD-1 is "Valid" on ALL EBRCS sites. While standing outside of the Alameda County radio shop, Radio 1 was powered up and confirmed via the Motorola Affiliation Manager that talkgroup OPD-1 registered on the EBRCS ALCO Northwest simulcast subsystem. Upon walking into the radio shop and thus losing signal from the ALCO Northwest subsystem, Radio 1 was observed entering into an automatic control channel scan and within approximately 2 seconds registering onto the EBRCS ALCO Southwest simulcast subsystem, which does have coverage inside the radio shop. The registration was also confirmed on the Motorola Affiliation Manager. A talkgroup call was placed to confirm that two Harris P7200 radios could successfully communicate across two different EBRCS simulcast subsystems.
19	Site Change Affiliation	n/a	Not tested. City of Oakland Harris System is not a Roaming system	Pass	Site Change Affiliation was inherently tested and confirmed successful in the "Roaming" test described above. The Motorola Affiliation manager was used to confirm successful Site Change Affiliations.
20	Site Access Control/"Talkgroup Only" Site Access Denial	n/a	Not tested. City of Oakland Harris System is not a Roaming system	Pass	Confirmed that Site Access Control by Talkgroup works properly. Note that at the Alameda County Radio Shop, only the EBRCS ALCO Southwest simulcast system can be received inside the Shop by the Harris P7200 portable radio, while outside of the shop in the parking lot both the EBRCS ALCO Southwest and EBRCS ALCO Northwest simulcast systems can be received by the P7200 portable radio. Site Access Control was confirmed by going into Motorola's ASTRO 25 User Configuration Server (UCS) and specifying that talkgroup OPD-1 is "Invalid" on the ALCO Northwest simulcast system. With Harris Radio 1 selected on OPD-1, the radio was then powered up outside of the Radio Shop. The radio was observed to register onto the system via the ALCO Northwest control channel, but then got a talk denial tone when PTT was pressed due to the Site Access setting.
21	Adjacent Site Control Channel Info Utilization	n/a	Not tested. City of Oakland Harris System is not a Roaming system		Unable to test. See description of Enhanced CC above.
Other Tests					
22	Over the Air Programming	n/a	Unable to Test		Unable to test.
23	Selective Radio Inhibit	n/a	Not Tested	Pass	Harris P7200 Radio 1 was successfully Selectively Inhibited via the Motorola Radio Control Manager (RCM). The radio was then successfully Uninhibited and brought back into operation.
24	Passing DTMF Tones Radio to Radio	Pass	The City of Oakland currently has a Federal siren system that is controlled by EDACS analog Orion mobile radios passing FSK (modem tone-like) signals. Federal has indicated that they can change their siren control to DTMF signalling,. Thus it was requested to test the Harris P7200 radios to confirm they could successfully pass DTMF tones over a P25 trunked system from one radio to another radio. This test was successfully demonstrated on the City of Oakland Harris simulcast system by keying up on Radio 1 Talkgroup D, and while keyed, pressing the portable keypad DTMF tones. The tones were heard on the receiving Radio 2 over Talkgroup D.	Pass	The City of Oakland currently has a Federal siren system that is controlled by EDACS analog Orion mobile radios passing FSK (modem tone-like) signals. Federal has indicated that they can change their siren control to DTMF signalling,. Thus it was requested to test the Harris P7200 radios to confirm they could successfully pass DTMF tones over a P25 trunked system from one radio to another radio. This test was successfully demonstrated on the EBRCS simulcast system by keying up on the P7200 Radio 1 Talkgroup OPD-1, and while keyed, pressing the portable keypad DTMF tones. The tones were heard on the receiving P7200 Radio 2 over Talkgroup OPD-1. The test was repeated using a Motorola APX 7000 portable radio as the receiving radio. The APX7000 also successfully received the DTMF tones.
Tests Unable to Perform but Important to Know					
25	Busy Queuing and Callback		Unable to Test		It was not possible to perform a Busy Queuing and Callback test because the test requires all voice channels on the system to be busy (in use). This was not possible on the live operational EBRCS system.

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		City of Oakland Harris Infrastructure		EBRCS Motorola Infrastructure	
		P/F	Comments	P/F	Comments
26	P7200 Radio Reaction to Site Trunking		Unable to Test		It was not possible to perform any tests involving a "Site Trunking" condition in the EBRCS system. Site Trunking is a system failure whereby one or more of the EBRCS simulcast subsystems (Ex. ALCO Northwest) becomes disconnected from the Master Site and therefore is no longer in Wide-Area communications with the remaining Simulcast subsystems and is no longer in "wireline" communication with the Dispatch Consols. However the Site Trunking simulcast subsystem may still be operational in a standalone trunked simulcast mode. It is very important to know and understand how the radio units (P7200's) will react to a Site Trunking condition. It is important to know: 1. Do the users get an audible and/or visual indication on the radio when in Site Trunking? 2. If in overlapping coverage with more than one simulcast subsystem, do the P7200 radios attempt to scan and move to a simulcast subsystem that has not failed and is therefore still in Wide-Area mode? This may create a condition whereby talkgroup members become dispersed and thus unable to communicate within their talkgroup. 3. The #2 condition above becomes even more critical when the selected talkgroup has been "Site Access Denied" via settings in the Motorola Network Manager at adjacent simulcast subsystems. To describe a potential problematic scenario, lets say a fleet of Harris P7200 radios have been programmed to operate on EBRCS and the primary Patrol talkgroup is allowed only on the ALCO Northwest simulcast system. This talkgroup is "Site Access Denied" on the remaining three EBRCS simulcast systems. This is in fact the way Oakland would likely be configured on the EBRCS system. Note that Site Access permissions are not programmed into the P7200 radios (see test #20 above). Rather, if a radio attempts to register to a site on which it does not have permission, the radio registers, then get a denial message from the site, then the radio may enter the control channel scan mode to find another site. Now lets say that ALCO Northwest enters Site Trunking. A very important question is "how do the P7200s react? Do they attempt to avoid Site Trunking and therefore scan to a wide-area site, register, then be access denied. The P7200 radios may take a significat amount of time stuck in this process before finally landing on a valid system, during which the user is unable to communicate. Motorola subscriber software has a programming feature which makes the radio "stay" on a site even if the site enters Site Trunking, which eliminates the potential problem described above. This scenario should be tested and the results understood prior to deploying P7200 radios onto the Motorola EBRCS system.
27	Radio Reaction to Motorola Master Controller Switch		Unable to Test		The EBRCS system has primary and backup "Master Site Controllers". They are at the same location and in the same rack. Should one Master Site Controller fail, the Backup automatically takes over call processing. However, the time required for the Backup to become operational may be 20 to 40 seconds, during which all EBRCS simulcast subsystems enter Site Trunking. The EBRCS radio managers may also elect to periodically manually switch the Primary and Backup Master Controllers, which would induce the same 20 - 40 second Site Trunking condition. Please read test #26 of this document to understand the questions relating to a Site Trunking condition.

Appendix 3 - Summary of EBRCSA Negotiation Issues

The Report identifies a number of issues that will need to be resolved via negotiations with EBRCSA before committing to a move to EBRCS. Those issues are summarized here for use by the City and EBRCS during their negotiations:

1. Administrative: The Alameda County grand Jury has recognized that a lack of representation on the EBRCSA Board is likely to be a significant obstacle to overcome before Oakland joins the EBRCS system. Based on current estimates of subscriber unit counts, Oakland will have roughly 17% of the users on the EBRCS system, and therefore will be paying roughly 17% of the ongoing operating costs of the EBRCS system. Consequently, Oakland should expect to be represented by 17% of the 23 seats on the Board (4 seats). Oakland should ensure that theses seats are guaranteed (via MOU or amendment to the JPA) before joining EBRCS.

2. Administrative: RCC has pointed out that the City would need a waiver to continue to operate or maintain their existing radio systems if any of their agencies moved EBRCS. Need to clarify the process for approving that waiver and who would make that decision. The waiver should be obtained BEFORE signing any agreement with EBRCS.

3. Operational: Radio Roaming - Details regarding the roaming operation of existing Oakland radios must be resolved before committing to join the EBRCS system, along with details governing the roaming permissions that will be granted to Oakland radios and Oakland talkgroups.

4. Operational: The City of Oakland will need to ensure that its current talkgroups can and will be replicated on the EBRCS system, and will need to verify that it will be allowed to preserve each of its interoperability relationships with agencies outside of the EBRCS system.

5. Operational / Consoles: Ensure that EBRCS and Motorola will replicate the phone and radio integration that Fire Dispatchers currently use in their headsets.

6. Operational / Siren system: Ensure that the EBRCS system will support radio control of the City's Federal Signals Siren System.

7. Nice Logging Recorders: The City uses the same brand of logging recorders as EBRCS. RCC has suggested that those recorders could be used as backups to the recorders that EBRCSA already has in place – essentially as parallel servers. The servers owned by Oakland could have their own retention policies. Need to confirm that EBRCS will support and allow this configuration, and will integrate the logging recorders as part of the dispatch center conversion. (In addition to the dispatch consoles that will be replaced.)

8. Microwave System: How much bandwidth would be required to connect the City's logging recorder servers to the EBRCS recorder system?

9. Dispatch Consoles: If the City were to agree to move to the EBRCS system in 2014, which model of Motorola console would be installed at Police and Fire dispatch?

10. Dispatch Consoles / Microwave System: How much bandwidth is required for each console added to the EBRCS system? (Individual circuits, full T1s, etc.)

11. Dispatch Consoles / Microwave System: The City needs specific confirmation that EBRCS will connect the EBRCS microwave system directly to EBRCS equipment in the Oakland dispatch centers (Police and EOC/Fire) and to Oakland dispatch equipment (as opposed to patching over to the Oakland microwave system at some point, and then requiring the Oakland microwave system to provide transport to the dispatch centers).

12. Microwave System: How much bandwidth is currently being used on the microwave system in the NW cell, and between the NW Cell and the Control Point?

13. Microwave System: The EBRCS microwave diagram does not seem to indicate the Glen Dyer jail site. Where and how is that site connected to the rest of the distribution system?

14. Technology Refresh: Does the current EBRCS Technology Refresh budget specifically include upgrading the system to P25 Phase II capability?

15. Technology Refresh / Microwave System: Does the current Technology Refresh budget specifically includes replacing TRuepoint microwave system equipment when repair parts are no longer available? If so, what is the expected replacement cost and timeframe?

16. User Fees: What is the current rate for individual units that join the EBRCS system in advance of the rest of the Oakland users? (Rates were quoted as $33 per month/unit for 2,300 subscribers, or $31/month/unit for 4,000 subscribers. What would be the rate per month for just 50 users or so for interoperability purposes?)

17. User Fees: Some Oakland personnel are under the impression that EBRCS has changed their policy to an "all or nothing" stance regarding the Oakland user radios. (RCC has not heard of such a policy directly from EBRCS.) Need to confirm that EBRCS is still open to usage and membership from a subset of users (e.g., Police only, Public Safety but not Public Works, Traffic only, SWAT only, etc.)

18. User Fees: If EBRCS is unable to secure additional grant funds for Oakland dispatch consoles and must instead assume the cost of the consoles as part of the system financing, how would that cost of financing be shared among the users? How much would that change the monthly user fees?

19. User Fees: Is there any cap that can be guaranteed for the maximum amount that the User Fees would increase on an annual basis?

20. User Fees: Are there any currently known expenses or situations that can be expected to require an increase in User Fees in the next three years?

21. EBRCS coverage: Does the EBRCS system currently provide coverage in BART's underground tunnel systems? If so, via what means? (BDA, dedicated channels, patch to BART's system, etc.) If in only certain BART tunnels, then which ones? If by patch to BART, then which talkgroups are patched and how are they patched?

RCC recommends using this as a checklist during negotiations, and adding to it as needed.

Attachment D
Staff Recommendation
Comparison Chart

Options		One-Time Joining Fees	Network Subscriber Fee (Per Unit/Per Month)	Annual Cost	Subscriber Maintenance (Monthly Per Unit)	Capital Cost Investment (Debt)	Interoperability	Coverage	Reliability	Sustainability	Governance
Option A	Oakland P25 Network	None	$33.10	$928,500.00	$51.98	$16,449,937.00	Fully Interoperable (Incl BART)	Good	Meets Public Safety Standards	Cost Recovery	User Governance
Option B	**EBRCSA P25 Network**	**$580,000.00**	**$34.00**	**$1,183,000.00**	$51.98	**$21,809,640.00**	**Interoperable (BART TBD)**	Good	Meets Public Safety Standards	**8 Years Remaining**	1 of 23 Board Members
5 Year Cost Difference			$0.90	$1,272,500.00		$5,359,703.00					

Attachment E
EBRCSA ACCMA Letter