

# City of Oakland Wireless Broadband Feasibility Study

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# 1. Executive Summary

## 1.1. Findings

The Oakland Wireless Broadband Feasibility Study finds:

- A point-to-point wireless broadband system serving specific community and institutional needs is financially and technically sustainable for the City of Oakland.
- The cost of building and operating such a system can be met through identifiable cost savings, efficiency gains and budgetary choices based on the economic value of benefits.
- Public Internet access by way of community anchor institutions is financially and technically feasible, and universally supported by a diverse range of Oakland residents, organizations, agencies and businesses if it is implemented in a fiscally sound manner.
- Enabling entrepreneurial opportunities for local businesses on a pay-as-you-go, public-private partnership basis is likewise backed by Oakland stakeholders and supported by the financial and technical analysis conducted for this study.
- Providing wireless Internet service to residences or individual consumers is not financially sustainable or technically feasible for the City of Oakland, and is opposed by nearly all stakeholders, who cite the widespread technical and financial failure of such systems in other cities.

## 1.2. Community Priorities

A comprehensive stakeholder assessment process gathered extensive comment from members of the public, local businesses and non-profits, City staff and other government agencies. This research included district-based focus groups, a town hall meeting, workshops, meetings, written staff surveys, and inbound and outbound telephone and email contact.

The top strategic goals identified by Oakland residents and other stakeholders are:

Stakeholder Assessment Strategic Goals	
Priority	Strategic Goal
1	Sound financial planning
2	Free school access
3	Free public access at libraries, community centers, parks, etc.
4	Affordable access for the public
5	System facilitates improved productivity
6	Public project awareness

Oakland residents, City staff and representatives from local businesses, non-profits, government agencies believe that a wireless broadband system must, to the extent financially and technically possible, meet five design criteria:

Stakeholder Assessment Design Criteria	
Priority	Strategic Goal
1	Flexible and interoperable
2	Reliable network
3	High level of security
4	Full city coverage
5	Mobile and real time data access

In the context of the stakeholder discussions, “full city coverage” means that any proposed wireless service or facility should be available equally and evenly throughout Oakland, within the limits of technology and finances. For example, if wireless broadband service is provided to City libraries, it should be provided to all libraries to the extent practical.

On the other hand, stakeholders strongly believed the City should not spend money on blanket wireless coverage based on inappropriate technology or unsustainable economics. Failed municipal wireless networks in other cities were frequently and emphatically offered as examples of what the City of Oakland should not do.

### 1.3. Current Opportunity

The American Recovery and Investment Act of 2009 (ARRA) includes \$7.2 billion in funding for broadband development. The bulk of that funding will come through Broadband Technology Opportunities Program (BTOP) grants administered by the National Telecommunications and Information Administration (NTIA).

Consistent with the BTOP grant criteria released by NTIA on 1 July 2009, this feasibility study presents a conceptual point-to-point system that will:

- Provide broadband access to community anchor institutions such as schools, libraries and organizations and agencies serving vulnerable populations, as well as job-creating strategic facilities in Oakland.
- Provide improved access to broadband service to consumers living in underserved areas of Oakland through community anchor institutions and proven middle-mile solutions.
- Improve access to, and use of, broadband service by public safety agencies that serve Oakland.
- Stimulate the demand for broadband, economic growth and job creation for all members of the Oakland community.

The reference architecture developed during this study is not intended as a final design, however it is a financial and technical proof-of-concept that will support a BTOP grant application by the City, and provide an objective basis for the system and performance requirements in subsequent requests for proposals (RFP).

#### 1.4. System Design

This study uses a modular implementation approach, and develops a reference architecture that employs a variety of spectrum, technology and applications to meet the diversity of stakeholder needs in the City of Oakland:

Reference Architecture	
Segment	Primary Users
Backbone	Central infrastructure for all users
Public Safety	Police, fire, health, public works
Government	All City departments, City staff in field
BayRICS	Police and fire
Public	Community anchor institutions
Business	Underserved commercial properties

In this conceptual design, the backbone segment provides the underlying broadband infrastructure necessary for supporting all users of the system. Once it is built, the system can be extended to serve any or all user groups, depending on policy priorities and funding availability.

For analytical purposes, the reference architecture is based on specific technologies, because concrete examples are necessary to developing benchmark specifications and costs. However, prospective vendors will not be asked to build the reference design or use any specific technologies. They will be free to propose any solution that meets the financial and technical requirements contained in the RFP.

The prospective budget for the system includes equipment costs for connecting to community anchor institutions and other public facilities. Funds for more than 600 such connections are included in the budget and are supported by the financial analysis.

## 1.5. Financial Analysis

Funding for construction and operation of the core system will come from five primary sources:

- Offsetting current expenditures by replacing some existing leased lines with faster and more survivable wireless links.
- Broadband Technology Opportunity Program grants.
- Federal and state public safety grants.
- Use of existing City facilities such as towers and telecommunications sites.
- Providing service to underserved commercial properties for a fee on a public-private partnership basis.

The system has the potential for reducing City expenditures, enhancing revenues and improving public services through increased efficiency. This productivity gain primarily comes from allowing staff to work from the field without having to return to their offices to access information technology resources.

The business case analysis also shows that the market value of the new services provided is greater than the cost of building and operating the system, even when discounted rates are available to government and nonprofit organizations. The cost offsets and other value created by the system pay its full costs over time, including capital financing costs.

## 1.6. Next Steps

To meet BTOP grant application requirements and deadlines, five steps should be taken in the next four weeks:

- Develop an implementation plan that meets BTOP schedule requirements and ARRA criteria for “shovel-ready” projects.
- Identify complementary ARRA-funded projects and potential partners, per BTOP guidelines.
- Determine the source for the 20% matching funds required by BTOP, including making any necessary applications to State agencies.
- Prepare and submit grant applications covering as those BTOP categories for which the City of Oakland qualifies.
- Release an RFP to support the BTOP grant application as soon as possible.

The NTIA schedule and qualification criteria will be difficult to meet. However, because of it, the ideal time to move forward with a wireless broadband system in the City of Oakland is now.

## 2. Findings and Recommendations

### 2.1. Introduction

The goal of the Wireless Broadband Feasibility Study is to determine if a wireless broadband system can be deployed, either comprehensively or modularly, in the City of Oakland to achieve key objectives:

- Enhance economic development.
- Improve public safety.
- Increase the effectiveness of public, private, and nonprofit organizations through improved access to state of the art broadband wireless technology.
- Help overcome the digital divide.
- Improve quality of life for all Oaklanders.

Tellus Venture Associates was engaged in September 2007 to conduct a thorough evaluation of this question through a process that included staff and community participation, and technical and financial analysis.

### 2.2. Needs and Requirements

The study began with an extensive assessment, consultation and research effort that included goal setting and technical meetings, and an assessment process with Department of Information Technology (DIT) staff. Workshops for staff from all City departments, and for representatives from local non-profits, businesses and other government agencies followed. Finally, a town hall meeting and a series of citywide, council district-based focus groups were held to gather comments from as broad a cross section of the public as possible.

The information collected was analyzed, and priorities, needs and design criteria were developed. The top strategic goals identified during the research were:

1. Sound financial planning.
2. Free school access.
3. Free public access at libraries, community centers, parks, etc.
4. Affordable access for the public.
5. System facilitates improved productivity.
6. Public project awareness.

From these strategic goals and after deeper discussions on needed capabilities, a set of top level system design requirements were established. According to the research, any wireless



broadband system deployed for the City of Oakland should, to the extent financially possible, meet five criteria:

1. Flexible & interoperable.
2. Reliable network.
3. High level of security.
4. Full city coverage.
5. Mobile & real time data access.

Operational requirements identified by all potential users and beneficiaries of the system were then evaluated against these design criteria and against the available technological options. Finally, seven prioritized operational requirements were established:

1. Extensible network backbone
2. Point to point networking
3. Citywide data access
4. Video: incidents and events
5. Video: surveillance and monitoring
6. Video: routine operations
7. Mobile communications

To ensure that any system deployed can address these requirements and priorities within tight budget constraints, a modular approach was used, so individual segments could be deployed separately, in any order, over a flexible time frame.

### **2.3. Reference Architecture**

An initial reference architecture for a citywide wireless broadband system was developed to meet these operational requirements, and the financial cost and benefits of each alternative were evaluated. Prime consideration was given to finding immediate offsets of existing costs, such as leased data lines, and the potential for grant funding.

Several iterations of this design/financial analysis cycle were performed, resulting in a conceptual system design that meets these operational requirements to the greatest extent possible given the limits of current technology, regulations and funding.

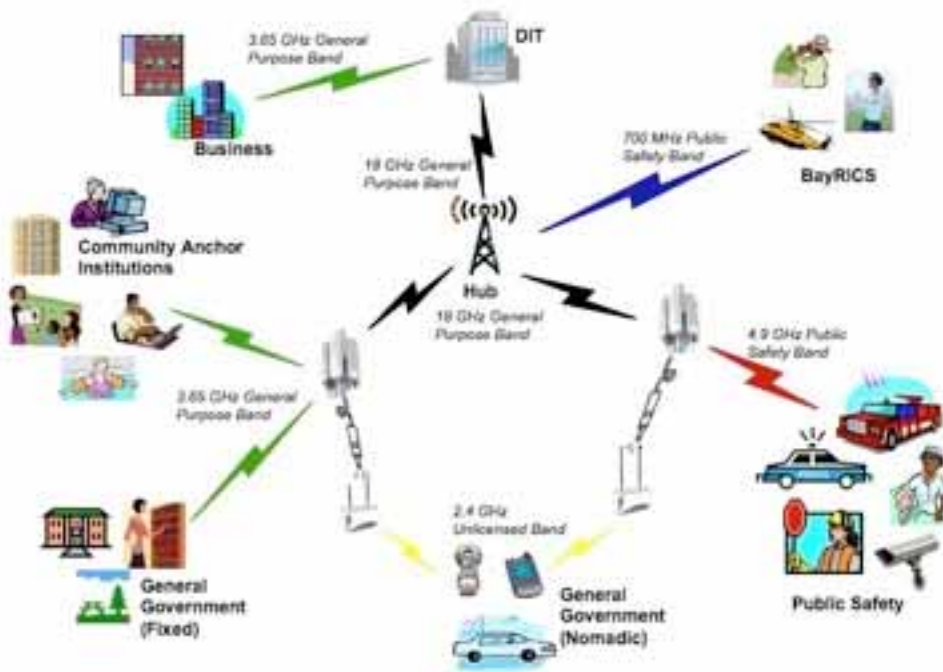
Public safety agencies require robust and redundant systems able to survive and perform under emergency conditions, and the federal government has set aside both valuable spectrum and grant funding for this purpose. General purpose grant funding, such as the American Recovery and Reinvestment Act of 2009 (ARRA) program, may also be used for public safety applications. This variety of possible sources greatly increases the chances of

successfully funding the project. Consequently, the reference architecture focuses on maximizing these resources.

Scenarios and alternatives for extending broadband capabilities to other City departments build on this core system. Other point-to-point links would serve other government agencies, businesses and the general public through community anchor institutions. As noted above, there is virtually no public support or financial case or technologically viable method for providing a ubiquitous citywide “cloud” of Internet access coverage by the City of Oakland.

The reference architecture provides an extensible backbone that minimizes the cost of adding these capabilities, and demonstrates that wireless broadband technology is deployable and effective in the City of Oakland.

**Figure 2.1 – Oakland Wireless Broadband System Conceptual View**



The backbone of the system is a wireless broadband system operating on licensed frequencies in the 18 GHz band. The backbone is built around six hubs, centering on the DIT facility at Frank Ogawa Plaza, and then extending first to fire stations and police department facilities, and then potentially to other city-owned locations. These links will operate at speeds up to 600 Mbps. There are no regulatory restrictions on the type of applications or users that may be supported.

Two types of connectivity are provided at each backbone location, or "node". First, high speed city network access is provided directly to the location itself. Second, wireless access points operating on the unlicensed 2.4 GHz band are installed at each node, providing convenient information technology network access at or near the backbone location for city employees, and potentially offering fixed IT network connectivity to nearby City facilities.

The second half of the core system described by the reference architecture is a public safety wireless broadband segment that radiates out from each of these backbone nodes. This segment takes advantage of the 4.9 GHz band that the federal government has set aside exclusively for public safety purposes. This segment will support fixed uses, such as surveillance cameras, and what are referred to as "nomadic" applications.

**Figure 2.2 – Core System**



Nomadic applications are midway between fixed uses, such as permanent cameras or links between buildings, and truly mobile applications such as video from moving vehicles or handheld devices that people use while walking around. Examples of nomadic applications include using a laptop computer in a parked car, or streaming video from the scene of a fire.

## 2.4. Alternatives and Scenarios

Beyond the reference architecture, and building upon it, additional system segments provide some level of wireless broadband service to every corner of the community. These segments include:

- Fixed links for general government purposes on the 3.65 GHz semi-licensed band.
- 802.11 standard hotspots on the unlicensed 2.4 GHz band for general government nomadic purposes.
- A 700 MHz system for mobile public safety applications that is being developed separately by a coalition of Bay Area cities, initiated by Oakland Mayor Ron Dellums.
- Public Internet access offered at community anchor institutions such as community centers, non profit organizations and public housing.
- Business grade Internet service to unserved and underserved commercial buildings.

Each of these alternatives and scenarios can be implemented independently. In some cases costs are offset by replacing existing leased lines or by improvements in efficiency and productivity. In other cases, costs are offset by users or through programs such as the ARRA package.

## 2.5. Business Case Evaluation

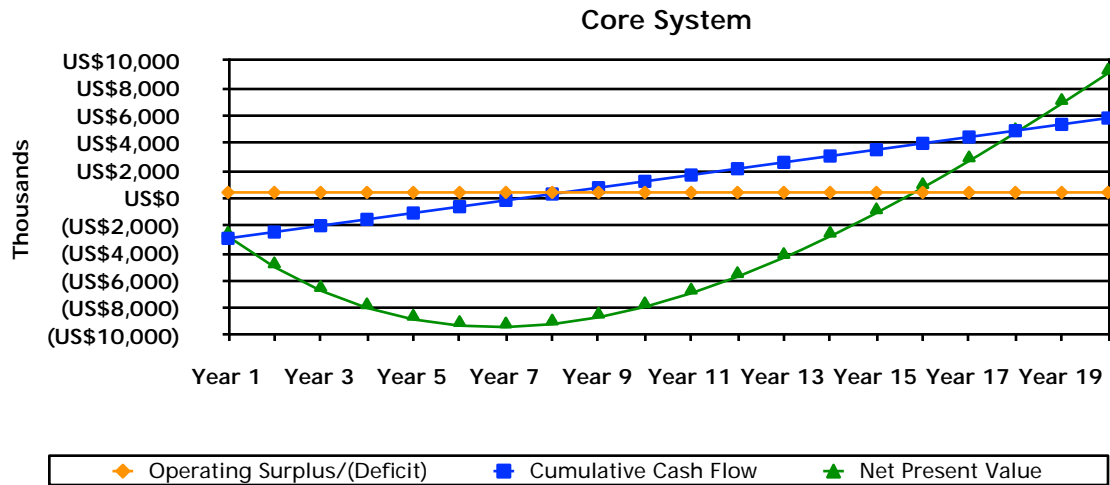
Financial analysis of the reference architecture's core system and the alternatives and scenarios is based on:

- The annual out of pocket cost of operations versus cost offsets and other funding
- The ability of the system to repay construction costs over time
- The long term capital value of the system

The core system pays for itself on an operating basis, based on the hard cost savings provided by replacing a few, redundant leased circuits. The system also pays for its full cost over time, even if no public safety grant funding is available. Enough cost savings are generated to support the ongoing operations of the 700 MHz public safety mobile system as well.

Various cost savings and efficiency gains, potentially including improved tax revenue collection, provide both an operating cost and long term capital cost justification for extending City network access to all employees and departments. Business-oriented services are designed to be self-supporting, and to provide an opportunity for local entrepreneurs to be part of an innovative public-private partnership with the City.

**Figure 2.3 – Oakland Wireless Broadband Core System Financial Analysis**



There is no immediate funding source for public Internet access via community anchor institutions, however the financial analysis clearly shows that the value of these services more than outweighs the cost of building and operating the necessary facilities. These facilities will provide essential digital inclusion services to unserved and underserved segments of the community, and are intended to meet the ARRA grant funding criteria.

## 2.6. Conclusion

This study demonstrates that a citywide broadband system based on wireless technology is both technically and financially feasible. This system can extend and enhance connectivity to the City's existing information technology network, providing new capabilities and enhanced efficiencies to City departments and employees. It can also provide sustainable Internet access to unserved and underserved communities in Oakland.

The ARRA program offers a unique window of opportunity to fund and operate this system, and significantly enhance the quality of life and public services available to Oakland residents. This study offers a solid basis for policy makers to evaluate the alternatives and decide how to move forward. Once those decisions are made, this study provides the tools needed to implement those decisions and support the quest for grant funding, including a shovel-ready request for proposal document.

## 3. Needs Assessment

### 3.1. Overview

Extensive primary research was conducted to facilitate the establishment of a sound vision for the deployment (or not) of an achievable and sustainable wireless broadband network in the City of Oakland. Under the direction of the City of Oakland's Department of Information Technology, several specific objectives were to be evaluated:

- Enhance economic development.
- Improve public safety.
- Increase the effectiveness of public, private, and nonprofit organizations through improved access to state of the art wireless broadband technology.
- Help overcome the digital divide.
- Improve the quality of life for all Oaklanders.

A total of 15 assessment sessions were conducted to obtain comments from and ascertain the needs and priorities of:

- Members of the public
- City of Oakland staff
- Businesses
- Nonprofit organization
- Educational institutions
- Other government agencies

In December 2007, a meeting was held with communications and information technology personnel from key City departments. Then, in July 2008, a series of workshops were conducted, three for city staff, and one each for the business community, nonprofit organizations, and educational institutions and other local government agencies.

Seven public focus groups were held in September 2008, one in each council district, along with a citywide town hall meeting at Oakland City Hall. Throughout this process, additional public comment was gathered in person and by phone and email.

Many concerns, issues and ideas were put forth during the course of this research. However this study is limited to the assessment of how the City of Oakland's needs might be met by wireless broadband technology, and a comprehensive examination of all related concerns is outside its scope. Key concerns that are noted and treated as potential limiting factors for a wireless broadband deployment include:

1. Web-based communications and service delivery by government agencies.
2. Interoperability between City departments, and with outside agencies.
3. General information technology and telecommunications infrastructure and policy.
4. Provision of computer hardware, software, training and technical support to underserved communities and individuals.

A summary of scope, methodology and findings is in Appendix A below, and complete minutes and research documents from all events are contained in Volume 2 of this study.

### **3.2. Analytical Framework**

The results of this research are broken down into two categories: strategic goals and design criteria. Strategic goals encompass top level concerns voiced by study participants, and are broad concepts that might be applied to any major project. These goals can help guide policy makers and managers as implementation progresses, and inform the recommendations made by this study.

Design criteria, on the other hand, are specific attributes that study participants believe a wireless broadband system should meet. Any wireless broadband system that might result from this study should meet these criteria to the greatest extent possible.

### **3.3. Strategic Goals**

Although each public session and community workshop was made up of different participants drawn from broad cross sections of Oakland's very diverse community, the groups were remarkably consistent in identifying and prioritizing strategic goals. Figure 3.1 provides a breakdown of these goals.

The top three goals identified during the focus groups, town hall meeting, and workshops for nonprofit organizations and local government agencies were free school access, free public access at community anchor institutions, and affordable access for the public.

The endorsement of these goals, however, was not unconditional. Nearly all the participants assessed these goals within the context of what were perceived to be greater needs of the Oakland community and with an explicit awareness of the fiscal constraints facing the City. Participants made a distinction between "free" and "affordable" service, and overwhelmingly chose not to endorse the provision of free Internet access to businesses and residences. Providing public access, free or otherwise, at public facilities, such as libraries and community centers, or high traffic areas, such as bus shelters, the convention center or the downtown area, was generally seen as a much higher priority than providing residential Internet service of any kind.

The city staff and business community workshops were similarly consistent, although the focus was on different goals and priorities. The top concerns were insuring that any system facilitates improved productivity and the public is aware and in support of any wireless broadband project. Both these goals received further endorsement from various public, nonprofit and local agency groups.

**Figure 3.1 – Strategic Goals**

	Free school access	Free access at public facilities	Affordable access	System facilitates improved productivity	Public project awareness	Employs local vendors	Facilitates community outreach
<b>City Workshops</b>							
Police, Fire, Admin				X	X		
Pub Wks, CEDA, Finance				X	X		
Library, Museum, Parks				X	X		X
<b>Community Workshops</b>							
Businesses				X		X	
Non-profits	X	X	X		X		X
Agencies & Education	X	X	X				
<b>Focus Groups</b>							
Focus group 1	X		X		X		
Focus group 2	X	X	X		X	X	
Focus group 3	X	X	X	X			
Focus group 4	X	X					
Focus group 5	X	X	X	X	X		
Focus group 6	X	X				X	
Focus group 7	X	X	X				
<b>Town Hall Meeting</b>	X	X	X	X		X	

Two other goals – using local vendors to build and operate a system and facilitating community outreach – were mentioned in a handful of groups, but overall received significantly lower support.

Although the groups did not specifically identify financial goals, such as lowering City operating costs or meeting specific budget requirements, a consistently high level of concern was expressed for the financial and managerial aspects of any broadband initiative. All of the various goals were explicitly discussed within this context. For this reason, an additional goal of sound financial planning and fiscal responsibility is included as a top priority.



Consequently, the six strategic goals identified by this research for a wireless broadband initiative by the City of Oakland are:

1. Sound financial planning.
2. Free school access.
3. Free public access at libraries, community centers, parks, etc.
4. Affordable access for the public.
5. System facilitates improved productivity.
6. Public project awareness.

These goals are further addressed in the final study recommendations.

### 3.4. Design Criteria

The fourteen groups discussed six design criteria that were seen as relevant to any wireless broadband network that the City might procure.

**Figure 3.2 – Design Criteria**

	<b>Flexible &amp; inter-operable</b>	<b>Reliable network</b>	<b>High level of security</b>	<b>Full City coverage</b>	<b>Mobile &amp; real time data access</b>	<b>Revenue stream for City</b>
<b>City Workshops</b>						
Police, Fire, Admin	X	X	X	X	X	
Pub Wks, CEDA, Finance	X	X	X	X	X	
Library, Museum, Parks			X		X	X
<b>Community Workshops</b>						
Businesses	X					X
Non-profits						
Agencies & Education	X		X	X		
<b>Focus Groups</b>						
Focus group 1	X					
Focus group 2	X					
Focus group 3	X	X				
Focus group 4		X		X		
Focus group 5	X					
Focus group 6	X	X	X			
Focus group 7	X					X
<b>Town Hall Meeting</b>		X	X			

The top concern, identified by city staff, businesses, local agencies and six out of seven focus groups, was that any system be flexible and interoperable. In other words, that it can be used by all city departments (although every department wouldn't necessarily need access to all the features and capabilities), that it serve as a means of communications with other public agencies, and that the public can use and benefit directly from it, as appropriate. System reliability (including disaster survivability for emergency systems) and security were also perceived as being necessary by most participants.

Complete coverage of the City and mobile access to real-time data was not seen as a necessary technical requirement by most groups, however both were particular priorities of City staff. Both requirements will have to be met if City of Oakland departments are assumed to be regular users of any citywide wireless broadband system. Additionally, there was a general concern expressed during most focus groups, the town hall meeting and some workshops that all areas of the City be served equally, if not fully.

There was some discussion of whether a wireless broadband system should be a source of revenue for the City, however only three groups identified it as a requirement. Instead, as noted above, when the focus of discussion turned to financial and managerial issues, the emphasis was on cost savings and greater efficiency rather than revenue generation.

Consequently, the research identified five attributes which can be described as necessary for a citywide wireless broadband system:

1. Flexible & interoperable.
2. Reliable network.
3. High level of security.
4. Full city coverage.
5. Mobile & real time data access.

It should be noted that “full city coverage” refers to providing a given service or facility equally and evenly throughout Oakland, within the limits of technology and finances. For example, if wireless broadband service is provided to City libraries, it should be provided to all libraries to the extent practical. It does not mean blanketing the City with wireless Internet access, in fact that approach was generally opposed by nearly all stakeholders.

These design criteria are taken into account in the assessment of functional system requirements and the design of the reference architecture below. In addition, the business case analysis looks at the costs involved in meeting these criteria to the fullest extent practical.

## 4. Operational Requirements

Strategic priorities and operational needs must drive the overall design, deployment and management of any citywide wireless broadband system in the City of Oakland, but ultimately prospective users of the system will individually decide whether the system meets their particular needs and whether or not they want to pay for it. Those needs are defined by the applications and information they use, and by the circumstances in which they use it. If a network does not meet the requirements imposed by these operational considerations on a given user, then that user will not be served by it.

**Figure 4.1 – Operational Requirements by User Group**

<b>Operational Requirement</b>	<b>Public Safety</b>	<b>Emergency Services</b>	<b>Public Works</b>	<b>Finance &amp; Admin</b>	<b>CEDA</b>	<b>Human Services</b>	<b>Parks &amp; Recreation</b>	<b>Other Agencies</b>	<b>Business</b>	<b>Non-Profits</b>	<b>Public</b>
Citywide data access	X	X	X	X		X	X	X			
Mobile communication	X	X	X								
Video: routine operations	X	X	X	X							
Video: incidents & events	X	X	X				X	X			
Video: surveillance & monitoring	X		X				X		X		
Point to point networking					X		X	X	X	X	
Extensible network backbone					X		X	X	X	X	X

Seven operational requirements were identified. The applications that drove these requirements are described below, followed by a technical summary. At a top level, though, no single type of user needs a network that meets all of these criteria. There is overlap between these requirements. Meeting one, for example providing citywide data access, might support another, such as transmitting live video from emergencies or planned events.

Three of these requirements concern video transmission. Video was singled out because it is the most bandwidth intensive application currently in common use. A network that supports the sustained, high bandwidth requirements of video transmission today, should support other types of applications well into the future. The three different video modes are:

- Planned transmissions to support routine operations at specific locations.
- Unplanned transmissions from as wide a range of City locations as possible.
- Surveillance and monitoring.

Other operational requirements are the ability to access data throughout the City, either through the City's IT infrastructure or the Internet, mobile communications, point to point networking and an extensible network backbone.

#### 4.1. Citywide Data Access

Provided that any system deployed meets the basic security and other design criteria of the various City departments, there was a nearly universal belief expressed throughout the research process that citywide data access would boost the efficiency, productivity and public accessibility of City operations and services. In particular, representatives from the police, fire, public works and emergency services departments indicated that wireless technology in the field would allow them to better communicate and access vital information where they need it most.

On a general basis, two-way data communication from the field can provide City departments with increased awareness of ongoing incidents and improve communications between and amongst supervisors and field personnel, as well as the emergency operations center. A citywide network could also enhance survivability of the City's communications system during a disaster by providing a redundant pathway. Another potential benefit is the ability to communicate with other government agencies, on a routine basis as well as in emergencies.

Emergency and routine communications priorities for the police department include high data rates, scalability, reliability and no dead spots. In addition, the fire department needs access above and below ground, for example in basements and tunnels.

Another potential application for citywide data access is improving communication to and from neighborhood service coordinators, and citizens groups such as neighborhood watch or CORE (Citizens of Oakland Respond to Emergencies).

City departments have a variety of needs. For example, simply having a nearby hotspot available would allow a human services caseworker to access current client information before making a site visit. Building inspectors stated that they spent considerable time in the field checking building sites and performing code compliance inspections, but then had to return to an office to complete their reports. Access to plans and documents for real time submission, approval and confirmation was identified as a potential benefit by both City staff and representatives from the business community.

Having remote access to information could allow the finance department to increase tax revenue by conducting more, and more thorough, field audits. Police officers would like better access to resources such as Department of Justice databases.

The City's human services department has a multipurpose senior services program (MSSP). Having access to a citywide wireless network could be helpful to the registered nurses (RNs) who go into the field to check on clients. Currently, they are using commercial wireless service to access the Internet, but not City IT resources. Such a network could also be used for remote health monitoring, and to deliver other services to the elderly, on a routine basis and in emergencies.

Another possible use of a citywide data network is to create the Internet equivalent of a traditional bookmobile. Computers and supporting technology can be brought directly into neighborhoods on a periodic basis (along with the necessary training and technical support) and connected to the Internet from wherever is most advantageous. Similarly mobile facilities could be used to deliver health care to under served communities, either at central locations or in homes.

The Oakland Unified School District and the Port of Oakland are two government agencies that could be primary users of the system. The jurisdictions of both agencies are essentially within the city limits, and therefor might be well served by a citywide network. Both agencies also have their own wireless broadband programs, and could be good partners in any City project. Other government agencies that have a presence in Oakland could also make use of a citywide network, but this use would be supplemental to whatever network strategy they may adopt to cover their entire jurisdictions.

#### **4.2. Mobile Communication**

Mobile communication is a specific kind of citywide data access need that is necessarily met wirelessly. Mobile users need to be able to communicate to and from moving vehicles, including boats and aircraft. In addition to adequate radio frequency signal strength, maintaining this sort of connectivity for data networking requires the use of appropriate protocols, modulation techniques and other network design elements.

The City of Oakland already has an extensive radio communications system designed to support public safety, public works and other City departments, particularly for voice communications. In other cases, City workers use commercially available facilities, for example data service provided by cellular telephone carriers.

Location-based services for vehicles and other assets is one mobile data application that was discussed by workshop participants which the City does not currently have. It was also identified as a need by business representatives.

Other mobile services might be, in effect, extensions of existing networks. For example, real-time information about transit bus locations and status could be gathered wirelessly, and delivered to members of the public through their mobile phones.

Achieving truly mobile communications is not an easy, or inexpensive, challenge. Options for creating a mobile data infrastructure, and the associated costs, are explored below.

### 4.3. Video Transmission

Three types of video transmission needs were identified:

1. *Live, high quality video from incident sites and organized events.* Live video from the scene, for example, of a major fire would allow field personnel who were staging or were not yet involved to gain situational awareness and to better prepare before deploying. Fire department representatives, in particular, identified visual information as being particularly valuable for deployment to and management of incidents, as well as for coordination with police and public works personnel. Command staff and communication center personnel would also gain increased awareness and be better equipped to make decisions, manage assets and communicate with field personnel. A technically similar application would be to transmit live coverage of a soccer match from a park via the City's KTOP cable access station.
2. *Video to support routine operations.* Video could be used to reduce the time and expense associated with transporting personnel to handle course-of-business operations at varying locations. Examples would be the use of video lineups at the Eastmont police substation or performing sewer inspections. Another would be to offer video-based training, either live from a central location to remote sites, such as fire stations, or on an on-demand basis. In the long run, wired connections are faster, more reliable and cheaper for fixed, point to point communications than wireless. However, wireless facilities could be used to test applications, rapidly deploy or extend connectivity to new or seldom used locations, and support operations until an economic case exists to install hardwired connections.
3. *Surveillance and monitoring.* The same economic and technical tradeoffs apply to these sorts of applications. Where a need is more or less permanent, such as watching high-traffic areas or a frequently flooded underpass, fixed wireline facilities would generally be preferred. However, those facilities are not available or

economically feasible at every location, or might be too expensive to acquire if the need had not yet been proven. Wireless technology can be used to reach problematic locations, test the effectiveness of video monitoring in a specific location, and quickly adjust coverage as needs change or as private sector participants join the system. For ad hoc surveillance, for example from an area experiencing a sudden increase in crime or of traffic congestion caused by a freeway closure, wireless technology would almost always be the means of choice.

#### 4.4. Point to Point Networking

Wireless technology is well suited to providing quick connectivity to, say, a someone who is using a laptop computer on a city street to connect to an access point. However, depending on location and the availability of wired connections, wireless technology could also connect a fixed location to the City's IT infrastructure or the Internet. In this sort of application, both ends of the connection would be wired (for example, a desktop computer connecting to a central server) but part of the intermediate transmission chain would be wireless.

City workers at some locations, such as park offices, lack wired connectivity to the City's information technology infrastructure. A wireless system could be used to quickly extend network access to such locations, or to test the effectiveness of a particular application at a particular location. The economic and technical case for extending hard wired facilities can then be properly evaluated.

In many respects, the requirement for point to point networking is the same as the requirement for video support of ongoing operations. The major difference is in the capacity and quality of service requirements involved. Live video requires continuous access to a large amount of bandwidth, with little tolerance for network congestion or capacity sharing, and little ability to make momentary use of empty bandwidth. Standard data networking, on the other hand, is more amenable to sharing facilities, can make good use of bandwidth that varies in capacity, and usually requires less capacity.

Point to point capability could also be used to extend Internet service to community groups and public facilities, where it can be made available to anyone at little or no cost. This approach has advantages over attempting to deliver wireless Internet service directly into homes.

First, the laws of physics make it very difficult, and very expensive, to achieve reliable two-way wireless data transmission from inside a building to an outside access point using consumer grade equipment or untrained personnel. Mobile phone companies have spent years and billions of dollars trying to solve this problem and have yet to deploy sufficient

assets to comprehensively do so. Municipalities that have attempted it have either failed or, at best, have achieved partial success at significant cost.

Second, raw bandwidth can be combined with properly configured and maintained equipment, neighborhood-specific training and ongoing technical support. Where cities have been able to provide some level of residential wireless Internet service to communities in need, usage of this service has been lower than anticipated. In some cases, usage has been unacceptably low because people lack the basic technological prerequisites to make use of it.

Point to point networking can also be used to enhance other programs, for example health care and education, that can make onsite use of Internet resources. These programs (or the facilities themselves) might be operated by non-profits or other government agencies who in turn might be able to help offset costs.

#### **4.5. Extensible Network Backbone**

Wireless network services, such as citywide data access, mobile communication, video transmission and point to point networking, would be supported by a shared network backbone that would connect these facilities back to the City's IT infrastructure and, possibly, the Internet. This backbone would likely include both wireless and wired facilities.

This backbone can be designed so that it can be expanded and extended to support additional services as desired. For example, the City could sell access to its network backbone to building owners that needed to upgrade Internet connectivity, or to groups – public and private sector alike – that wanted to install public wireless hotspots.

A few research participants thought that it would be a good idea for the City to provide utility-like Internet service to the general public, either on a subsidized basis to targeted communities, or on a general market basis. Most participants did not support the idea, and in many cases expressed emphatic opposition. For technical and economic reasons, the municipal wireless Internet utility model has generally failed. As also noted below, there are a handful of cities where this model is still being pursuing, usually with significant public subsidies, but these exceptions have little in common with Oakland.

For these reasons, this study will not recommend the adoption of the municipal wireless Internet utility model by the City of Oakland. Nevertheless, an extensible network backbone would support such an endeavor, should circumstances change.



Other government agencies that have a significant presence in Oakland, such as BART or the County of Alameda, but that have operations that extend well beyond Oakland's borders, could use this backbone to supplement and extend their existing network architecture where they have a specific need. Likewise, the City of Oakland may be able to share wireless or other broadband facilities owned by other agencies. For example, BART has a broadband system with wireless capabilities throughout its right of way, and offers some level of access to City departments.

## 5. Network Design Priorities

### 5.1. Methodology

The network design attributes needed to support these operational requirements are assessed according to five criteria that measure resource intensity – bandwidth, quality of service (QoS), ubiquity, simultaneous users of a given network segment, and mobility – and are rated as low, medium and high. At this stage in the analysis, resource intensity also provides a rough proxy for cost: higher resource intensity generally equates to higher cost.

**Figure 5.1 – Ratings Scale for Operational Requirements**

	<b>Low</b>	<b>Medium</b>	<b>High</b>
Bandwidth	2 Mbps or less per session	2 to 20 Mbps	More than 20 Mbps
Quality of Service	Variable & bursty (web browsing, database queries)	Fault tolerant (file transfer)	Uninterrupted streaming
Ubiquity	Specific points	Designated areas	Citywide
Simultaneous Users	One	Few	Many
Mobility	Fixed	Portable	Mobile

When resource intensity is plotted against the relative number of user groups identified as likely beneficiaries of a given operational requirement, a rough picture emerges that helps to clarify design priorities. In this analysis, the simultaneous users criterion is given double weight because being able to support many users at once, across a wide range of applications and departments, is a critical requirement for a cost-effective network.

**Figure 5.2 – Prioritization of Categories**

<b>Category</b>	<b>Priority</b>
High demand, low cost	High
Low demand, low cost	Medium
High demand, high cost	Medium
Low demand, high cost	Low

Using these categories, operational requirements can then be assigned a rough, provisional priority. This prioritization has a very limited purpose. It is used to guide the initial development of the reference architecture and business model, and provide a starting point for further analysis of the technical feasibility and constraints of, and the economic case for deploying a network that can support these operational requirements. This prioritization is

also relative: it compares the demand for and the cost of any given requirement against the other requirements. It is an intermediate step used in determining the total cost and the ability or willingness of potential users to defray those costs, which is the central focus of the business case analysis below.

Operational requirements that have a high demand and low cost relative to other requirements are assigned a high priority. The applications supported by these requirements should provide the biggest bang for the buck. Requirements that have costs commensurate with demand – low demand/low cost, high demand/high cost – are assigned a medium priority. Lowest priority are requirements that have a relatively low demand and high cost.

## 5.2. Prioritization

This provisional analysis first assesses the resource intensity of the seven operational requirements identified by the research conducted in the City of Oakland.

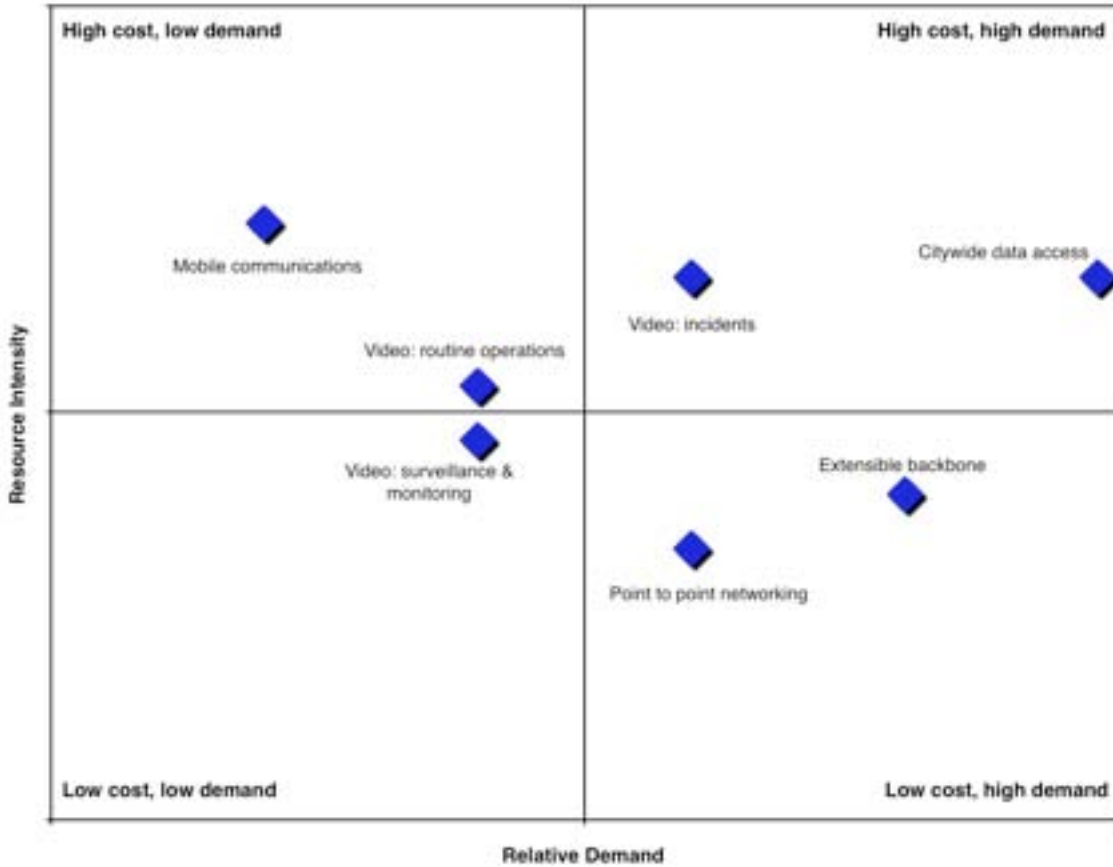
**Figure 5.3 – Operational Requirements by Resource Intensity**

	<b>Bandwidth</b>	<b>QoS</b>	<b>Ubiquity</b>	<b>Simultaneous users</b>	<b>Mobility</b>
Citywide data access	Low	Low	High	High	Medium
Mobile communication	Low	Low	High	High	High
Video: routine operations	Medium	High	Low	Medium	Low
Video: incidents & events	High	High	High	Low	Medium
Video: surveillance & monitoring	Medium	Medium	Low	Medium	Low
Point to point networking	Medium	Medium	Low	Low	Low
Extensible network backbone	Medium	Medium	Medium	Low	Low

Figure 5.4 then shows how these operational requirements sort into the four prioritization categories described above.

By this analysis, an extensible network backbone and point to point networking are the operational requirements with the highest priority, in that order. Although an extensible backbone is somewhat more costly than point to point networking, the potential demand is significantly greater. Citywide data access has the third highest priority, despite its relatively higher cost, because of its potential to serve a greater number of users than any other requirement.

**Figure 5.4 – Relative Demand versus Resource Intensity of Operational Requirements**



Video from incidents and events is fourth on the list, showing a cost generally in line with demand.

**Figure 5.5 – Provisional Operational Requirement Priority**

Priority	Operational Requirement
1	Extensible network backbone
2	Point to point networking
3	Citywide data access
4	Video: incidents & events
5	Video: surveillance & monitoring
6	Video: routine operations
7	Mobile communication

Next, in order of priority, are video for surveillance and monitoring, and video to support routine operations. Both have midlevel demand and cost, with surveillance and monitoring showing a marginally better balance between the two factors. Last priority is mobile communications, which has the lowest relative demand and highest relative resource intensity of the seven operational requirements.

It is important to note that all of these operational requirements were identified as being both desirable and beneficial by the research process. The fact that one requirement is low on the list does not necessarily mean that it shouldn't be supported by the reference architecture, or by any eventual network that the City deploys. Conversely, a high provisional priority does not guarantee implementation.

Nor are these seven requirements mutually exclusive. Implementing one can create basic infrastructure that lowers the cost of another, or can attract additional users, which in turn could raise demand. One example given above is video to support routine operations, which might be added to a point to point network facility for a low marginal cost. Another example is mobile communications, which might be supported by a citywide data access network to a degree that is sufficient for certain applications. Finally, creating a wireless broadband network with an extensible network backbone will ensure that operational requirements that are not supported in an initial deployment can be accommodated in later phases.

The next step in the process is to create a reference architecture and a business model that support these operational requirements, while meeting the strategic goals and design criteria identified by this study.

## 6. Reference Architecture

### 6.1. System Overview

Public safety and other departments in the City of Oakland have requirements for fixed and nomadic broadband communications that can be met by a wireless Ethernet system.

This system can also serve other government agencies, private businesses, community based organizations and non-profits, and the community at large.

**Figure 6.1 – Operational Requirement Matrix**

Priority	Operational Requirement	Comment
1	Extensible network backbone	Phase one design can be expanded for additional bandwidth, and infrastructure can support phase 2 scenario for citywide Internet access.
2	Point to point networking	Design supports bidirectional point to point links up to 15 Mbps, throughout the city.
3	Citywide data access	Basic design covers entire city limits, and budget allows for supplementation in difficult areas. User terminal options range from USB-enabled data modems to vehicle or building-mounted subscriber units)
4	Video: incidents & events	Ad hoc, high bandwidth coverage (up to 15 Mbps) is available throughout the city. Field units are available to support needs.
5	Video: surveillance & monitoring	Scalable bandwidth (up to 15 Mbps in theory) is available throughout the city.
6	Video: routine operations	Point to point bandwidth (up to 15 Mbps) is available throughout the city.
7	Mobile communications	Network not optimized for mobile use, but can support up to a point. Network is designed to be upgradable when mobile protocols are finalized.

A reference system plan using a hub/spoke/cloud architecture has been designed using:

- Antenna towers, space and power at existing public safety radio repeater sites which are owned and operated by the City of Oakland and provide city wide coverage at radio frequencies.
- Point-to-point (PTP) FCC licensed 18 GHz radio links from these existing repeater sites.
- Point to multipoint (PMP) FCC licensed 4.9 GHz radios installed at city fire department stations and police department sub stations to support fixed and transportable broadband Ethernet links from city agencies.
- Point-to-point (PTP) 4.9 GHz subscriber units (SU) that can be fixed or nomadic to support video camera links, voice over Internet protocol (VoIP) links and high speed internet data.

- A second phase scenario which allows the system to be expanded to include provision of Internet service to the community, either directly or indirectly via City facilities such as community centers.

This design provides wireless Ethernet connectivity throughout the city limits of Oakland. The traffic generated, from units in the field and from police or fire stations, is aggregated into five major hubs, located at existing City of Oakland communication facilities, and from there to a sixth hub at the Oakland City Hall complex. There are three options for connecting these hubs into the City of Oakland's existing information technology network:

- Use existing data links, either upgraded for the purpose or used as is.
- Install high capacity wireless PTP links.
- Multi-Point Label Switching (MPLS) IP Virtual Private Network (VPN) links from the five hub sites to a central location.

For the purposes of this study we have used the second option, the high capacity wireless PTP links, to connect five hubs into the central aggregation point (and sixth hub) at the City Hall complex. This option is the middle-case alternative, providing cost-effective connectivity with minimal impact on the City's existing IT infrastructure.

In some of the scenarios, some or all of the hubs are connected to the public Internet by DS3 grade (45 Mbps) MPLS lines. These lines can be used to route traffic directly onto the public Internet and to connect the hubs to the City Hall complex.

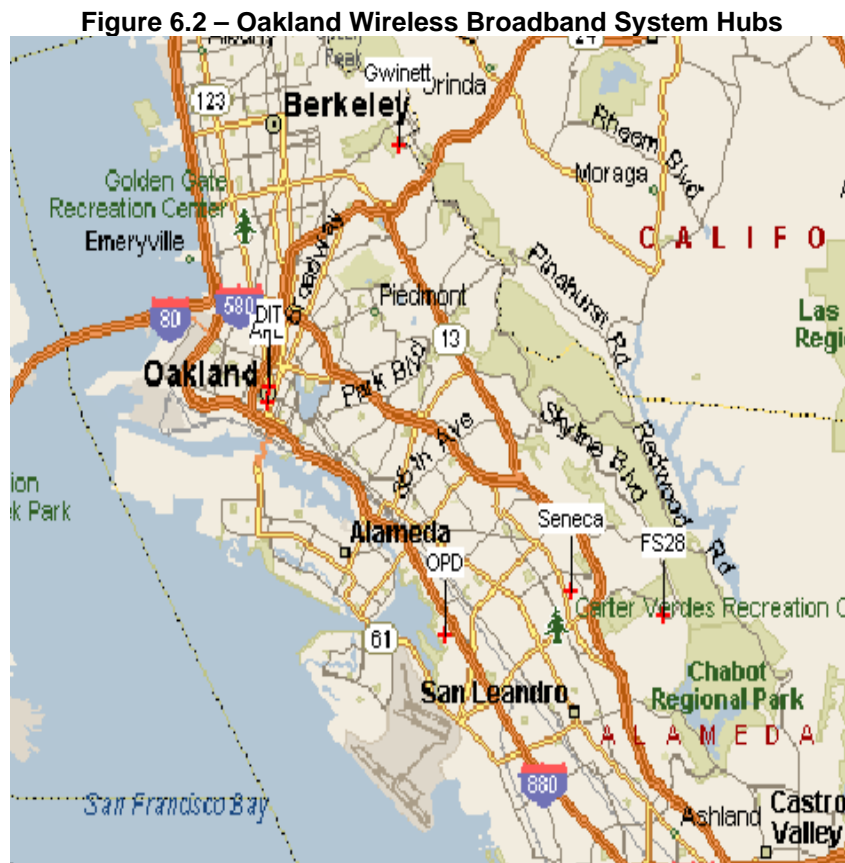
## 6.2. System Plan Description

This reference architecture for a citywide wireless broadband system has been designed to take advantage of existing City of Oakland facilities. The system relies on a star network architecture consisting of the six hub sites, twenty-six spokes and thirty-two wireless local area network (WLAN) clouds to service subscriber radios in the field, and provide the means to establish fixed links as needed, either permanently or temporarily.

In the some scenarios, additional "spoke" links are added to the hub sites. These additional spokes could terminate, for example, at community centers, schools, businesses or nonprofit organizations. From these sites, Internet access could be further extended into the community. At the hubs, these spokes would connect directly to the public Internet and could be physically separate from the City's IT infrastructure, sharing only logistical facilities such as towers and power supplies, and management and maintenance resources. Alternatively, this added capacity could be fully integrated into the initial system, with public traffic securely and logically separated from City traffic.

### 6.3. System Hubs

Four existing radio repeater sites (which include a fire station) that currently support 800 MHz public safety radio services to the City’s police and fire departments, a police department site at 7101 Edgewater Drive, and the Department of Information Technology in City Hall were selected to be hub sites for the wireless system. Each of the hubs would be equipped with PTP 18 GHz radios installed on repeater site towers linking to a corresponding 18 GHz radio installed at twenty-five fire stations (the City’s twenty-sixth fire station is a hub location) and one police substation. Each of the hub sites would then be connected back to the central aggregation point at the City Hall complex via additional 18 GHz PTP radio links.



For some scenarios, radios used for public Internet access (or the entire system, if desirable) would be interfaced to DS3 leased lines provided by a local telecommunication carrier. These lines would utilize Multi-Point Label Switching (MPLS) technology to provide public Internet access and to create an Internet Protocol (IP) Virtual Private Network (VPN), exclusively for City use if desired



Figure 6.3 – System Plan

Site Base Station	Address Oakland, California	Latitude	Longitude	AMSL Feet	Tower Height (ft)	Hub Location	RF Path Length	Ch. BW
Station 1	1605 Martin Luther Way	37°48'27.55"N	122°16'30.30"W	28	TBD	APL	0.45	15
Station 2	100 Jack London Squa	37°47'41.79"N	122°16'31.86"W	12	TBD	APL	0.49	15
Station 3	1445 14th Street	37°48'39.91"N	122°17'34.29"W	14	TBD	APL	1.27	15
Station 4	1235 E. 14th Street	37°47'24.60"N	122°14'51.25"W	32	TBD	APL	1.57	15
Station 5	934 34th Street	37°49'17.44"N	122°16'35.40"W	33	TBD	APL	1.29	15
Station 6	6080 Colton Blvd.	37°49'56.97"N	122°12'28.35"W	918	TBD	Gwinett	2.30	15
Station 7	1006 Amito Dr.	37°51'37.38"N	122°14'3.41"W	912	TBD	Gwinett	0.62	15
Station 8	463 %1st Street	37°50'13.32"N	122°15'41.21"W	119	TBD	Gwinett	2.76	15
Station 10	172 Santa Clara Ave.	37°49'7.37"N	122°15'8.52"W	115	TBD	Gwinett	3.49	15
Station 12	822 Alice Street	37°47'55.28"N	122°16'7.62"W	23	TBD	APL	0.27	15
Station 13	1225 Derby Ave.	37°46'38.86"N	122°13'40.63"W	45	TBD	Seneca	4.12	15
Station 15	455 27th St	37°48'57.26"N	122°15'59.43"W	38	TBD	APL	1.00	15
Station 16	3600 13th Ave.	37°48'10.36"N	122°13'49.29"W	197	TBD	APL	2.26	15
Station 17	3344 High Street	37°47'9.60"N	122°11'50.37"W	185	TBD	Seneca	2.97	15
Station 18	1700 50th Ave.	37°46'19.30"N	122°12'23.53"W	50	TBD	Seneca	2.82	15
Station 19	5766 Miles Ave.	37°50'44.47"N	122°15'0.19"W	236	TBD	Gwinett	1.89	15
Station 20	1401 98th Ave.	37°44'39.88"N	122°10'13.56"W	34	TBD	Seneca	1.04	15
Station 21	13150 Skyline Blvd.	37°47'21.28"N	122° 8'59.07"W	1140	TBD	FS-28	3.00	15
Station 22	751 Air Cargo Way	37°43'13.50"N	122°13'12.11"W	5	TBD	Seneca	4.18	15
Station 23	7100 Foothill Blvd.	37°46'10.18"N	122°10'24.01"W	104	TBD	Seneca	1.20	15
Station 24	5900 Shepard Canyon	37°49'31.66"N	122°11'57.71"W	781	TBD	Gwinett	2.89	15
Station 25	2795 Buters Drive	37°48'33.36"N	122°11'27.25"W	836	TBD	Gwinett	4.07	15
Station 26	2611 98th Ave.	37°45'4.54"N	122° 9'20.66"W	185	TBD	FS-28	1.76	15
Station 27	8501 Pardee Drive	37°43'49.53"N	122°12'6.97"W	9	TBD	FS-28	4.51	15
Station 28	4615 Grass Valley	37°45'3.52"N	122° 7'22.86"W	485	TBD	Hub	0	15
Station 29	1061 66th Ave.	37°45'33.21"N	122°11'51.91"W	245	TBD	FS-28	4.06	15
Eastmont PD	2651 73rd Ave.	37°46'4.33"N	122°10'27.41"W	94	TBD	OPD	2.33	15
APL	1100 Broadway	37°48'8.09"N	122°16'20.63"W	13	450	Hub	0	15
Gwinett	7185 Marlborough Terra	37°51'50.09"N	122°13'22.94"W	637	45	Hub	0	15
Seneca	9000 Seneca	37°45'25.36"N	122° 9'27.88"W	220	60	Hub	0	15
OPD	7101 Edgewater Dr.	37°44'49.23"N	122°12'18.91"W	7	250	Hub	0	15
DIT	150 Frank Ogawa Plaza	37°48'18.19"N	122°16'16.07"W	39	TBD	Hub	0	15
RF Hub	Address	Latitude	Longitude	AMSL	Tower Hgt	FCC ULS#	Radios	BW
APL	1100 Broadway	37°48'8.09"N	122°16'20.63"W	13	450	yes	8	113
Gwinett	7185 Marlborough Terra	37°51'50.09"N	122°13'22.94"W	637	45	yes	7	105
Seneca	9000 Seneca	37°45'25.36"N	122° 9'27.88"W	220	60	yes	6	90
FS-28	4615 Grass Valley	37°45'3.52"N	122° 7'22.86"W	468	12	yes	4	60
OPD	7101 Edgewater Dr.	37°44'49.23"N	122°12'18.91"W	7	250	yes	1	15
DIT	150 Frank Ogawa Plaza	37°48'18.19"N	122°16'16.07"W	39	TBD	yes	5	75
Notes:	1. Tower height in feet. Fire station towers average 50' to 75' -TBD							
	2. RF Path lengths in miles.							
	3. Channel bandwidth in Mbps.							
	4. PTP Backhaul channel frequency at 18.0 GHz (licensed). Bandwidth per link is 15 GHz.							
	5. PMP WiMAX radio frequency at 4.9 GHz.(licensed).							
	6. WiMAX radio can be sectored for 360 degree coverage in six sectors (6 radios).							
	7. All Radios have SMNP and vendor supplied M&C for network management.							
	8. Network Operations Center located at DIT.							

If implemented, the wireline Layer 3 MPLS VPN (L3VPN) facility in some scenarios provides enhanced border gateway protocol (BGP) signaling, MPLS traffic isolation and router support for VRF's (virtual routing/forwarding) to create an IP based VPN. A Layer 3 MPLS VPN also provides Quality of Service (QoS) facilities which rely on resource reservation control mechanisms rather than achieved service quality methods.

Quality of service is the ability to provide different priority to different applications, users, or data flows, or to guarantee a certain level of performance to a data flow. For example, a required bit rate, delay, jitter, packet dropping probability and/or bit error rate may be guaranteed. Quality of service guarantees are important if the system capacity is insufficient, especially for real-time streaming multimedia applications such as VoIP and video (since these often require fixed bit rates and are delay sensitive) and in networks where the capacity is a limited resource. In the absence of network congestion, QoS mechanisms are not required.

#### **6.4. System Spokes**

Each of the PTP radio hops supports data channels up to 108 Mbps in bandwidth operating in the 18 GHz radio frequency band and would require FCC licensing. The radio path lengths are all less than 5 miles line of sight (LOS). The financial analysis below evaluates 15 Mbps and 108 Mbps alternatives, and even higher speeds are possible through software upgrades.

#### **WLAN Base Stations**

The hubs, fire stations and the police substation would be equipped with 50 to 75 foot towers to support the PTP radio and the PMP radios that create the Internet "clouds" around each of those sites. Each of the six hub sites will also be equipped with 4.9 GHz radios and function as base stations as well as hubs.

These locations will function as a WLAN base station. Each antenna tower will be equipped with three (3) PMP radios using 802.16 (WiMAX) standards that operate in the 4.9 GHz band and require FCC licensing.

Additionally, 802.11 standard outdoor access points operating in the unlicensed 2.4 GHz band would be installed at each spoke and hub location, to provide additional connectivity to City workers wishing to access the City's information technology network. In some cases, these access points could also be used to provide fixed links to nearby City facilities. There are no significant regulatory restrictions on the type of traffic or applications that can be used on these access points.

However, the available frequencies in the 4.9 GHz band are designated for public safety use, which “must be related to the protection of life, health or property.” This definition is fairly broad, and does not necessarily limit usage to police, fire and emergency services agencies. It would include, for example, supporting most public works field operations, or enhancing security at City facilities, through such things as surveillance equipment or through increased onsite availability of trained personnel. It would not include supplying public Internet access or providing television coverage of sporting events.

On the other hand, there is no significant usage restriction on the 18 GHz spoke links, or on the 3.65 GHz cloud radios designated for the second phase scenario. This reference architecture provides sufficient flexibility to deploy additional 18 GHz spokes (or remote units for applications such as public video coverage) or 3.65 GHz point-to-point links on an as-needed basis in the event a specific City application is deemed unacceptable for use at 4.9 GHz.

Each of the radios will be tower mounted and interfaced to 120° sector antennas to create 360° radio coverage of the local area. Coverage at 4.9 GHz is in the 3 to 5 mile range. Overlapping “clouds” in some parts of the city center will create very intense coverage and could support mobile interconnection from subscriber units as 802.16 technology is improved. All the radios used in the system are software upgradable and care must be taken to ensure forward compatibility with upcoming mobile 802.16 standards to the greatest extent possible.

There are several options for connecting City users or equipment to the cloud, including:

- Fixed 802.16 protocol user terminals, such as might be connected to a surveillance camera or installed in a park office to provide LAN facilities.
- Portable 802.16 protocol user terminals that could be installed, for example, on a truck used for remote video production.
- Hybrid 802.16/802.11 terminals that could be installed on a vehicle, such as a fire engine, or at an office or worksite.
- USB-compatible 802.16 modems which could be connected directly to laptop computers.

This public safety cloud coverage would be available outdoors. Not every type of public safety user terminal will be able to directly access the cloud from every point in the City, so consideration will have to be given to matching terminals to user needs in order to provide the appropriate range of coverage.

Indoor coverage will depend on building location, type, size and construction. Cost effective solutions are available for extending fixed access from the cloud to the interior of structures, however the use of portable equipment, such as USB modems, will be restricted.

For the second phase scenario, similar radios operating preferably in the 3.65 GHz band (assuming successful frequency coordination with existing users) or at alternative frequencies could be used to extend Internet access to community anchor institutions.

### 6.5. System Coverage

The geographic coverage of the 4.9 GHz reference architecture was modeled by RCC Consultants, Inc. using their proprietary Comsite tool. A complete set of maps can be found in Appendix B.

**Figure 6.4 – Oakland Wireless Broadband System Coverage at 4.9 GHz**



These maps show the expected reach of the 4.9 GHz base stations to users in the field. The parameters used assume maximum allowable effective radiated power, tower height of 75 feet (except for three hubs which were modeled using 25 foot towers) and QAM modulation. General assumptions were made for all locations. No effort was made to shape or optimize coverage for specific sites.

Three different contours were mapped: -85 dBm, -95 dBm and -100 dBm, which roughly correspond to connection speeds of 24 Mbps, 6 Mbps and 1 Mbps respectively. Nearly all of Oakland west of the SR13/I-580 line is covered by the 6 Mbps contour, and the 1 Mbps contour covers most of what remains in that area. Site-specific engineering can mitigate the small white areas and further extend the 6 Mbps contour. Given the generalized parameters of the reference architecture, the modeling shows that full coverage is feasible at 4.9 GHz west of the SR13/I-580 line.

Coverage east of the SR13/I-580 line, in the Oakland hills area, is more problematic. It is difficult to fully cover that sort of terrain and vegetation using the 4.9 GHz band. There are two options: build an extensive 4.9 GHz repeater network or look at other frequencies. As more fully described below, the City of Oakland is part of an effort to create a Bay Area-wide 700 MHz public safety network.

**Figure 6.5 – Comparative Coverage at 700 MHz**



For comparison purposes, coverage of a mobile network operating at 700 MHz was modeled. No effort was made to optimize coverage or transmitter sites. The six hub locations used for the reference architecture were also used for the 700 MHz sites. With only these six locations, a 700 MHz system covers nearly the entire Oakland hills area. A

frequency-specific network design and use of advantageous locations in neighboring jurisdictions should provide as close to 100% coverage as is physically possible.

Although the 4.9 GHz reference architecture can provide very useful service in the Oakland hills, further optimizing coverage there will quickly reach the point of diminishing returns. This system will provide excellent service throughout the balance of the City, and because licensing requirements are well established and equipment is widely available, it can truly be regarded as “shovel-ready.” Once the core system is constructed and actual coverage is evaluated, a decision can be made whether to attempt to enhance 4.9 GHz coverage in the hills, or to rely on a 700 MHz solution.

Finally, the coverage of 802.11-standard access points at 2.4 GHz was mapped. The result shows that placing access points at hub and spoke locations will provide ample laptop-grade connectivity for City workers who drive to those locations.

**Figure 6.6 – Coverage at 2.4 GHz from Seneca hub and spoke locations**



The maps show the -85 dBm contour line, which is the practical limit for reliable fixed connectivity using specialized, higher powered bridges (which cost about \$200). City facilities which lie within that limit have an excellent chance of establishing a 1 Mbps or better connection to the system. It should be noted, however, that the 2.4 GHz spectrum is

unlicensed and subject to interference and competition from other users. These maps should be used as guides for field testing fixed 2.4 GHz links, rather than as firm predictions of results.

## 6.6. System Flexibility, Interoperability and Security

A system which supports Ethernet traffic throughout is more flexible, interoperable and secure than one which relies on Internet protocol alone. Extending Ethernet connectivity all the way to the end points of the system allows data to be transmitted seamlessly between this wireless broadband system and the City of Oakland's existing information technology network, in the process extending existing network protocols and security measures.

Broadband networks are commonly described in terms of "layers". Layer 1 is the physical equipment used to construct the network. In a wireline network, this layer might consist of fiber optic cables or copper wire, along with the other devices, such as routers and switches, which connect and manage the traffic. In a wireless network, radio waves or, sometimes, beams of light replace copper and fiber optic connections.

Layer 2 is called the data link layer. This layer is where the "ones and zeros" of digital communication are formed and transmitted. Ethernet, which is specified in the reference architecture, is a robust and commonly used Layer 2 protocol.

The next step up is the network layer, or Layer 3, which chops up the stream of ones and zeros into manageable packets and routes those packets from the beginning, through what might be a maze of connections, to the final destination. Internet protocol (IP) is the most familiar Layer 3 standard.

In effect Layer 3 rides on top of Layer 2, and Layer 2 rides on top of Layer 1. There are several more layers to consider when designing a complete system which might include computers, applications and data structures. But the first three layers are collectively referred to as the media layers and form the fundamental structure of a broadband network.

Each layer has its own security considerations and methodology. At Layer 1, security is a physical issue. For an outdoor wireline network, Layer 1 security is provided by locking up equipment and either burying a line or stringing it high and out of reach. Because lines can cross great distances, Layer 1 security is problematic. For a wireless network, the problems are multiplied because radio transmissions can be intercepted. The radios can be physically locked up, but the actual transmissions are easily accessible to anyone.

The solution, for wireline and wireless networks alike, is to build encryption and other security technology into Layers 2 and 3. All traffic going through the radios specified in the

reference architecture can be encrypted using 256-bit Advanced Encryption Standard (AES) security, which meets the latest Federal Information Processing Standard 197 for data security.

However, because the reference architecture allows for a seamless extension of the City's existing IT network, additional security levels and methods can be used as needed. For example, a secure "tunnel" – a virtual private network – can be formed inside the encrypted data stream going from a police car to a relay point on a fire station and then on to a central hub. The data flowing through that tunnel can be further encrypted, providing several layers of security that will continue uninterrupted as the information from the wireless system to the City's existing IT network and finally to a secure database at Police Department headquarters.

Likewise, outside agencies or public users can access the system using common Layer 2 and 3 protocols that are already implemented on their own networks or individual equipment. At its basic level, this reference architecture is interoperable with the standard data transmission protocols used for nearly every purpose. Any given department, agency or other authorized user can access the system and run their existing data communications through it.

Interoperability between different users would be determined by those users on a case by case basis. There are factors which limit interoperability between different users and data networks, however this network design should not provide additional obstacles or limits. In that sense, it is neutral ground.

Another interoperability consideration is forward compatibility with other potential wireless broadband systems. One such system is the region-wide proposal to establish a 700 MHz wireless broadband system for public safety purposes. This network would be more specialized than the system defined in this reference architecture and would encompass a 10-county region. Although the proposed 700 MHz system could not be accessed by the equipment described in this report, using a common, widely used Layer 2 protocol such as Ethernet should make it easier to integrate data traffic if desired. Layer 1 forward compatibility issues to be considered include selecting equipment that is not likely to cause radio frequency interference and making sure that physical assets, such as tower sites, can support the larger antennas and/or power requirements that a 700 MHz system might require.

This architecture allows public Internet traffic to be transported on the same system as public safety or other sensitive and confidential data, and for one agency's data to be completely separate from another's. Although wired networks provide an extra measure of security over wireless systems, both are vulnerable to tapping. True and effective protection



comes from thorough, end to end network design and rigorous application of security principles. The reference architecture adopted by this study allows each City department, outside agency or other user to adopt and implement the most appropriate data networking and security methods for its individual needs.

### **6.7. Expandability, Mobile Access and Citywide Coverage**

“Citywide” coverage, in the context of this report, does not mean ubiquitous, cloud-type availability for all users, at all times, within the boundaries of the City of Oakland. Even the 4.9 GHz “cloud” intended for public safety users will have spotty coverage in parts of the Oakland hills. The anticipated 700 MHz BayRICS system will have effectively ubiquitous coverage, and within the limits of its capacity can fill those gaps for public safety users.

Other segments of the reference architecture are intended either as limited reach hotspots, for example for City employees working in the field, or as point to point links serving specific locations such as a community center or library. For a number of reasons, including a near total lack of public support, expense and technical issues, the reference architecture does not attempt to provide ubiquitous public Internet access.

However, to insure that these point to point links are available throughout the City, this reference architecture can be expanded to include additional fixed lines of communication, for example by placing additional PTP “spoke” radios at locations which require high bandwidth connectivity such as a computer education lab at a community center.

Each hub location can support up to 10 spoke sites, and if necessary additional back haul capacity out of each hub can be acquired. To carry this example to the extreme limit, more hub radios could be installed at each hub location, and additional hub locations could be established, without having to do a fundamental redesign of the network or replacing any significant components.

It is likewise possible to increase the number of public safety “cloud” radios, and to extend the system into moving vehicles and hard to reach canyons. If additional spoke locations, such as libraries, are added to the system, those sites could also be used to add more capacity to the cloud. This reference architecture is designed to be scalable. Hub locations will be able to support additional spokes, which could be either integrated into the existing system or kept physically separate, depending on security considerations and other operational needs. Backhaul capacity from the hubs to City Hall could be increased by adding additional wireless links, or even by installing land lines if the demand for capacity grows sufficiently.

Although it is possible for users to connect to the system while moving, it would not always be with the highest degree of reliability. In particular, as a user moved from the area covered by one cloud radio to another, there is a chance the connection would be dropped, and there would be a momentary interruption in connectivity while the link was being reestablished. More robust mobile protocols are being developed for this technology and this reference architecture is designed to support it when it becomes available, largely through software upgrades.

## 6.8. Reliability

All equipment and other system infrastructure and design features selected for this reference architecture meet 99.99% availability standards. All hub and initial phase spoke locations are already hardened to public safety standards. Overlapping coverage of hub, spoke and cloud radios provides redundancy if there is a failure, and the modular design of the system allows for rapid replacement of faulty or damaged equipment.

In addition, in the event of an emergency, equipment intended for routine portable applications, such as event video transmission, could be repurposed to fill in sudden gaps. Subscriber terminals mounted on public safety apparatus could also be used for emergency coverage.

## 6.9. Case Studies

The technology presented in this reference architecture has been deployed by cities and other public agencies, and its effectiveness has been field proven. The Federal Communications Commission set aside the 4.9 GHz band specifically for public safety purposes, and local agencies have made extensive use of it for many years. Examples include:

Galveston County, Texas is using 4.9 GHz point to point links, deployed using a hub and spoke topology very similar to the reference architecture developed for this report. The system links the county's central 911 dispatch center with seven local emergency communications facilities. It has already fulfilled its role as back up capacity to the primary landline network, supporting all operations for a week in 2008 when the wired network went down completely.

The U.S. Coast Guard is using a point to point 4.9 GHz broadband network as the primary path for its coastal surveillance system based at the Port of Miami. This particular network is optimized for high reliability over long distances (up to 13 miles), but still supports a minimum throughput rate of 10 Mbps and meets all military security standards.

The Phoenix police department deployed a 4.9 GHz network in 2006, primarily for surveillance purposes. The objective, which they met, was to create a system that allowed cameras to be installed and moved quickly, to respond to day to day changes in crime patterns and investigative needs. The video is monitored by officers in a central location, and relayed wirelessly to police cars as needed.

The Cities of Lewiston and Auburn, and the Auburn schools in Maine are using 4.9 GHz point to point links over distances as far as 10 miles to serve an extensive network of surveillance cameras, and to provide connectivity to government IT networks. The network has been operating since 2006. Some links are primary connections, others are used to provide redundancy to critical locations.

In 2005, Beaverton, Oregon installed a hybrid 4.9 GHz WiMAX and WiFi network very similar to this reference architecture. The usage case is very similar as well. Police cars have been fitted with nomadic radios, and officers access the public safety network from the field. In addition, the system supports point to point links for surveillance purposes.

The general government alternative described above relies on the semi-licensed 3.65 GHz band, rather than the 4.9 GHz public safety spectrum. The same kind of equipment used for 4.9 GHz public safety networks is available for the 3.65 GHz band, as well as unlicensed frequencies in the 5 GHz range.

System roll outs are just beginning in the 3.65 GHz band, but early adopters, such as business Internet service providers Rapid Link and VoiceNetworks, have successfully built commercial operations using that spectrum in Southern California and other large urban markets. Internationally, the 2.5 and 3.5 GHz bands are used extensively for Internet service, and enterprise and government data networks. Taiwan has been using WiMAX-based 2.5 GHz technology for networking since 2005. 3.5 GHz networks are common in Asia and Europe.

In the U.S., Clearwire is providing Internet service by way of 2.5 GHz facilities in Baltimore and Portland, Oregon, and plans a nationwide roll out. In California, the City of Santa Barbara uses unlicensed 5 GHz spectrum for public safety communications.

Likewise, WiFi (802.11) based networks and hotspots are very common, and are used for both public Internet access and secure municipal networking. The City of Milpitas was one of the first cities to adopt WiFi for city networking purposes in 2004. Tucson, Arizona uses WiFi to transmit video from ambulances to hospital emergency rooms.

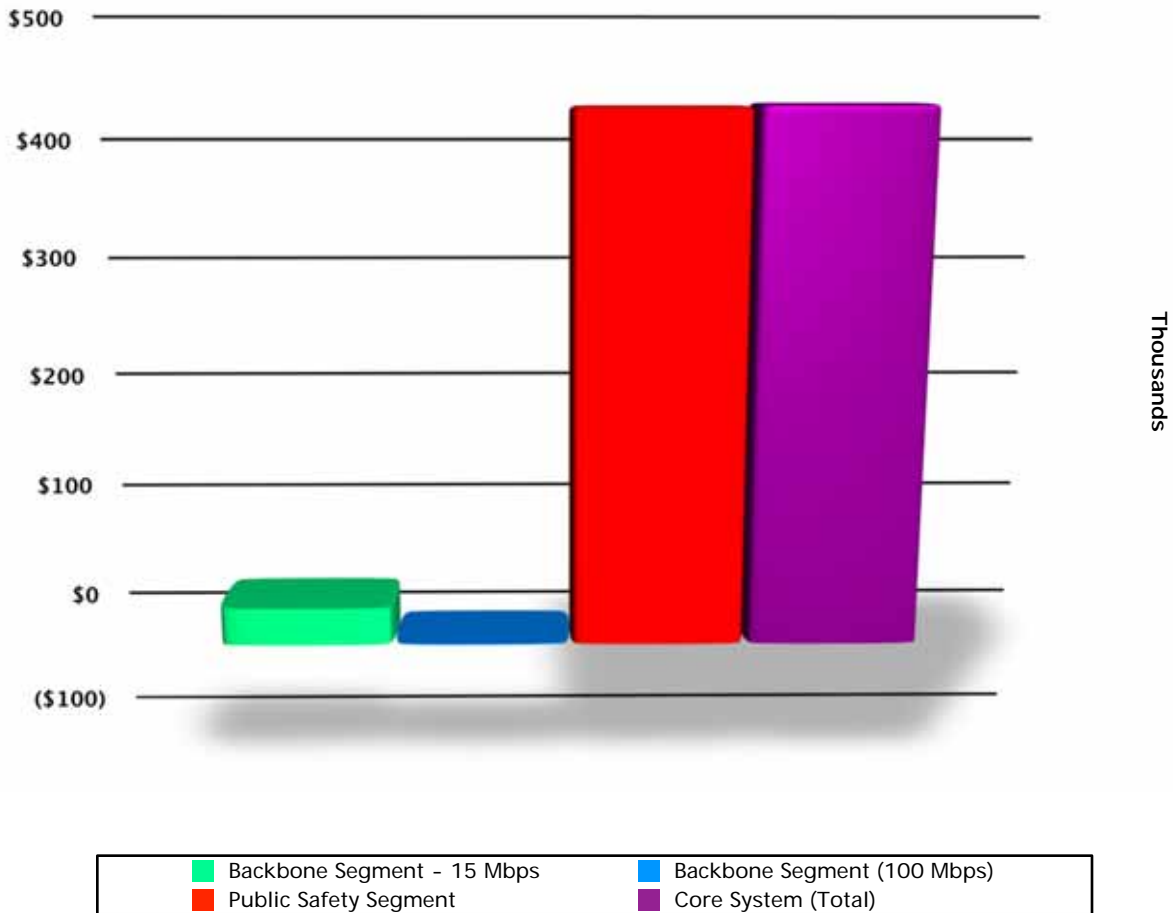
One of the most dramatic examples of WiFi suitability for public safety applications occurred in 2007, when emergency responders used a partially completed municipal WiFi network to support rescue operations following a bridge collapse in Minneapolis. Cellular phone and data facilities near the incident were overwhelmed by the public, but responders were able to use standard, consumer-grade WiFi equipment to securely carry emergency communications.

The 18 GHz system used for backbone connectivity in the reference architecture is an engineered, point to point wireless network. Rather than rely on wide area coverage to reach nomadic or randomly located fixed locations, this system would be designed location by location and link by link. These sorts of engineered wireless networks have been in operation for decades by many organizations, including the City of Oakland.

## 7. Business Case and Financial Analysis

### 7.1. Modeling Framework

Figure 7.1 – Core System Operating Surplus/Deficit)



The business model analysis is broken into five segments:

- Core system, which includes:
  - a. Common backbone infrastructure with a minimum link bandwidth of 15 Mbps,
  - b. Expanded common backbone, with a minimum link bandwidth of 100 Mbps,

- c. Public safety facilities
- General City of Oakland IT support alternatives, which include:
  - a. Fixed wireless broadband links
  - b. City IT network access by field workers (also referred to as nomadic or portable applications).
- Mobile video scenario
- Business and entrepreneurship opportunities scenario
- "Drinking fountain" model public access scenario

The core system is described by the reference architecture and evaluated by the primary business model. In addition, alternatives and scenarios have been developed and analyzed. Taken together, these segments support the requirements identified in Chapter 4 above. To evaluate these system elements...

- Specific cost offsets, value propositions, revenue enhancements and operating efficiencies have been identified as sources of and justification for funding each segment of the project.
- Cost estimates have been developed for construction and operation.
- Each segment is evaluated on the basis of surplus/deficit, cumulative cost and net present value calculations.

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**Figure 7.2 – Business Model Assumptions**

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**Expenses**

Site installation costs are averaged, with an expectation that some existing facilities will be available  
Cost estimates do not include additional IT infrastructure beyond boundaries of wireless broadband facilities  
Project management, design, furnishing & commissioning is estimated at 25% of total base capital expenditure  
DOIT wireless network security cost is estimated at 10% of total base capital expenditure  
DOIT acceptance, testing & documentation cost is estimated at 12.5% of hardware related capital expenditure  
Cost of capital is benchmarked at 5%  
Base operating costs are annual rates per node and per site  
DOIT overhead is estimated at 15% of base operating cost  
Annual software upgrades and licensing are estimated at 20% of software capex  
Annual hardware replacement is estimated at 5% of hardware capex  
Internet bandwidth costs are included only in public service provisioning scenarios  
Public service provisioning scenarios include a 5% franchise & facilities fee payable to the City

**Funding**

Commercial carrier cost offsets & new facility market values are based on actual City landline circuit costs  
Efficiency gains are based on FTE costs and performance measures in the 2007-2009 City budget  
Tax revenue gains are based on efficiency gains and City Auditor revenue/cost ratio

**Modeling**

All cost and revenue figures are expressed in constant 2009 dollars  
No intra-system charge backs are included

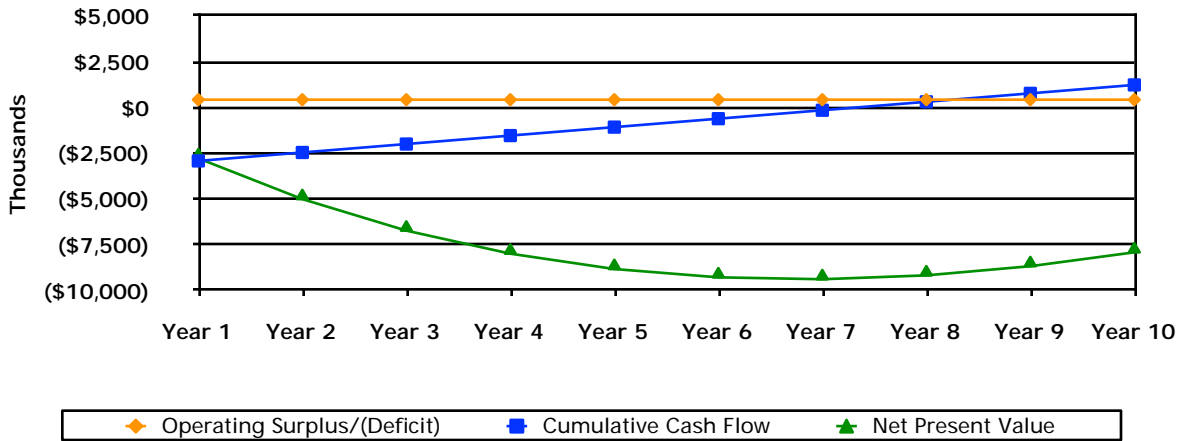
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A number of assumptions have been made in creating this business model. These assumptions are based on nominal City of Oakland cost estimates and management

accounting practices where applicable, on research conducted specifically for this study and on standard industry experience and practice.

The public safety segment is assumed to be the base case deployment option and as such provides the capital cost justification for the overall backbone infrastructure. The backbone segment is self-supporting on an operating basis, but does not pay off its full capital cost without factoring in the additional public safety benefits.

Figure 7.3 – Core System



This backbone infrastructure will also support all other segments and sub-segments. The general government IT alternative is broken into two sub-segments: fixed and nomadic (also referred to as portable).

A mobile video solution for public safety applications is presented as an alternative scenario, using a 700 MHz broadband system proposal (BayRICS) developed by a Bay Area-wide public safety consortium, of which the City of Oakland is a member.

Two other potential options for high speed mobile video are the prospective deployments of a 2.5 GHz mobile WiMAX service by Clearwire and various LTE systems by incumbent mobile telecom carriers. Any RFP requirements developed as a part of the Oakland Wireless Initiative will, to the extent possible, allow commercial carriers to respond as they deem appropriate.

Business and entrepreneurship opportunities and drinking fountain model public access are also presented as alternative scenarios within the business model. The core backbone of the system, developed to support governmental uses, is integral to these two segments. The

business model will also outline the cost of additional equipment and operating costs to support these two segments.

## 7.2. Methodology

The complete business model, including detailed breakouts and alternate scenarios, can be found in Appendix C. The information in this chapter is summary only, and most figures have been rounded for the purpose of clarity.

All cost and funding figures are expressed in constant dollars. In other words, inflation is not figured into the model. A piece of equipment or a service that sells for a dollar today is assumed to sell for a dollar ten years from now. The constant dollar method is a clearer and simpler analytical method for comparing cost and funding projections over time.

For example, a quick glance at a graph of constant dollar surplus/deficit projections over ten years tells whether the trend is up, down or flat. If an inflation adjustment was included in the model, then the slope of such a graph would have to be calculated and the inflation adjustment backed out before meaningful year to year comparisons could be made.

Although inflation adjustments are useful for budgeting purposes, adding a constant inflation figure unnecessarily complicates trend analysis and other long term comparisons. The constant dollar method allows for rapid and meaningful analysis of the value of the project over time, including the cost of funding.

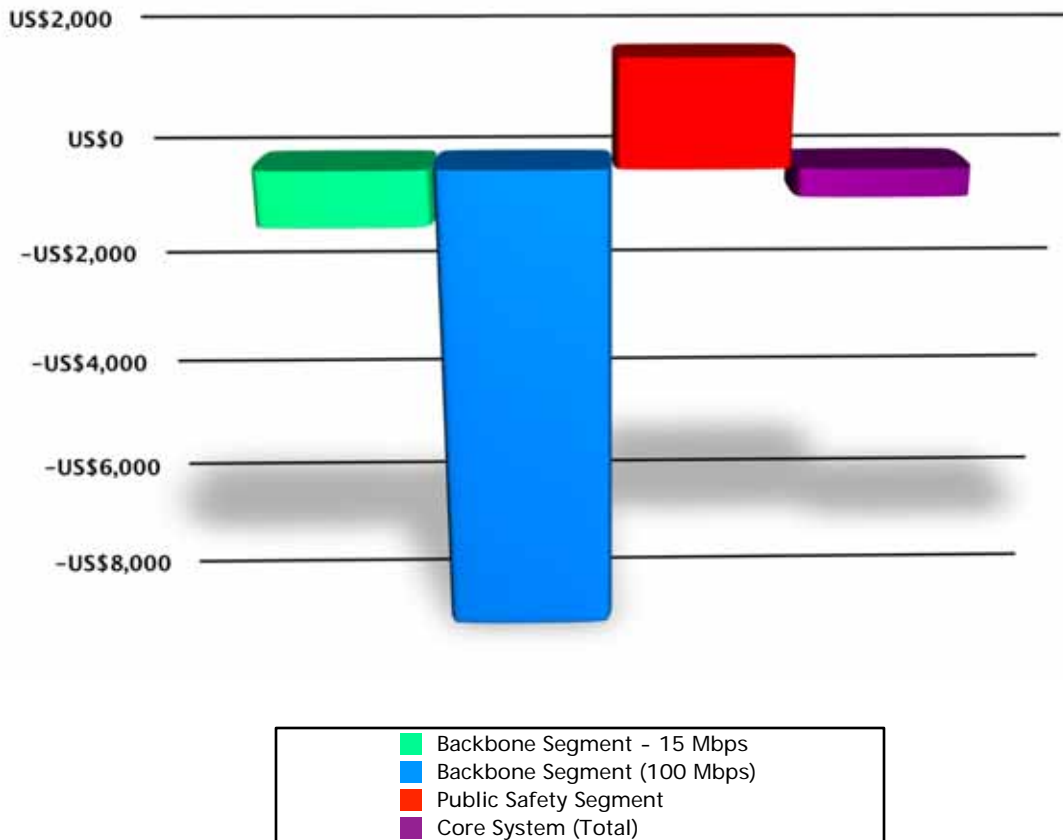
A three step process is used for bottom line analysis of any given segment or scenario:

1. Annual operating surplus or deficit. Without considering the construction cost, which is treated as a capital expense, the annual cost to operate a given segment is subtracted from the associated funding source. This step shows whether funding is sufficient to support ongoing operations from year to year.
2. Cumulative cash flow. The capital costs incurred in each year are subtracted from the operating results, and then carried forward to show whether operating deficits and capital expenditures are eventually covered by the funding sources.
3. Net present value. Finally, the net present value technique is used to factor in the time value of money. A dollar received today is worth more than a dollar promised today and received in ten years, because the dollar received today could be earning interest during that time. By assuming that the City would have to pay interest on any money it borrows (5% is used for the purposes of calculation) and calculating the net present value on that basis, a clearer picture emerges of the long term financial cost of the project.



These three metrics show to what extent the cost of building and operating the system is offset by the cost savings, new value creation, efficiencies and increased revenue it generates.

Figure 7.4 – Core Network Year 10 Net Present Value (000)



This information can be applied in two different ways. First, it can be looked at as a pro forma business plan for construction and operation of the system by the City itself. Second, it can be used to evaluate the feasibility and market value of a public/private partnership, such as a build/lease arrangement, or a simple purchase of services from a telecommunications vendor.

### 7.3. Cost Estimates

#### Capital Expense

Construction cost estimates are based on suggested retail prices from a variety of digital radio, tower and network equipment manufacturers. Installation and licensing estimates are based on standard costs. Furnishing and commissioning is estimated at five percent of hardware cost, engineering and design is estimated at 10% of hardware cost, and project management is estimated at ten percent of hardware and installation cost.

<b>Core Segments</b>	<b>Nodes</b>	<b>Licensing</b>	<b>Towers</b>	<b>Network</b>	<b>Installation</b>	<b>Total</b>
Backbone (15 Mbps Base)	US\$613,267	US\$74,400	US\$77,438	US\$208,713	US\$35,700	US\$1,198,697
Backbone (100 Mbps Increment)	US\$367,685	US\$0	US\$0	US\$90,713	US\$24,600	US\$482,998
4.9 GHz Public Safety Segment	US\$1,175,988	US\$235,200	US\$0	US\$0	US\$0	US\$1,693,428
<b>Sub Total</b>	<b>US\$2,156,940</b>	<b>US\$309,600</b>	<b>US\$77,438</b>	<b>US\$299,426</b>	<b>US\$60,300</b>	<b>US\$3,375,123</b>
<b>Scenarios &amp; Alternatives</b>						
General Government Fixed	US\$682,294	US\$190,800	US\$245,588	US\$245,588	US\$66,600	US\$1,966,369
General Government Nomadic	US\$627,273	US\$0	US\$0	US\$0	US\$0	US\$751,113
BayRICS 700 MHz Scenario	US\$885,000	US\$14,400	US\$0	US\$13,275	US\$3,600	US\$934,275
Business and Entrepreneurship	US\$83,084	US\$0	US\$0	US\$0	US\$0	US\$129,164
Drinking Fountain Model	US\$927,130	US\$0	US\$44,250	US\$44,250	US\$12,000	US\$1,977,310
<b>Sub Total</b>	<b>US\$3,204,781</b>	<b>US\$205,200</b>	<b>US\$289,838</b>	<b>US\$303,113</b>	<b>US\$82,200</b>	<b>US\$5,758,231</b>
<b>Total</b>	<b>US\$5,361,721</b>	<b>US\$514,800</b>	<b>US\$367,276</b>	<b>US\$602,539</b>	<b>US\$142,500</b>	<b>US\$9,133,354</b>

Department of Information Technology expenses are estimated at 10% of base capital expenditure for network security and 12.5% for testing, acceptance and documentation. Costs do not include information technology or network facilities beyond the boundaries of the reference wireless broadband system architecture.

The capital cost of each segment is calculated individually and in isolation, for the purpose of analytical clarity. Adding in a charge back for the cost of constructing the backbone segment, for example, would result in money being shifted back and forth through the model. The bottom line result would remain the same, but the model would be more complicated and harder to understand. However, as with inflation adjustments, such charge backs would be appropriate in a budgetary document.

#### Operating Expense

In the model, most annual operating costs vary according to the number of nodes and sites. A node is a radio, which is the essential active data transmission hardware. Switches, routers and network interfaces associated with a given radio are considered to be integral to the node. A site is a physical location which contains one or more nodes.

As an example, take the backbone infrastructure proposed for a typical fire station. A single tower would be installed, which would support one 18 GHz radio link back to a central hub and a WiFi radio for local network access. The station would count as a single site with two nodes. Adding the proposed public safety capability would involve installing three 4.9 GHz radios at the fire station. In that case, there would be a total of five nodes at the location, but it would still count as a single site.

<b>Figure 7.6 – Operating Expense</b>	
<b>Core Segments</b>	<b>Annual</b>
Backbone (15 Mbps Base)	US\$85,145
Backbone (100 Mbps Increment)	US\$29,175
4.9 GHz Public Safety Segment	US\$178,065
<b>Sub Total</b>	<b>US\$292,385</b>
<b>Scenarios &amp; Alternatives</b>	
General Government Fixed	US\$222,967
General Government Nomadic	US\$84,529
BayRICS 700 MHz Scenario	US\$55,032
Business and Entrepreneurship	US\$94,209
Drinking Fountain Model	US\$788,059
<b>Sub Total</b>	<b>US\$1,244,796</b>
<b>Total</b>	<b>US\$1,537,181</b>

Ongoing equipment replacement and software upgrades and licensing are calculated as a percentage of original purchase price, 5% and 20% respectively.

For services provided to the private sector, including non-profits, a 5% franchise and facilities fee is included to account for the value of City resources such as antenna mounting locations, rack space and indirect IT support.

Finally, a 15% overhead charge is applied to all operating costs (except the franchise and facilities fee, which is in effect an overhead cost itself) to account for the value of administrative and support services provided by the City. As with capital costs, each segment is treated separately, without considering charge backs or cross-subsidies.

Except for this general overhead charge, only direct system expenses are included in the model. For example, where providing Internet access is integral to a segment, such as the Business and Entrepreneurship Opportunities scenario, the cost of outside bandwidth is included. But when a segment is primarily intended for internal City IT network use, the potential cost of incidental Internet usage is not considered.

## 7.4. Grant Funding Considerations

The American Recovery and Reinvestment Act of 2009 (ARRA), commonly referred to as the stimulus package, has a total of \$4.7 billion allocated for the Broadband Technologies Opportunities Program (BTOP) administered by the National Telecommunications and Information Administration (NTIA).

**Figure 7.7 – National Telecommunications and Information Administration  
Broadband Technologies Opportunity Program (millions)**

Broadband deployment	US\$3,900
Expand public computer center capacity	US\$200
Innovative programs to encourage sustainable adoption of broadband service	US\$250
State-level broadband mapping	US\$350
<b>Total</b>	<b>US\$4,700</b>

NTIA has released specific grant request specifications, and evaluation and scoring methods. Goals and specifications include:

- Provide access to broadband service to consumers living in unserved areas.
- Provide improved access to broadband service to consumers residing in underserved areas, which can include urban neighborhoods.
- Provide broadband education, awareness, training, access, equipment and support to community anchor institutions, which include:
  - a. Schools, libraries, medical and healthcare providers, community colleges and other organizations that facilitate greater broadband use by these organizations.
  - b. Organizations that provide outreach, access, equipment and support services to facilitate greater use of broadband service by low-income, unemployed, ages and otherwise vulnerable populations.
- Job-producing strategic facilities located within state-designated economic zones.
- Improve access to, and use of, broadband service by public safety agencies.
- Stimulate the demand for broadband, economic growth and new jobs.
- No less than one grant in each state.
- Increase the affordability and take up of service, and the greatest broadband speed possible to the greatest population of users in the area.
- Enhance service for health care delivery, education or children to the greatest population of users in the area.

A similar program administered by the U.S. Department of Agriculture allocates \$2.5 billion for broadband development in rural areas, however Oakland is not eligible for that funding.

In general terms, NTIA funding is available for cities such as Oakland. However, to qualify for grants to build infrastructure, cities have to meet stringent qualification criteria. At this time, Oakland does not appear to qualify for first round infrastructure funding, but criteria might change in later rounds.

There is a requirement for matching funds, usually 20%, from a non-federal source. The requirements follow typical Federal telecommunications grant guidelines, which can allow in-kind services to be counted towards matching funds. This business model identifies and puts a value on potential in-kind services which could fill the gap.

Another potential source of grant funding is the U.S. Department of Homeland Security (DHS). Most DHS grants focus on public safety and security needs. Consequently, the business model divides the proposed system into public safety and non-public safety segments to facilitate DHS grant applications.

Although the business model is intended to support grant funding efforts, it does not include any grant funds in the analysis. Each segment is evaluated on the basis of its direct benefits to the City of Oakland. Insofar as grant funding is available to offset capital and operating costs, the financial case for building the system is only improved.

## 7.5. Core System Analysis

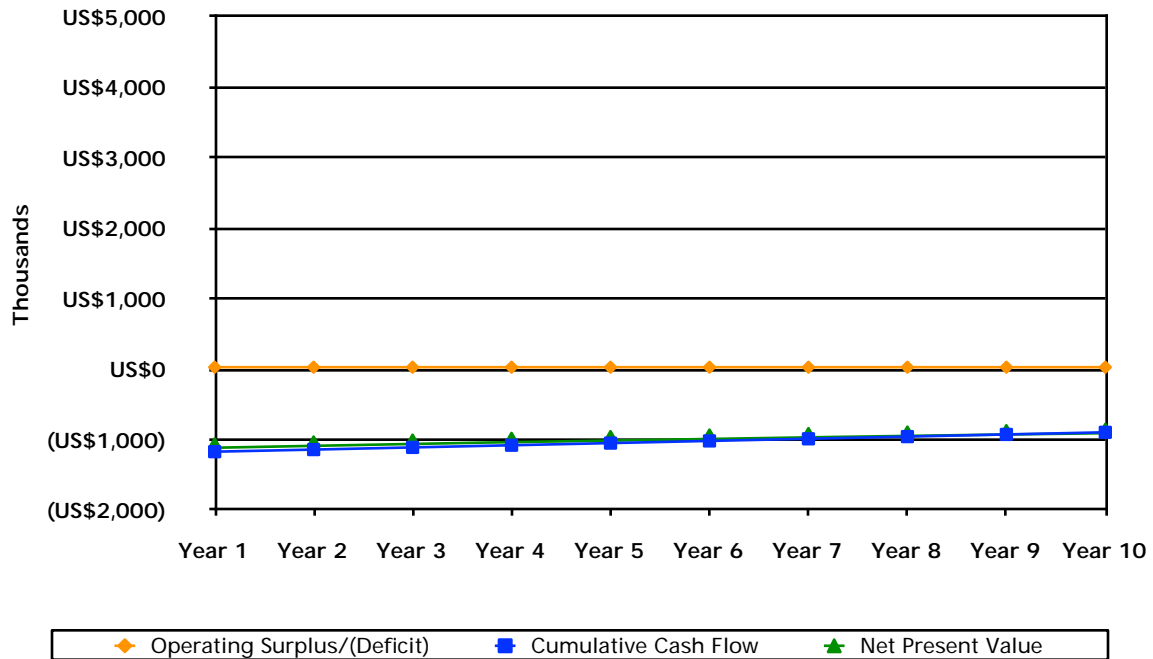
### Backbone Segment

The backbone segment is analyzed in two steps: first, a base facility with a minimum link bandwidth of 15 Mbps is evaluated. Then, the cost of an incremental upgrade to 100 Mbps is considered. The working assumption is that the higher bandwidth option is preferred, however a two-part analysis provides flexibility for future budgetary evaluations.

One-time construction costs for the 15 Mbps base total \$1.2 million, which includes the cost of radios, towers, licenses, network connectivity equipment, installation, design and project management. Segment facilities include:

- High speed (100 Mbps) links between the Department of Information Technology (DIT) and all five hub locations (Edgewater 911 center, Fire Station 28, and the APL, Gwinett and Seneca sites), plus Fire Station 1/EOC and the Eastmont police substation.
- Multiple T1 grade (15 Mbps) links between DIT and the remaining fire stations.
- Secure network access via WiFi (802.11n at 2.4 GHz) at the above locations.
- Network Operations Center (NOC), including test equipment, at DIT.

Figure 7.8 – Backbone - 15 Mbps Base



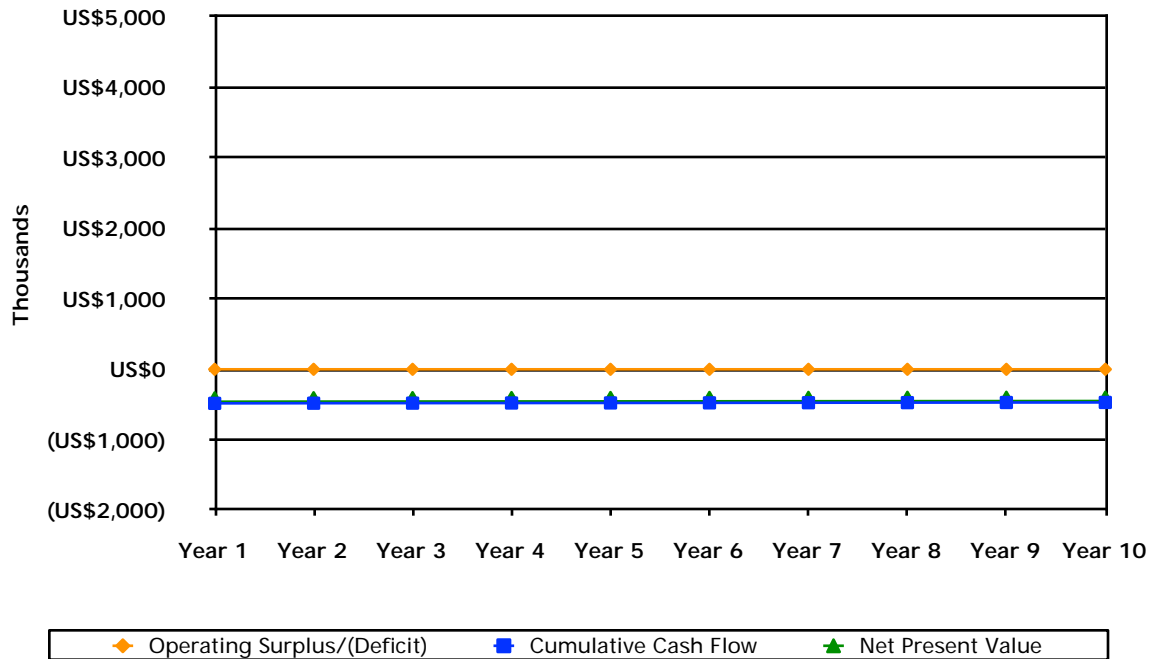
Annual operating expense for the base 15 Mbps segment is estimated to be \$85,000 per year, with maintenance, replacements and upgrades accounting for \$50,000 of that cost.

Upgrading the backbone to a minimum link bandwidth of 100 Mbps adds \$483,000 to the capital cost for a total of \$1.7 million. Annual operating cost increases by \$29,000.

Additional facilities include:

- 108 Mbps bi-directional, upgradable radios used for all 18 GHz nodes.
- All links between hubs and DIT are upgraded to 622 Mbps bi-directional via software upgrades and additional radios.
- The links to Fire Station 1/EOC and the Eastmont police substation are upgraded to 311 Mbps bi-directional via software upgrades.

Figure 7.9 Backbone - 100 Mbps Upgrade



Several high speed data links used by public safety agencies have been identified as replaceable by this segment. Annual out of pocket costs for these links are approximately \$116,000.

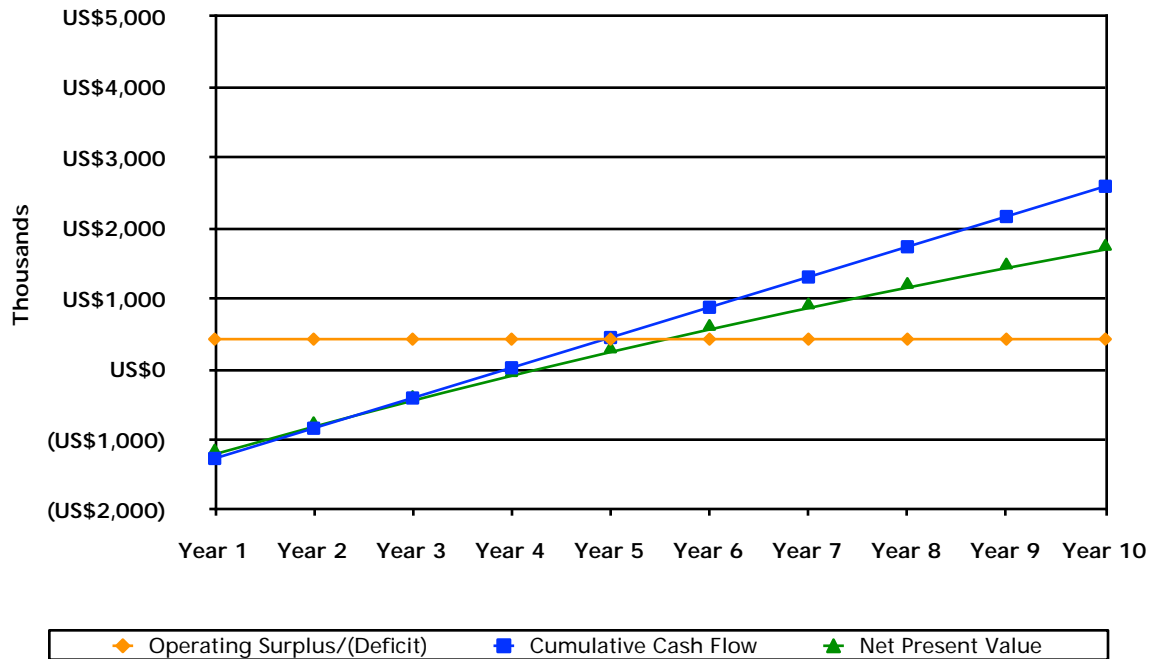
The backbone segment would provide better than T-1 grade circuits to all fire stations, replace two T-1 circuits serving the Police Department, and replace three DS-3 circuits serving the EOC, the Eastmont substation and the Edgewater 911 center. These three circuits represent a fraction of the total landline bandwidth leased by the City to serve these locations, and would enhance overall survivability and reliability by providing independent alternate pathways.

### Public Safety Segment (Fixed and Nomadic)

The public safety segment of the reference architecture provides high speed broadband connectivity, sufficient for video applications, to fixed locations and vehicles. However, the technology is not designed to work while vehicles are moving. In other words, it is intended for fixed and nomadic (or portable) applications, and not for mobile use.

The capital cost to build this segment is estimated at approximately \$1.7 million. Operating costs are pegged at \$178,000 annually, with maintenance and equipment replacement accounting for about half of that figure.

Figure 7.10 – Public Safety Segment



The bandwidth provided by this segment can be used by public safety personnel to access either the City’s IT infrastructure or the Internet from the field. Some manufacturers claim to offer USB-enabled devices that can be plugged into personal computers and used in the same way as a cellular data card. However, these devices have not been field proven at this time, and should be assumed to have a limited range and/or high power consumption requirements.

An alternative is to mount more robust devices into vehicles. For the purposes of evaluation, the business model assumes 100 of these vehicle mounted devices would be bought, however the infrastructure and the operating cost offsets can support many times that figure, if non-reimbursable funding sources can be found for additional vehicle mounted units. These units can be used to provide connectivity to laptops and handheld devices through WiFi or other technology.

Cost offsets for the public safety segment include the cost of providing commercial cellular data service to laptop and handheld computers that have been acquired or are already in the purchasing pipeline. The Police Department has identified 842 such nomadic devices, the Fire Department 50 and the Public Works Agency 120. The estimated annual cost for providing commercial data service to these units is \$607,000.

A comprehensive, integrated wireless broadband infrastructure will provide Oakland's public safety agencies with more options and greater capabilities than simple Internet



access through commercial carriers. However, the Police and Fire Departments have already committed to widespread deployment of laptop and handheld computers and, to some extent, commercial data services. Both agencies already make use of extensive fixed data lines from commercial carriers as well. Additionally, quantifying the efficiency and performance measures used by these two agencies is difficult to do in ways that are directly relevant to their true mission. Taking all these factors together, it would be speculative to try to value the gains in efficiency and performance measures that the Police and Fire Departments could realize through a wireless broadband system.

Similar considerations apply to the Public Works Agency, particularly where public safety issues are concerned. However, routine operations are more quantifiable and more easily enhanced by information technology. The public works agency has purchased an advanced management information system for that purpose, and it is reasonable to assume that integration of that system into the City's IT infrastructure and extending it to workers in the field will result in efficiency gains. Consequently, efficiency and performance measure gains for public works activities are included with other departments under the general government nomadic segment below.

### **General Government Alternatives: Fixed and Nomadic Segments**

Deploying fixed wireless broadband capacity that can be used for non-public safety purposes will allow replacement of landline circuits that are currently costing the City \$89,000 per year. As with the public safety segment, this figure only includes a fraction of the circuits being leased by the City.

More than sixty locations operated by the Parks and Recreation and Human Services Departments do not currently have this sort of high speed service, and the market value of extending the City's information technology infrastructure to these locations is estimated to be \$87,000 annually. Because there is no regulatory restriction on the use of these segments, these new wireless links can also support public Internet access and other programs at recreation centers, swimming pools, rental facilities, Head Start/Early Head Start locations, shelters and senior centers.

Community gardens and open spaces have not been included in this calculation. To the extent such locations are included in this segment, the business case for deployment will be improved.

The Public Works Agency manages more than 300 separate locations for the City. This study identifies approximately half of these locations as being suitable for high speed wireless data links. The other half could also benefit from wireless connectivity. We have based the value of connecting these locations on the cost of providing a minimal data link

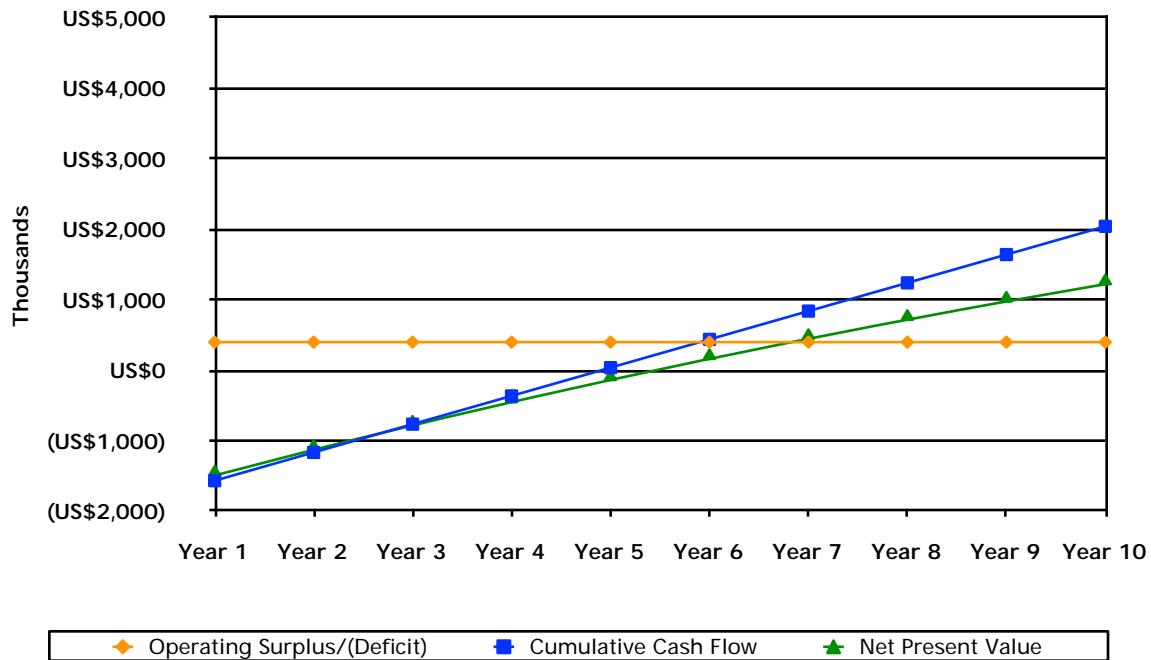
for security purposes. To the extent these facilities could make use of greater bandwidth, the business case for the system is only enhanced. The estimated market value of these security links is \$143,000 per year.

Adding remote monitoring capability should result in fewer routine trips and improved emergency response to these 157 sites. We estimate the value of the annual efficiency gain at \$84,000, which is approximately equal to the average cost of one full time equivalent (FTE) for the Public Works Agency's facilities and management program.

Allowing non-public safety workers to access the system from the field is also an identified need with quantifiable benefits to virtually every department. Besides the Public Works Agency, major beneficiaries include the Finance and Management Agency, the Human Services Department and the Community and Economic Development Agency (CEDA). Parking enforcement personnel, tax auditors, tax officers, case workers and field inspectors can all make use of the system on a daily basis. The market value of providing remote data access to these workers is estimated to be \$53,000 annually.

Allowing these workers to access their departments' IT resources and file reports from the field will result in greater operating efficiencies, estimated to be an average of one hour saved per day by eliminating repetitive trips and speeding up access to information.

Figure 7.11 – General Government Fixed Alternative

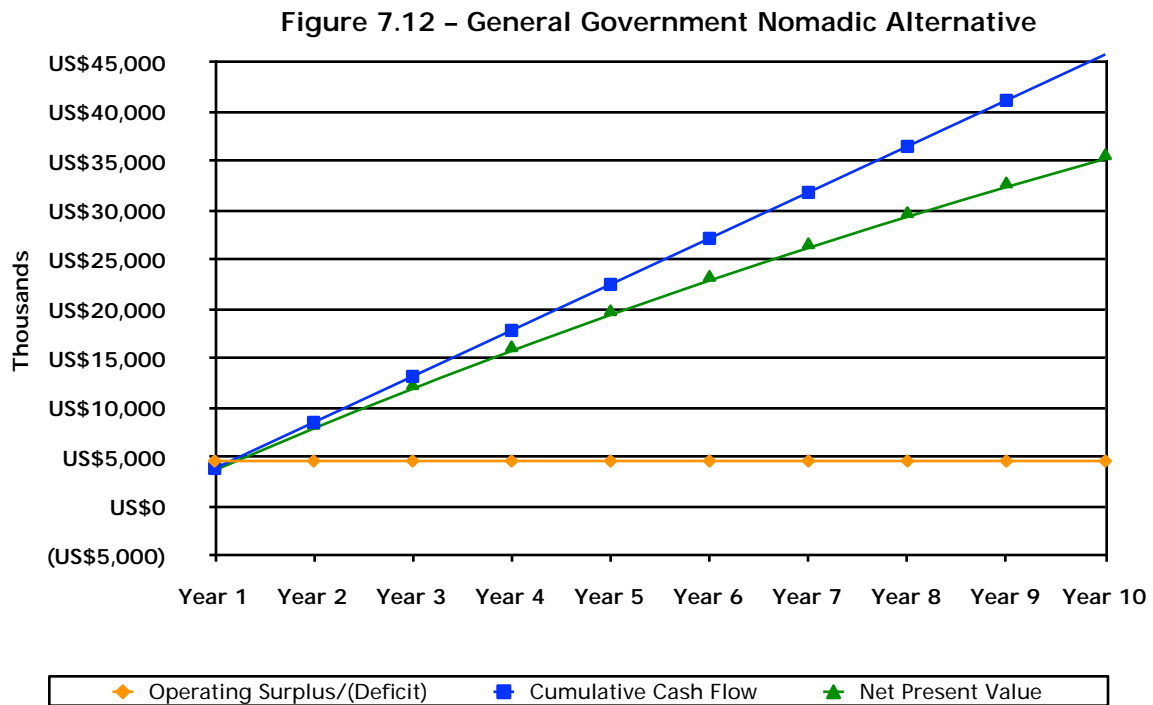


Performance improvement measures adopted by the Finance and Management Agency directly relate to enhanced tax revenue flowing to the City. Using the City Auditor's performance standard of a 4 to 1 dollar return on direct, specific auditing activities (as opposed to overall agency activities), the resulting annual revenue enhancement is estimated to be \$2.5 million.

For Public Works, CEDA and Human Services field workers, the estimated yearly gain in FTE value is \$2.2 million annually. Likewise, extending fixed wireless link capability to non-public safety locations will improve operating efficiencies. For example, supervisors will be able to securely access and report personnel data from their primary work locations. The value of these gains in efficiency and performance measures is estimated to be \$221,000 annually.

In total, \$624,000 in recurring funding offsets have been identified for fixed general government applications, such as providing broadband access to recreation centers, and \$4.7 million for nomadic applications.

To support the fixed applications, an additional 18 GHz link has been budgeted to serve the main library, 33 additional access points would be installed at existing backbone sites, and 120 non-public safety locations would receive lower cost subscriber devices. The construction cost for this segment is estimated at \$2 million.



To support nomadic user by providing widespread access by way of common WiFi devices, 86 WiFi access points would be added to the 32 budgeted for the backbone segment. Together, these 118 access points would not provide ubiquitous coverage, but would ensure that city employees are never very far – walking distance or a short drive at most – from access to the City’s IT infrastructure or the Internet. The capital cost of extending this kind of nomadic connectivity is \$751,000.

Annual operating cost is \$223,000 for the fixed general government segment and \$85,000 for the nomadic segment.

## 7.6. Additional Scenarios

### BayRICS 700 MHz Mobile Segment

One option for providing mobile, or near-mobile, broadband coverage throughout the City – of the sort contemplated for public safety video applications – is to blanket the city limits with outdoor WiFi coverage. This level of coverage would not be sufficient to provide Internet connectivity to homes or businesses, but it would effectively cover streets and open spaces.

The construction cost would be approximately \$10 million, with an annual operating expense of nearly \$1 million. The surplus generated by the public safety segment above does not come close to covering this additional expense.

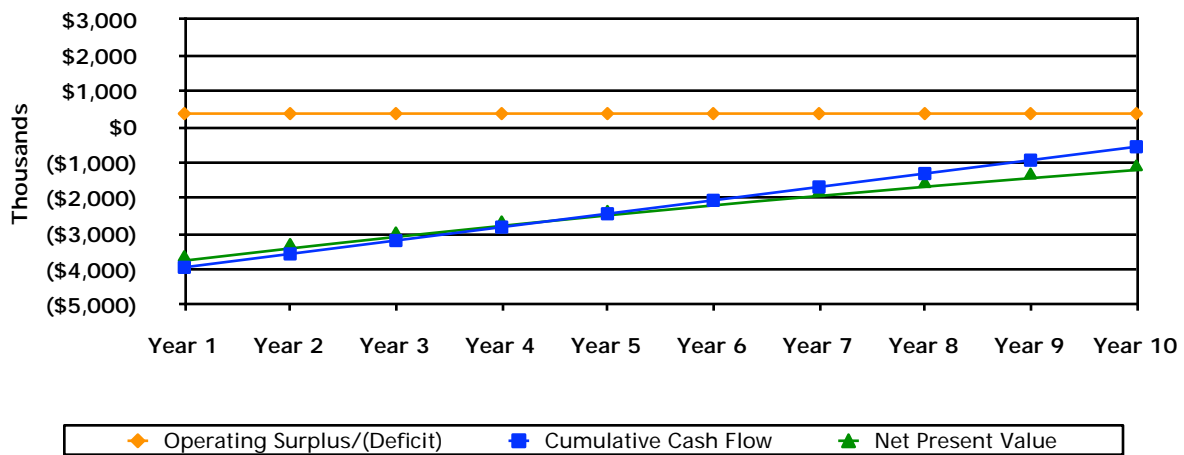
Although it is likely that such a system would support most mobile video applications, it is not at all certain. The technology employed is not specifically designed to support mobile applications, and the spectrum used can be problematic. The high cost and unknown reliability of a WiFi-based mobile video system eliminate this option from further consideration. Its only advantage is that it could be deployed immediately.

A cheaper and more reliable option is the 700 MHz BayRICS (Bay Area Region-wide Voice and Data Interoperable Communications System) system proposed by Oakland Mayor Ron Dellums, San Francisco Mayor Gavin Newsom and San Jose Mayor Chuck Reed on 11 September 2007. City of Oakland staff have been participating in the consortium, and have ensured that it will take into account the unique characteristics and needs of Oakland.

No additional funding sources have been identified to support this segment, however in the core business model, the core system shows a significant operating surplus and pays back the entire capital cost within eight years.

At this point, the details of the BayRICS system have not been fully defined. For comparison purposes, we assumed that six BayRICS sites would be built in Oakland and used the cost estimates generated by the Major Cities Chiefs' Workshop. The operating surplus is more than sufficient to meet the added operating expense of this conceptual segment, and the additional capital expense delays full positive cash flow by only four years. This analysis assume a worst case funding situation: no grant money would be available and the entire cost would have to be self-funded by the City of Oakland.

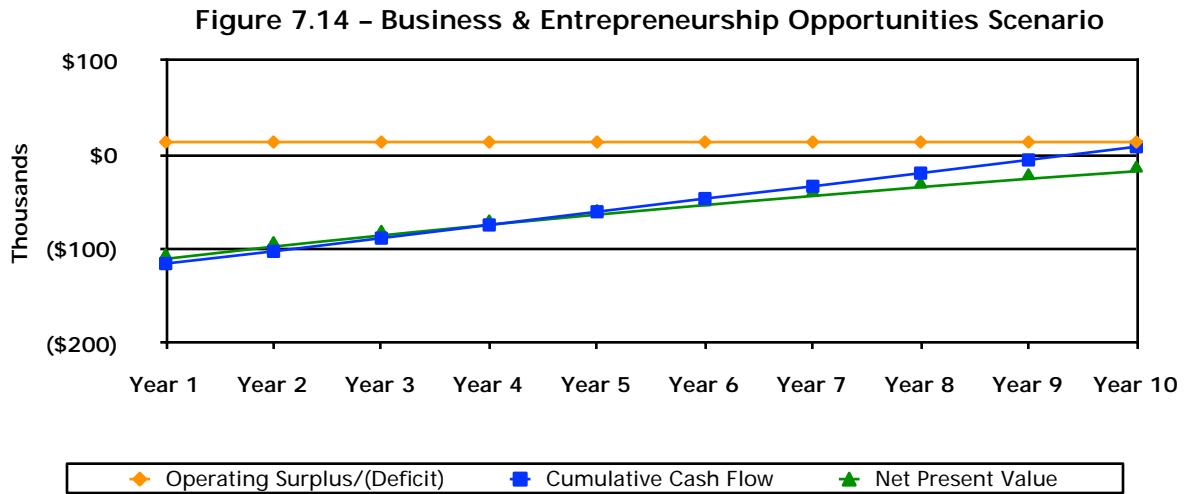
Figure 7.13 – BayRICS 700 MHz Scenario



### Business and Entrepreneurship Opportunities

Some commercial properties in Oakland are unable to obtain affordable high-speed broadband service from existing carriers. This lack restricts business and employment growth in Oakland, particularly in areas where it is needed most. The reference architecture developed for this study, in particular the core system, can be used to enable delivery of T-1 grade or better service to problematic locations.

It might not be appropriate for the City to directly compete with incumbent telecoms carriers. However, it is appropriate for the City to enable opportunities for new and/or small businesses, particularly in areas or locations where services are lacking. The City can help the business community overcome challenges by making facilities and technical resources available on a wholesale basis to qualified small businesses and business groups.



This scenario assumes that independent, commercial DS-3 grade Internet bandwidth, selected portions of the backbone system and standardized customer premise equipment (CPE) will be combined to create a facility that can support multiple T-1 grade circuits and lower bandwidth hotspots. Building this infrastructure would require a capital investment of \$129,000, with annual operating expenses of \$94,000.

Revenue would be derived from selling this capacity to local resellers or associations at the monthly wholesale rate of \$300 per T-1 equivalent and \$200 per hotspot. Providing standardized CPE and core maintenance service would generate additional revenue.

A pro forma estimate puts annual wholesale revenue to the City at \$108,000, allowing for pay-as-you-go funding of the program.

### Drinking Fountain Model Public Access

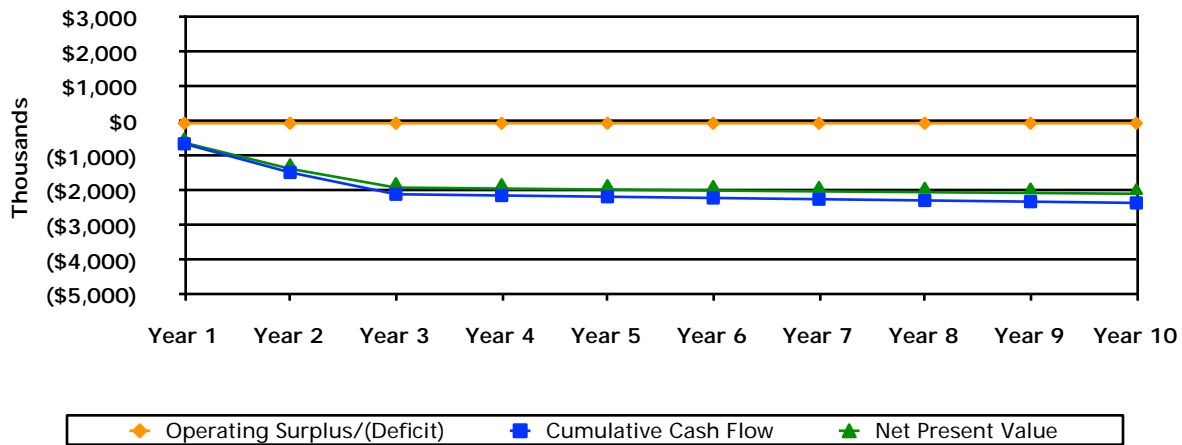
The backbone infrastructure and technical resources created through the Oakland Wireless Initiative can also be used to extend Internet access into the community, providing free or low cost access at community anchor institutions. This access also provides an enabling element for educational, economic development, employment, social, health and other programs. This increased service to the community would be in addition to any Internet access or related programs provided at city-owned community anchor institutions such as recreational centers, senior centers, libraries and the Oakland Museum.

One of the top priorities identified by Oakland residents during the stakeholder analysis process was ensuring that schools had sufficient Internet access. During the workshop process, it was determined that the Oakland Unified School District and other educational institutions already have access to adequate bandwidth through existing programs.

However, those programs place restrictions on the usage of that bandwidth. Offering alternative Internet resources to these institutions could expand their policy and programmatic options.

Community organizations and neighborhood institutions also support programs that could be enhanced by access to high speed Internet bandwidth. For example, the Oakland Housing Authority operates 267 sites where common area Internet access might be offered to residents. In total, the business model assumes that 627 such sites could be supported, including providing each site the necessary equipment to connect to the system.

Figure 7.15 – Drinking Fountain Model Public Access Scenario



Assuming a discounted T-1 equivalent rate of \$100 per month, the yearly value of providing high speed bandwidth to these community anchor institutions is estimated to be \$752,000, against a capital cost of \$2 million and an annual operating budget of \$788,000. Although the value proposition justifies the operating expense, accounting for the capital cost is more problematic.

No specific funding source has been identified for this program. However it would be a viable candidate for ARRA funding as well as other broadband funding initiatives currently in the pipeline. The job creation, digital inclusion, educational and public safety benefits are significant, and are directly in line with the BTOP goals and priorities set by Congress.

It is also possible to find funding sources on a case-by-case basis for individual sites. Because this program relies on unrestricted segments of the overall system, it can be built out as needs are prioritized and funds become available.

## 8. Appendix A: Summary of Research

### 8.1. Scope

While the scope of this feasibility study is restricted to the assessment of wireless broadband technology, applications and economics, and the needs that might be served directly by such technology, the scope of the assessment sessions was necessarily much broader.

Participants were not expected to immediately make distinctions between needs that might be met by the deployment of wireless broadband facilities, and needs that were either general in nature or for which wireless technology is not an appropriate solution. Conversations with and among participants were far ranging, and covered a wide variety of topics, concerns and needs. Volume 2 of this report contains detailed minutes of these sessions, along with other public comments, and could be very useful for a number of purposes unrelated to this study.

Topics discussed that are either outside the scope of this study or are too general to be comprehensively addressed by it include:

1. *Web-based communications and service delivery by government agencies, including the City of Oakland, to the public.* From an information technology perspective, general purpose content and applications are a key service government agencies provide to the public, a fact which was emphasized throughout the research process. Examples included the City of Oakland web site, an online permit process and a number of educational opportunities and applications. Although increased demand for online resources would tend to support a case for wireless broadband deployment, the same could be said of wired access. It is important to ensure that any public wireless Internet access deployed is able to support online services, but this study does not encompass determining the type, extent and need for such services.
2. *Interoperability between City departments, and between City departments and outside agencies.* As detailed below, to the greatest extent possible, any wireless broadband system deployed by the City of Oakland should be usable by all appropriate parties, and should facilitate rather than hinder cooperation. However, full interoperability is also a function of policy, management and other factors, which extend into areas that this study is not intended to address. Interoperability also depends on existing technology, which this study assesses in the specific context of wireless broadband feasibility, rather than in terms of general interoperability.



3. *General information technology and telecommunications infrastructure and policy.* Any wireless broadband system that might be deployed is necessarily an extension of the City's existing information technology network, and must support and adapt to the policies, standards and network architecture already in place. Where appropriate, this report will make recommendations concerning changes in this infrastructure insofar as it concerns integrating wireless resources, but it does not address general information technology strategy or implementation.
4. *Provision of computer hardware, software, training and technical support to underserved communities and individuals.* As noted below, in order for underserved communities and individuals to make use of broadband access of any sort, they must also have access to computer resources, including training. This consideration is a limiting factor for some aspects of a wireless broadband system, and must be assessed during any implementation process. Wireless technology, and the policy adopted to deploy it, can also create opportunities to increase the availability of these resources. However, a full assessment of this need and the means to fill it are outside the scope of this study.

## 8.2. Methodology

Examples of the agenda, discussion guides and other material used in this research can be found in Volume 2 of this study. The primary research program consisted of a series of targeted workshops and public focus groups, as well as a town hall meeting.

The six workshops were structured as semiformal meetings in a business setting. Three workshops were for city personnel, with participants invited from all city departments. One workshop was held for the local business community, one for local non-profits, and one for educational organizations and other government agencies. Department of information technology personnel were present at all workshops, and contributed information and observations as appropriate. However, since DIT is the department that is responsible for this study, they were not primary participants.

The workshops opened with introductions, and then moved to a presentation of background information about the study and on wireless broadband initiatives elsewhere. Participants then discussed their particular needs and concerns. This information was gathered on flip charts, which were then used to facilitate a brainstorming session. The workshops closed with participants prioritizing needs and solutions.

One focus group was held in each of the seven Oakland City Council districts, and participants were recruited from people who live and work in the respective district. An effort was made to recruit people from all demographic categories in each district, and although every focus group did not include participants from all possible demographic

categories, taken as a whole the groups did encompass nearly every segment of the greater Oakland community. Focus group participants were assured of anonymity.

Each group was led through the same discussion guide, with the goal of sparking a wide ranging discussion of needs that could then be channeled into topics specific to wireless broadband. To set the stage, participants introduced themselves and were given a brief presentation of various examples of municipal broadband deployments. They were then asked open ended questions about their perceptions of needs and existing City services, which led to interactive discussion of relevant topics. Each session closed with a summary of the points raised in the discussion and a brief prioritization exercise.

The town hall meeting was designed as an open and unstructured public discussion, with no screening or targeted recruitment of participants. It began with a presentation about various municipal wireless broadband projects and an overview of the study process. Members of the audience then asked questions and presented their own views about what they thought were the important needs and service priorities for the City of Oakland, and their opinions and suggestions concerning wireless broadband specifically. All public comment was taken as presented, with no effort made to channel the discussion or produce a group consensus or identify common conclusions.

### **8.3. Technical Kickoff Meeting**

On 7 December 2007, City of Oakland personnel responsible for networking and telecommunications met with prime study contractor Stephen Blum and technical lead Stuart Browne to discuss information needs, and to be briefed on the planned course of the study. Blum and Browne presented background information on the technology and economics of municipal wireless broadband and discussed technical information needs.

All participants agreed to help collect the technical data and later did so, using a guide and questionnaire prepared by Browne.

### **8.4. Workshops**

#### **Workshop 1: Police and Fire Departments, Mayor's Office, Administrator's Office, KTOP**

This workshop focused on public safety and emergency services. Participants brainstormed and discussed potential applications that could increase response time, improve service efficiency and increase interoperability between agencies in times of emergency. A representative from the Human Services Department attended, and provided ideas on how wireless technology could be used to serve the elderly.

Police department representatives discussed a current effort to provide all police officers with laptop computers, and the need to provide those computers with data access in the field. Fire department representatives stated that they are not currently accessing data from the field and that personnel, for example fire inspectors, are recording information on paper in the field and returning to their offices to manually enter it into computers.

Police and fire representatives believed that better visual information from the scene of incidents would lead to improved coordination between their departments, and would enhance their ability to respond to those incidents.

Network independence and cost savings were two key potential benefits identified. Using commercial networks for public safety can be problematic, primarily due to security concerns. There was a belief that costs could possibly be reduced if a Citywide network was in place. Increases in efficiency and productivity also could be possible. Participants identified an opportunity to make field workers more efficient by providing remote access to records, and to file reports and record other information without having to return to the station. The result could be better service and faster response, as well as an increase in the amount of time field workers could spend in the field.

Security and privacy were key concerns. Participants agreed that, in general, any wireless technology used must be secure and able to support Federal standards, including encryption and segmentation for law enforcement communications. Privacy standards, for medical records for example, must also be met.

Coverage must be adequate to support intended users and should represent an upgrade in capability, according to participants. They observed that police and fire personnel already have to contend with radio dead spots because of hilly terrain, and ideally any wireless network deployed would help alleviate that problem. Another challenge is the need to communicate with aircraft and boats.

Another concern of participants was system survivability during a disaster, such as an earthquake, and ensuring that the system is adaptable to meet the rapidly shifting needs and circumstances that major emergencies present. Participants believed that any system must have a high degree of reliability, with adequate emergency power, backup equipment and spare capacity to function at all times, during emergencies as well as routine operations.

## Workshop 2: Public Works, Facilities Management, Risk Management, Human Services, Community Economic Development Agency (CEDA)

In this workshop, the focus was cost savings, productivity, and driving new revenue opportunities for the City. Some of the same issues mentioned in Workshop 1, such as gaining efficiency in work management systems, were also raised. Location-based tracking was identified as a way to manage City assets. Ideas for emergency and disaster management applications were also offered.

Participants discussed ways wireless technology might improve efficiency and productivity, echoing comments in the earlier workshop about the benefits of being able to access information and file reports from the field. Potential cost savings were identified as well. For example, the public works department is acquiring 150 new laptop computers. Purchasing commercial wireless data service would cost approximately \$50 per month for each computer, for a total budget of \$90,000. An independent City wireless network might be able to provide comparable service for less money.

Specific applications that could enhance productivity were discussed, such as remote reporting and two-way access to the City's geographical information system (GIS). City tree crews would like to be able to access right of way and property line information while in the field. The traffic division is currently looking at wireless technology as a way of managing radar feedback signs. Currently, they are transferring data by swapping out physical media on individual units. Managing and monitoring traffic signals was also mentioned as a potential application.

Other uses for wireless technology mentioned included filling in dead spots in current City radio and commercial carrier data network coverage, providing remote access to desktop computers and enabling telecommuting. One observation made about telecommuting was that in addition to being a potential productivity enhancer, it is also useful in preparing for emergencies. According to one of the participants, the federal department of homeland security requires some employees to work from home one day per week, to ensure they can do their jobs if they are unable to report to their primary offices during an emergency.

Wireless technology was also mentioned as a potential economic development tool, which could boost the value of some properties by enabling state-of-art broadband facilities. In other cases, it could provide a back-up service for businesses that rely on wired connections or as an extension of wired networks for businesses with significant numbers of field workers within the city limits. Another potential economic development opportunity identified by participants was providing wireless public Internet access in high traffic areas, which could be of particular benefit to mobile workers and the travel industry.

Participants also thought that wireless technology could aid in increasing the trust of the general public and promoting transparency. The rationale was that when field workers were interacting with the public, for example during an inspection, wireless data access would allow them to show processes and results in real time, rather than having to wait days, or longer, to provide feedback. Another need identified was the lack of affordable Internet access in some neighborhoods, and wireless technology was discussed as one element of a potential solution.

### **Workshop 3: Finance Department, Office of Emergency Services, Oakland Museum, Parks and Recreation Department**

The discussion in this workshop centered on ways that wireless technology could plug holes in current networking capabilities, extend information technology resources into the field and enhance existing City services.

Participants came from a diverse group of departments, with a variety of institutional needs. Both the finance and parks and recreation department representatives saw value in being able to access their existing information technology assets directly from the field. For example, being able to access information remotely would allow the finance department to conduct more and better field audits, potentially leading to increased tax revenue flowing to the City.

Adding geographic information to existing databases, and accessing that information automatically through location-based services, was seen as a way to enhance tax code compliance, as well as compliance with other City requirements. Location-based services were identified as a way of improving City operations and services, such as emergency response management.

Some parks and recreation offices do not yet have wired access to the City's information technology infrastructure, and wireless technology was mentioned as a potential means of providing connectivity. Currently, supervisors have to go to a central office to file routine reports, such as personnel-related records. This situation was seen by the group as being inefficient and a specific application where wireless technology could improve productivity. As with previous groups, participants believed that being able to access and file information from the field would increase productivity by reducing the need to travel back and forth to an office.

Security was a central concern. Participants noted that the two examples above involve confidential information that has to be carefully controlled, both while it is being transmitted and on any devices that are used in the field. The City's current IT infrastructure

already has extensive safeguards, such as virtual private networks (VPNs) built into it. Any wireless extensions to the existing network would have to support those safeguards.

The representative from the office of emergency services echoed comments made by police and fire department personnel during the first workshop. Wireless facilities could improve communication with emergency responders on a routine basis as well as during major incidents, and provide a back-up to existing systems.

Finally, improving communications with and service delivery to the public was seen as a significant potential benefit of wireless technology. For example, it could enhance interactive tours of the Oakland museum, provide better public access to the museum's collection, and aid in volunteer recruitment and management.

#### **Workshop 4: Oakland Businesses**

Participants discussed gaps in services and facilities, both public and private, and ways wireless technology might plug those gaps. Much of the discussion focused on the economic case for extending networking resources and capabilities, including ways that the City might pay for the facilities needed, and on opportunities for private businesses and individuals to participate in such a project.

Business representatives generally believed that adding wireless connectivity to the City's IT facilities could increase the productivity of field workers, potentially reduce crime by improving surveillance, and improve service delivery to business, such as expediting building inspections permit processes.

A couple of specific business opportunities were identified and discussed. First, downtown Oakland has a number of "Class B" buildings that lack commercial-grade Internet access. A wireless network could be a way to bring connectivity to those buildings, and the use of wireless technology internally could be a way of quickly distributing access throughout a property. Second, adding wireless hotspots in key locations, such as bus shelters, the downtown area and Jack London Square, could help increase tourism and convention business.

Several suggestions for financing wireless facilities were offered. One idea was to allow business owners to buy in to a video surveillance network, making it possible for them to add supplemental coverage of their own locations, and to assist with monitoring and reporting. Another was to maximize advertising and sponsorship opportunities.

One suggestion made was to integrate public transit information and dial-a-ride service with mobile phone networks, offering both a way to deliver information to the public and a

means of billing. Transportation-related applications were seen as potentially fundable through grants.

Participants generally believed that any wireless system deployed should be financially sustainable, and the costs of the system should fall primarily on those who benefit from it. They also emphasized that the value of any system should be determined before decisions are made, and that costs be in line with the value added.

A City wireless system could also encourage other wireless-related businesses to develop, according to participants. For example, access to wireless facilities might make it possible to offer new voice communication or Internet access services, or extend the reach of current, commercially available services to new places and new customers. Businesses might also be able to use a citywide system to track employees and assets.

### **Workshop 5: Oakland Non-profits**

Participants were concerned about providing access to Internet resources and services to those who don't yet have it, particularly youth and the economically disadvantaged. They generally believed these individuals would be left behind, academically and technologically, if efforts were not made to educate them with the basics of technology. The discussion focused on the benefits of Internet access, regardless of whether it was provided wirelessly or otherwise.

One of the key points of the discussion was that the inability to access Internet resources and services is due to several factors, including access to the necessary hardware and software, basic technology skills, computer-specific skills and professional technical support, as well as an inability to obtain Internet access service, either because it is not available or it is not affordable.

Two ways of overcoming Internet access issues were discussed. One was to deliver alternate Internet service into homes for free or at a reduced rate. Another was to provide it to community groups and at public facilities, making it easier to combine it with hardware, software, training, technical support and other necessary resources, and to create programs that serve the specific needs of different parts of the community. A variation on this idea, which favors the use of wireless technology, is to create mobile centers, similar to bookmobiles, that take these programs directly into neighborhoods.

One of the participants was from Kaiser Foundation Health Plan, Inc. He described a mobile medical clinic that Kaiser is currently testing in Hawaii. Its immediate purpose is to provide health care to under served communities, but ultimately it could be a platform for providing care directly to people in their homes. Other Oakland area hospitals are also

expanding online services, and City infrastructure, wireless or otherwise, could help link these efforts.

Internet access, wireless or otherwise, was seen as a means to help achieve goals, rather than as a goal itself. Those goals included improving educational levels, teaching skills, encouraging the pursuit of higher education, improving delivery of health care, increasing access to social services, and community building. Participants generally had a sense of urgency about reaching these goals, and saw needs as being immediate and pressing.

Workshop participants generally favored business models, network architectures and technology that was non-exclusive and available to all. Creating competition for incumbent Internet service providers was seen a beneficial. Job training opportunities were also identified, for example training local residents to become network technicians.

### **Workshop 6: Education and other Government Agencies**

Participants in this workshop were primarily management level information technology and telecommunications staff from local government agencies. As a result, the discussion focused on common technical challenges, and interagency cooperation and the means to foster it. There was considerable willingness amongst all participants to discuss sharing resources and cooperating where possible.

Several of these agencies, for example the Oakland Unified School District (OUSD), BART, the Metropolitan Transportation Commission and the Port of Oakland, have existing broadband networks within the Oakland city limits, including wireless facilities. In addition, BART is extending public wireless access, through mobile phone carriers and other means, throughout its system. OUSD and the Port operate more or less completely within the city limits, and face some of the same networking challenges as the City. In some cases, participants said, the City could share existing facilities. In other cases, agency representatives said they would be interested in making use of City resources.

One example of project congruency is the Port's current program to install public wireless Internet access in high traffic areas that it controls, such as the airport and Jack London Square. Another example is OUSD's program to create a wireless overlay of its existing information technology network within all its buildings. This network is not intended to provide public Internet access, however one suggestion made was for the City and OUSD to cooperate in providing public access in common areas, such as auditoriums, after school hours, if legal and security concerns could be addressed.



OUSD and Peralta Community College District representatives expressed other security concerns. Rogue wireless access points – personal wireless routers that are attached to a secure network – are an issue, and in some instances have shut down networks.

Emergency planning is another area of potential interagency cooperation. For example, some OUSD schools are designated as emergency evacuation shelters. If activated, those sites would have communication needs that are radically different from normal day to day operations, and could benefit from wireless broadband facilities that could be quickly adapted to satisfy those needs.

Ongoing technical coordination, from the planning process on through to deployment and operations, was seen by participants as essential to any partnership. Security was one area of particular concern. Individually, agencies have to meet security requirements that are unique to their jurisdiction. Consequently, any common broadband facilities have to be able to meet all the security requirements of all the partners.

One suggestion that was generally endorsed by all participants was that interagency planning and coordination should extend beyond the workshop, as a group or one-on-one as appropriate. One existing group that was mentioned as an example, and potentially as a forum, is the recently formed Bay Area transportation CIO roundtable.

Participants also believed that policy-level coordination is an important element in creating any ongoing cooperative effort. The governing authorities of each agency have concerns and priorities that might or might not be consistent with City policies and, according to participants, advance coordination would be necessary to ensure a smooth process.

## 8.5. Focus Groups

### Focus Group 1 - District 6

The majority of the participants either lived or worked in East Oakland. This focus group had the highest youth participation of all the focus groups, with young people comprising more than half of the participants. Council member Desley Brooks, who represents this district, made opening remarks to the participants.

#### Top priorities

- Overcome economic and educational hurdles to hardware and access, ensuring that everyone who wanted access could afford it, and who needed hardware could get it.
- Equip all schools.
- Secure post-disaster resources.

(Prioritization of topics was done by participants themselves as part of the concluding process of each focus group.)

### **Focus Group 2 - District 5**

This focus group was the smallest. The participants either live or work in this predominantly Latino area of Oakland. Perhaps because of its smaller size, this group engaged in a very lively discussion. Participants ranged in age from high school students to senior citizens.

#### **Top priorities**

- Access for all, “not just free access, but having the tools – the hardware and the software – to even endeavor taking advantage of the access”.
- Service providers ought to be a part of Oakland.
- Make sure any public services are multilingual.

### **Focus Group 3 - District 4**

This session was very interactive. The focus group took place in the Dimond library, one of the few libraries that offer free wireless access to the Internet. While the focus group was taking place, members of the public parked outside the closed library, just to make use of this access. This group seemed well versed on innovative technologies. Council member Jean Quan and members of her staff participated in this focus group.

#### **Top priorities**

- Easy and inexpensive access for all, the more people on the network, the more valuable it becomes.
- Bandwidth and strong infrastructure to support use
- Public access should start in public areas.

### **Focus Group 4 - District 1**

Senior citizens were well represented at this focus group and it was held at a senior center. The group seemed very engaged with the city, in terms of volunteerism and other roles, and very educated about the status of Oakland politics. Overall this group focused more on city issues than on issues relating to their personal needs.

#### **Top priorities**

- Better real time communication in emergencies.
- Public safety and emergency response.
- Education.
- Technology and software.
- Accessibility across Oakland.

### **Focus Group 5 - District 2**

This focus group had the most culturally diverse group of participants, who spoke a remarkable variety of languages. Language issues might have led some to engage in discussion less than others, but even so a broad range of issues, some unique to the district, were put forth.

#### Top priorities

- Leadership necessary to effectively implement.
- “Public face” on this initiative.
- Public utility-type service.
- Training.
- Access.

### **Focus Group 6 - District 3**

This focus group was one of the most balanced in terms of male/female ratio and above/below 40 age range. The majority of participants in this focus group lived or worked in West Oakland.

#### Top priorities

- Infrastructure.
- Public access.
- Content, in terms of what is accessible over the system.

### **Focus Group 7 - District 7**

The participants of this focus group lived or worked in East Oakland. Just under half of the participants were young people. Perhaps as a result, the discussion was free flowing and covered topics and ideas that had not yet been considered.

#### Top priorities

- More WiFi at community centers, schools, libraries, etc.
- If the city wants to create more revenue, focus on WiFi on buses so people will use them more.
- Have WiFi available as a public service.

## **8.6. Town Hall Meeting**

The Town Hall meeting was well attended. Participants focused on the City’s plans and what should be considered during the assessment process. A good portion were technology-oriented and seemed to have a good understanding of what would be involved in designing and deploying wireless broadband solutions for the City of Oakland.

#### Top priorities

- Access for unserved areas is important, but needs to be combined with other necessary resources such as equipment, training and support.
- Some solutions are easier to implement than other, and can be deployed quickly, such as offering free WiFi access at all City libraries.
- Costs have to be carefully considered.
- Wireless broadband facilities created for City staff should address genuine needs.
- Wireless technology can help provide public as well as infrastructure support in emergencies.

#### 8.7. Samples of Public Comment

As noted above, detail notes and other documentation from all the sessions, as well as other public comment received during the study, is contained in Volume 2 of this study. Typical comments include

“The Diamond Library has WiFi, but the Eastmont Branch doesn’t. All the libraries need it.”

“Residents could use Internet to report incidents to the City, or the police department. With wireless reporting police could see whether there are clusters of incidents happening repeatedly in an area, and send a cruiser to that area.”

“Need to know what benefits the taxpayers are getting from the wireless service as well as what benefits the vendor is getting.”

“Will development of this infrastructure produce the kinds of jobs we need in Oakland?”

“Security is important for privacy.”

“Let’s not spend all this money to hire brand new people to recreate stuff that already exists. See what already exists... and leverage existing resources.”

Train teenagers to be technicians to support access and hardware. “ The point is to train people in the community, not bringing folks from outside.”

“Wireless access is only good if you have the equipment. Consider lending programs such as Berkeley’s tools program for home improvements, for video cameras, digital cameras, computer equipment.”

“Provide WiFi access in bus shelters as well as on buses. “[While riding the bus] people spend a lot of time sitting around doing nothing; it would be much more enjoyable and productive for people with WiFi access. In Japan they provide all the messaging in different languages.”

“It’s fairly common throughout the country that most libraries have WiFi, so we are a little bit behind the times now. The main library does not have it. We get asked for it easily five times per week. In terms of the digital divide, patrons who come in to use equipment at the library don’t have computers or printers at home, so providing WiFi in some neighborhoods might not actually provide access.”

“I have a concern that commercial implementation of WiMAX or a 4G system by a major corporation could easily render something that we put up ourselves obsolete.”

“Must be careful not to underestimate the cost associated with broad-scale wireless access. This makes me think pragmatically about the drinking fountain model, where you focus first on services that can piggyback on existing wired connections at schools, recreation centers, and public buildings as a nexus for people to come together that might otherwise have difficulty accessing the Internet.”

“I love technology – wireless everywhere would be wonderful. However, given other cities' problems with wireless, Oakland's current resource problems, and frankly track record – please don’t do it.”

## 9. Appendix B: Frequency Mapping

# Oakland Reference Architecture

## Coverage Maps

4.9 GHz

2.4 GHz

700 MHz





# Oakland Reference Architecture

## Coverage Maps




4.9 GHz

2.4 GHz

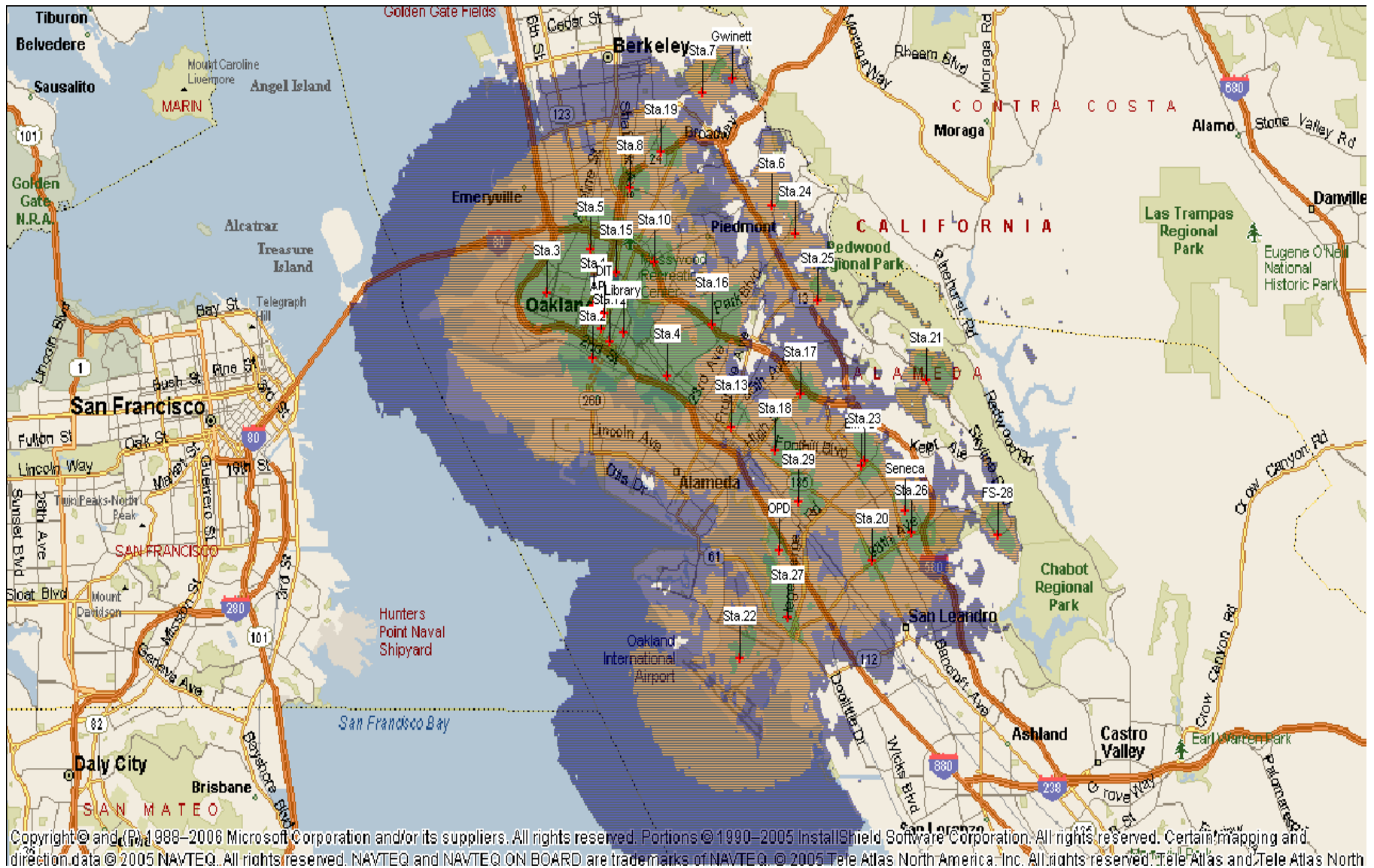
## 4.9 GHz and 2.4 GHz Assumptions

- Maps are for informational purposes only.
- Do not assume a particular system design, other than frequency band.
- Maps do not account for subscriber density or multi channel access points.
- Maps are based on Talk Out- Base Station to Subscriber
- All maps are based upon a reliability of approximately 95% Area Reliability.
- 2.4 GHz Maps are based on an ERP of 36 dBm - Maximum allowable per FCC.
- 4.9 GHz Maps are based on an ERP of 29 dBm - Maximum allowable per FCC.
- Gwinnett, Seneca, and FS 28 location on tower adjusted to 25 ft.

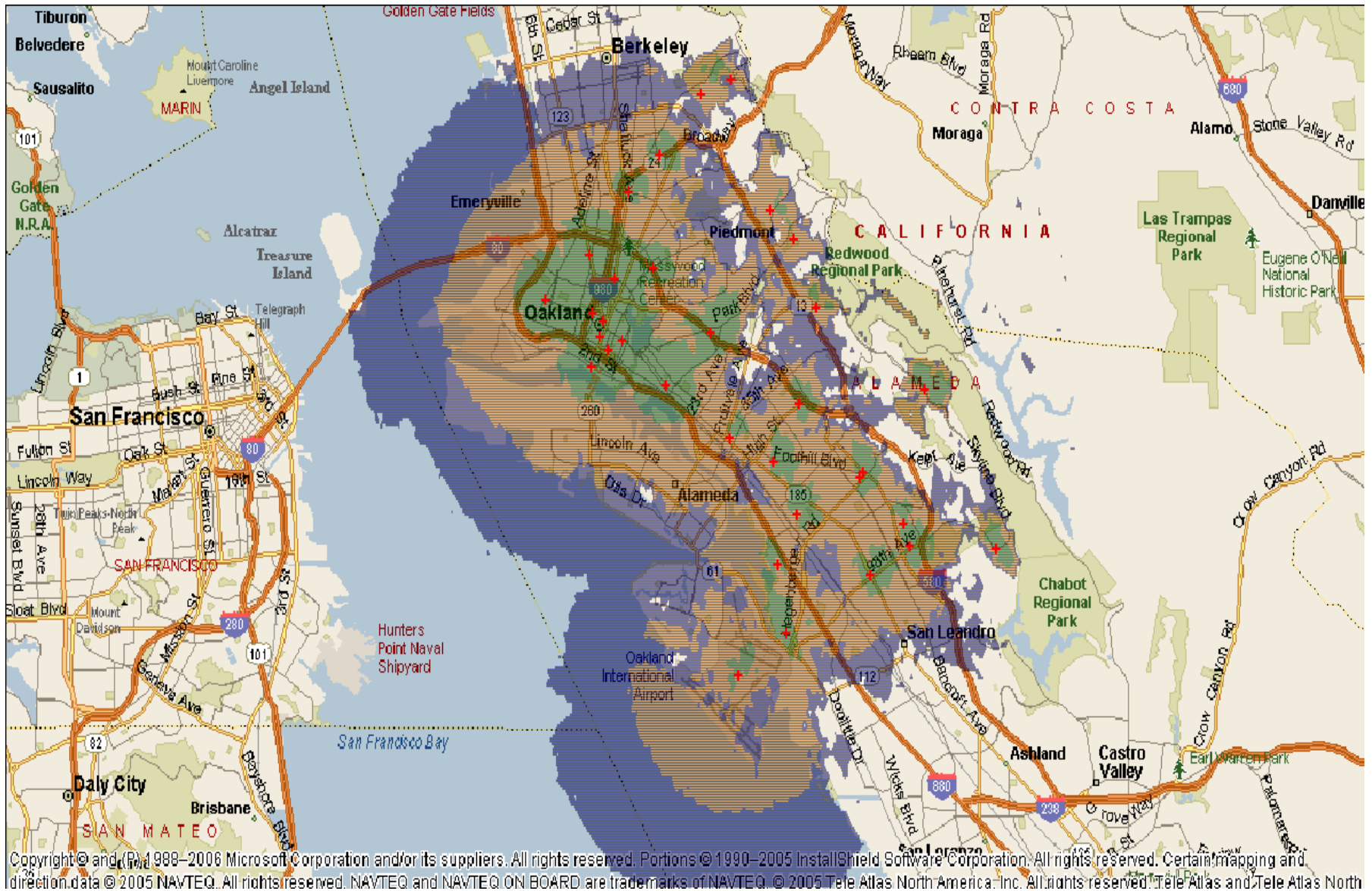
## Map Legend - 4.9 GHz and 2.4 GHz

	Base Station to Device = -85 dBm
	Base Station to Device = -95 dBm
	Base Station to Device = -100 dBm

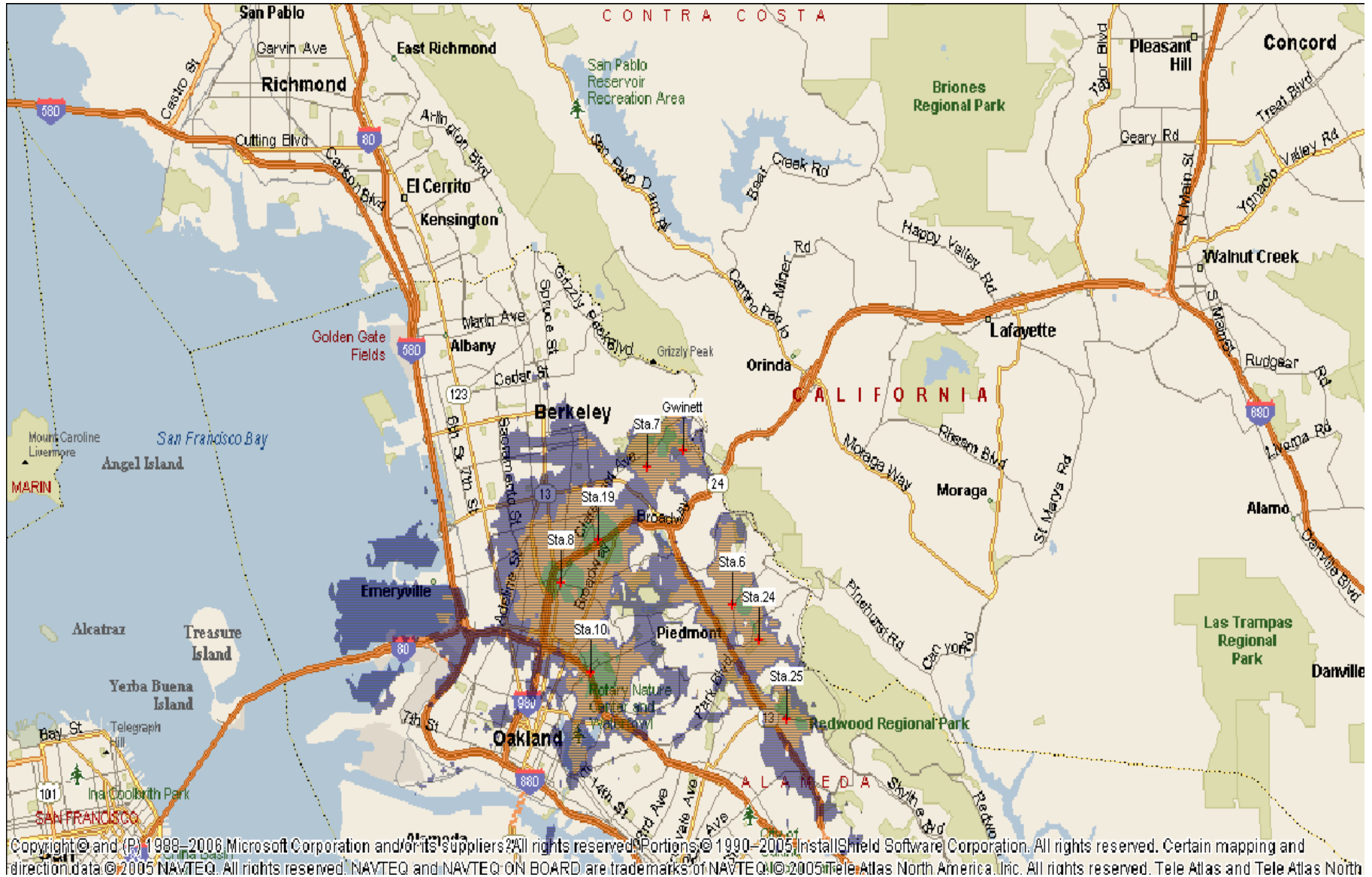
# Composite - 4.9 GHz



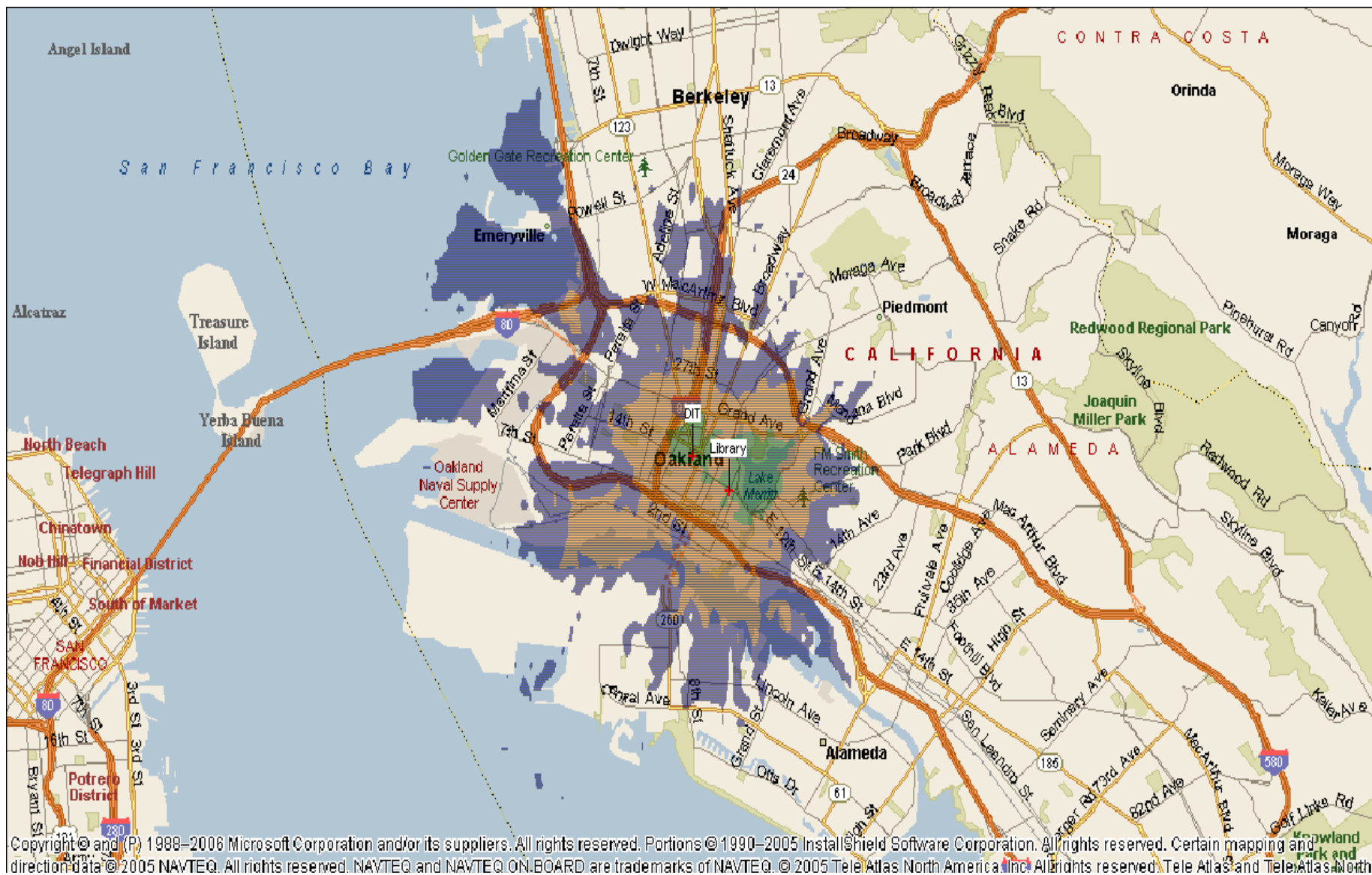
# Composite - 4.9 GHz



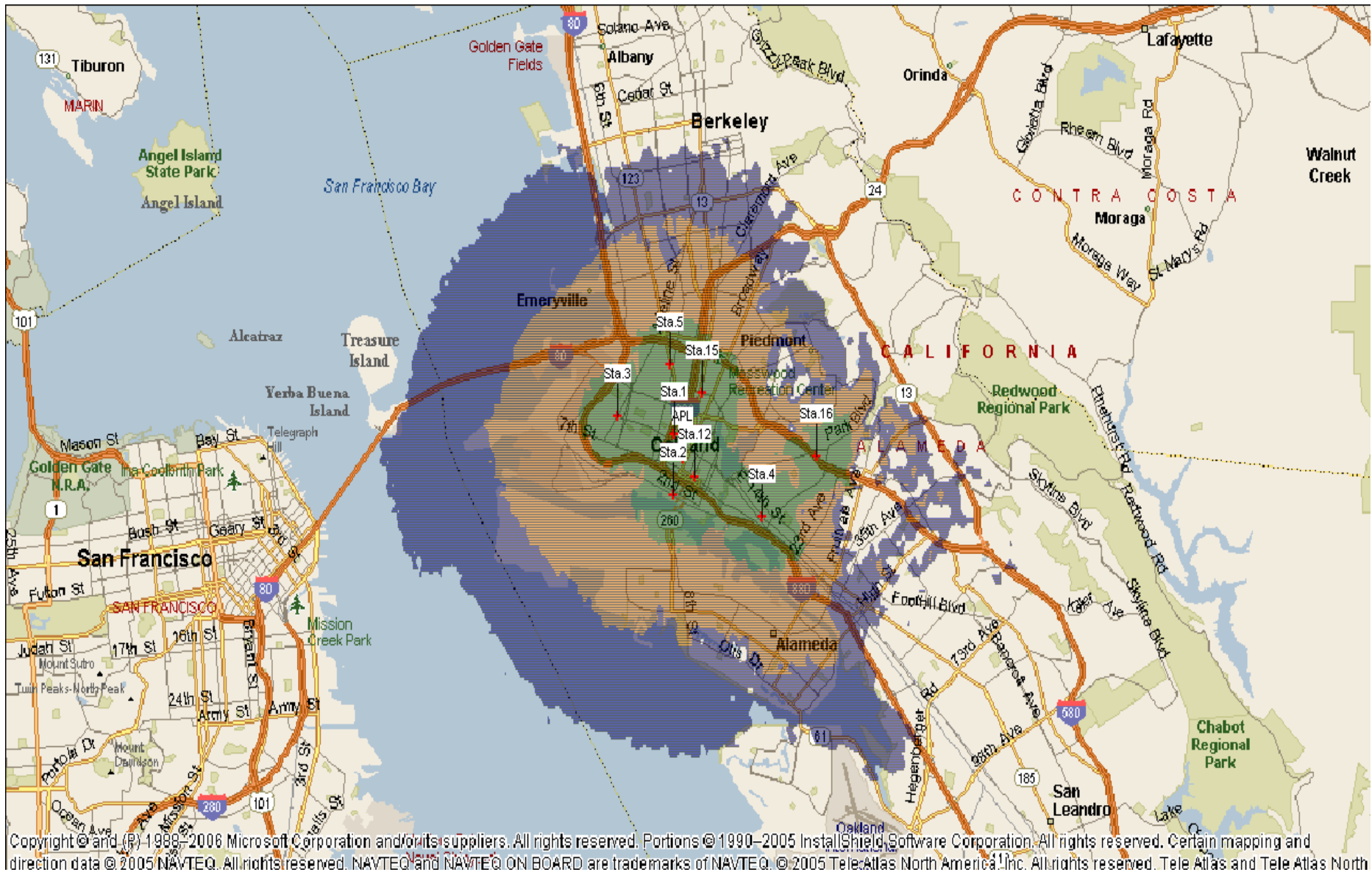
# Gwinnett - 4.9 GHz



# DIT- 4.9 GHz

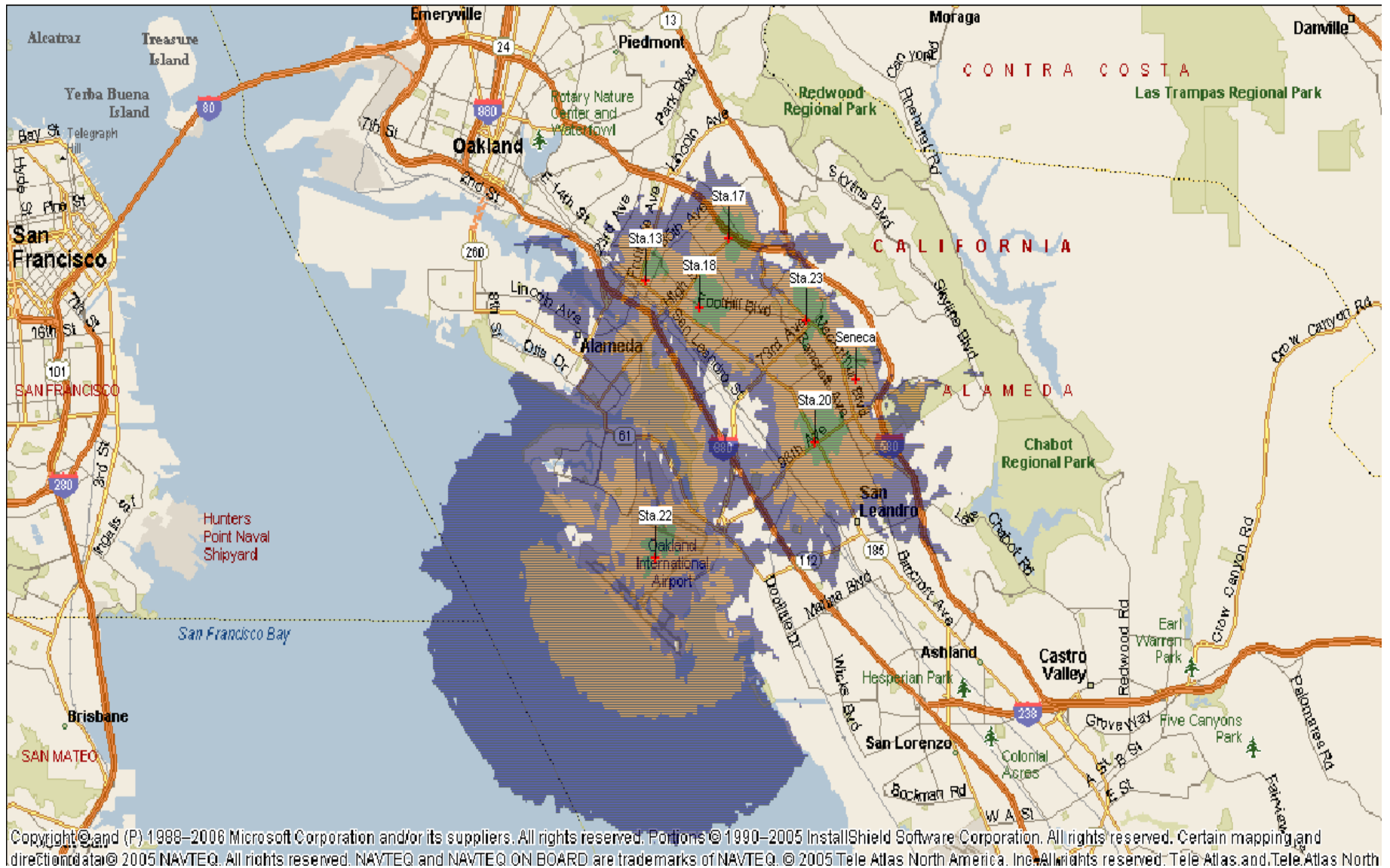


# APL - 4.9 GHz

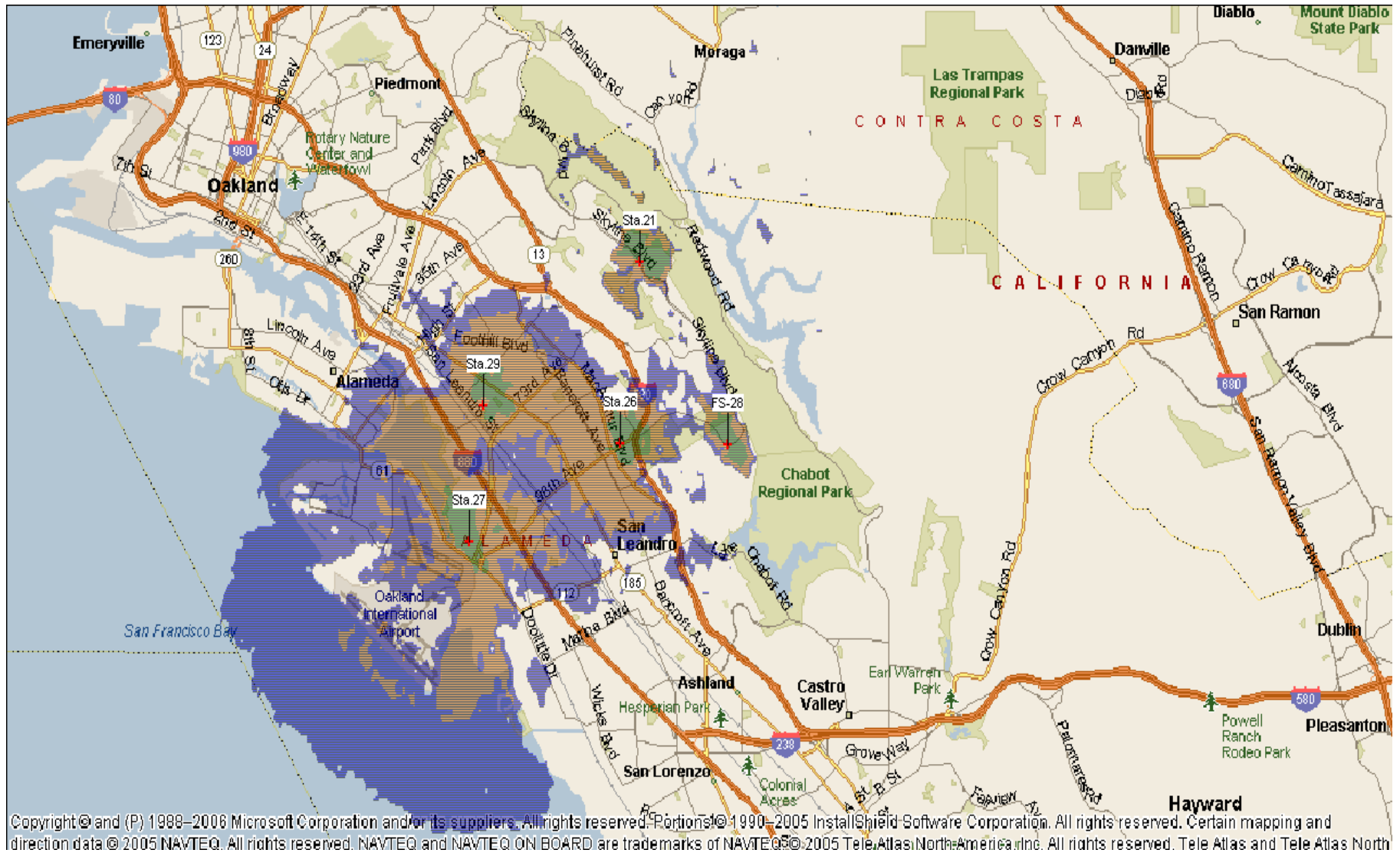




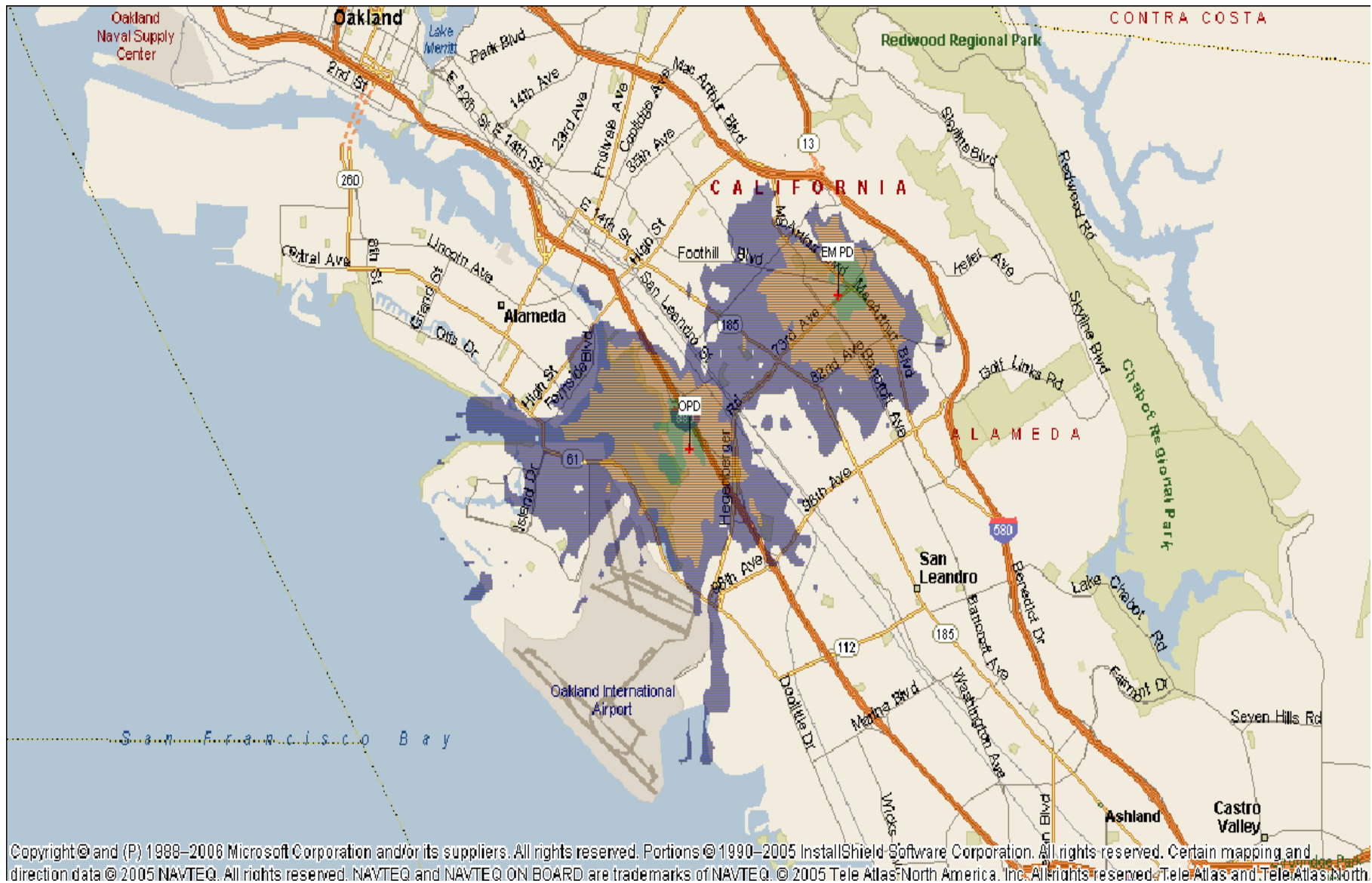
# Seneca - 4.9 GHz



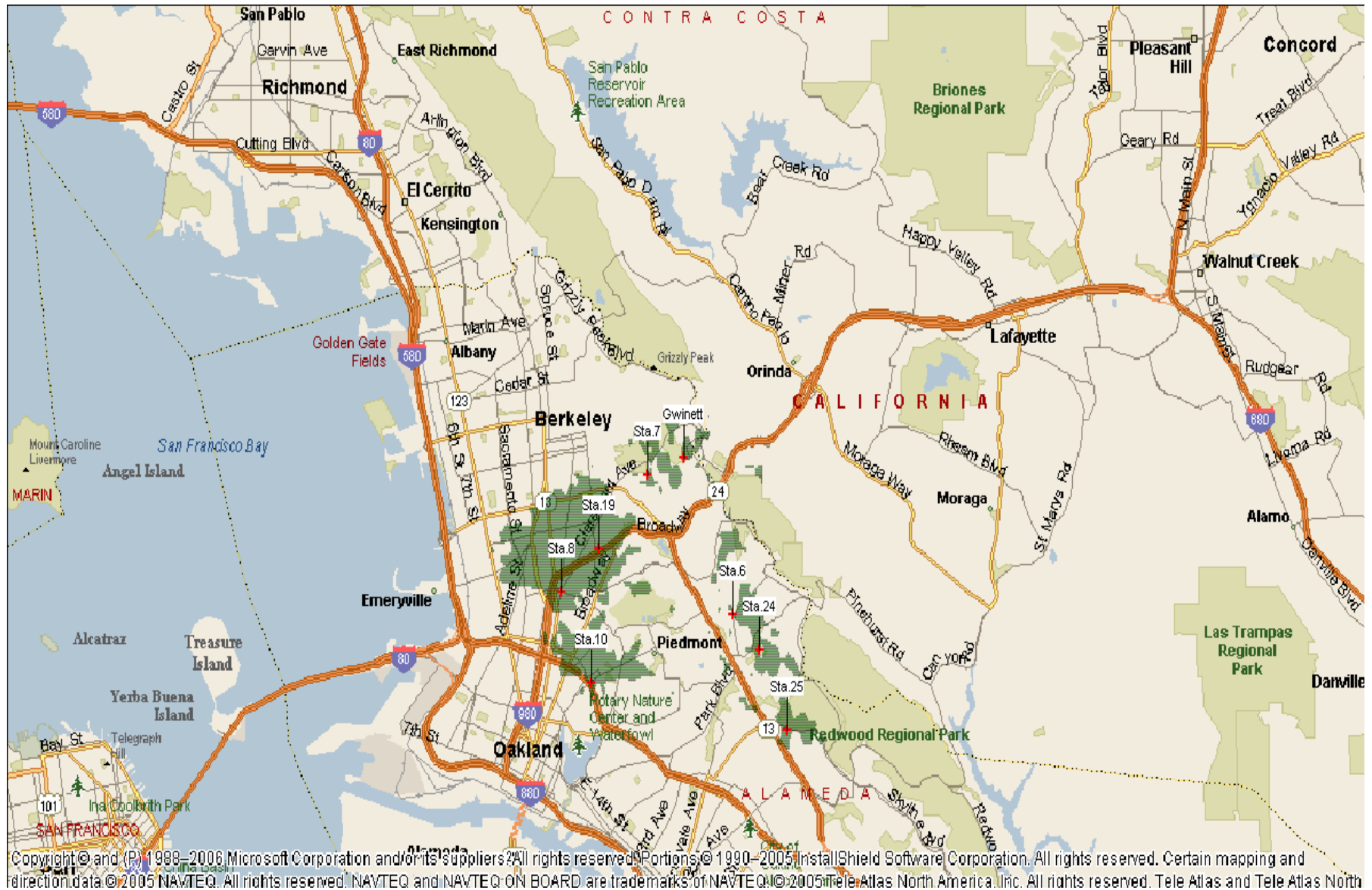
# FS 28 - 4.9 GHz



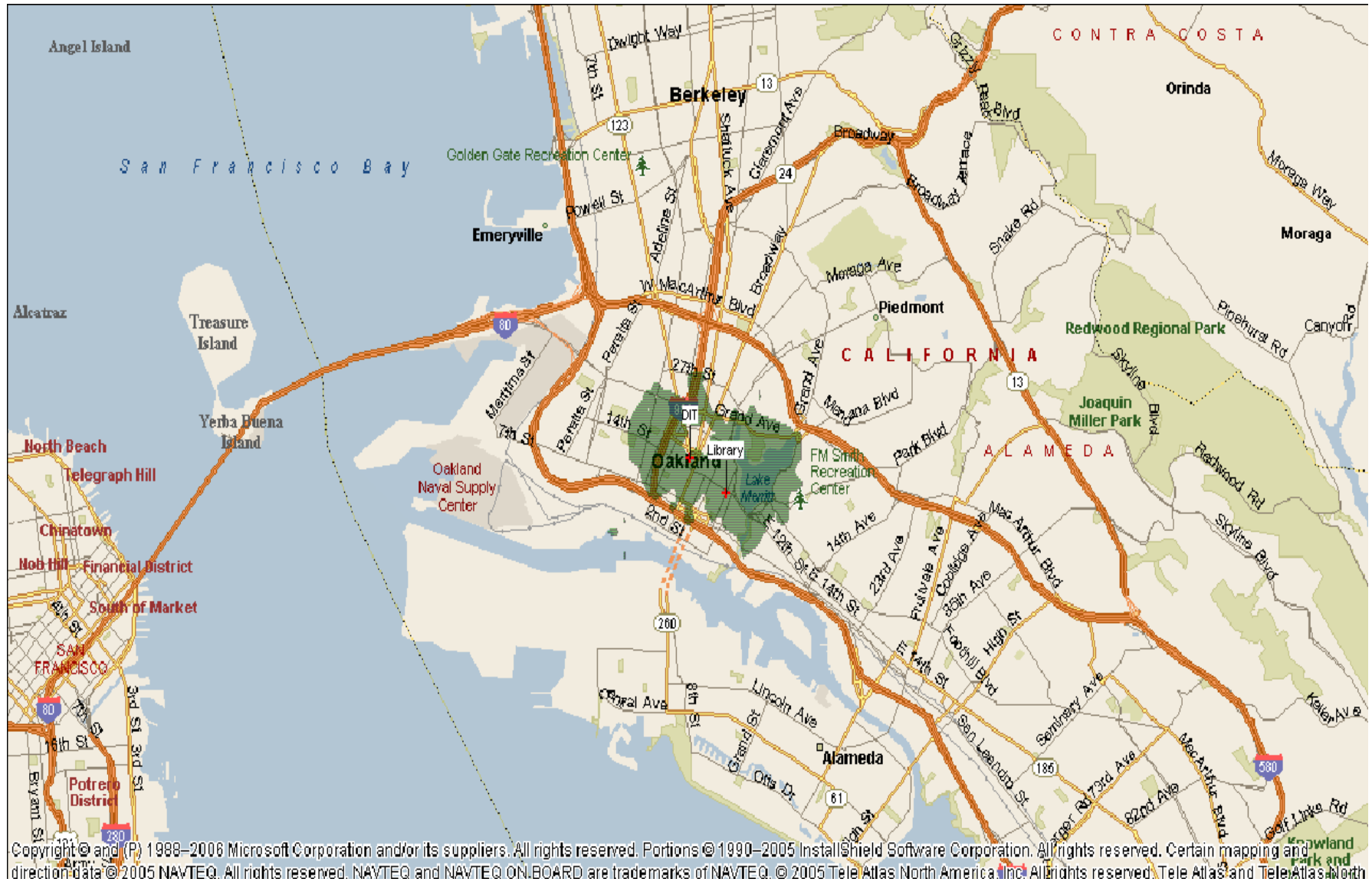
# OPD - 4.9 GHz



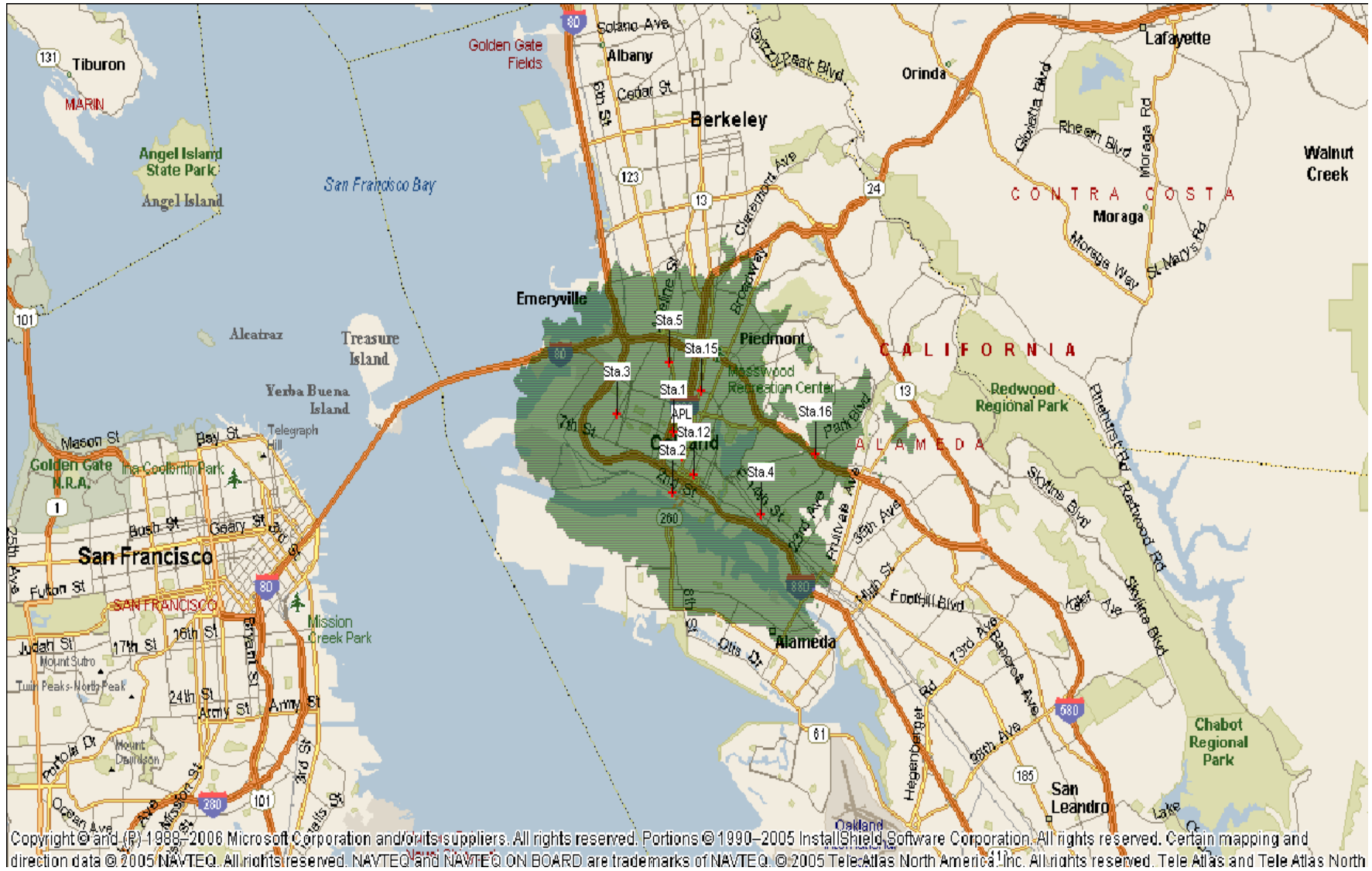
# Gwinnett - 2.4 GHz



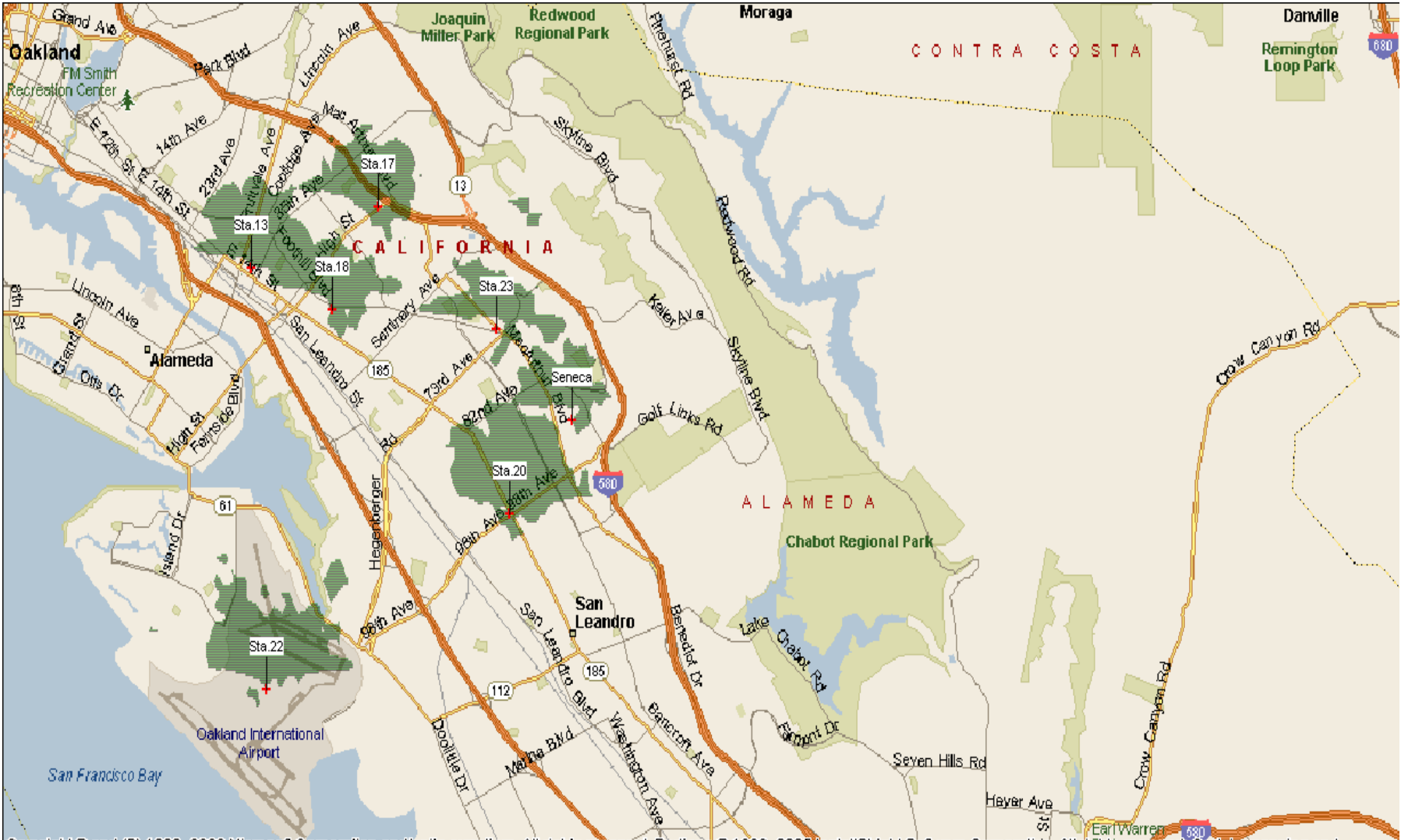
# DIT - 2.4 GHz



# APL - 2.4 GHz

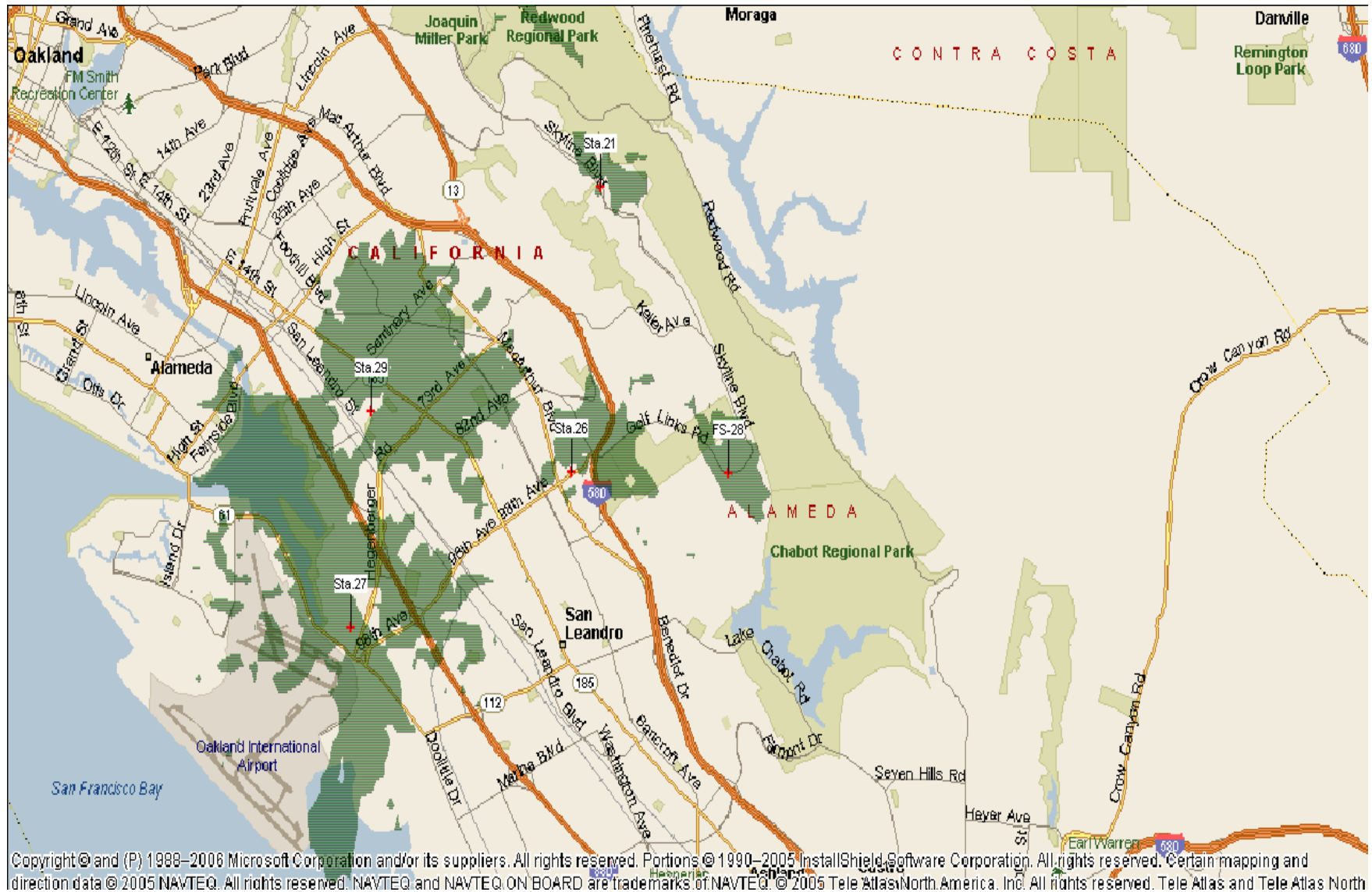


# Seneca - 2.4 GHz



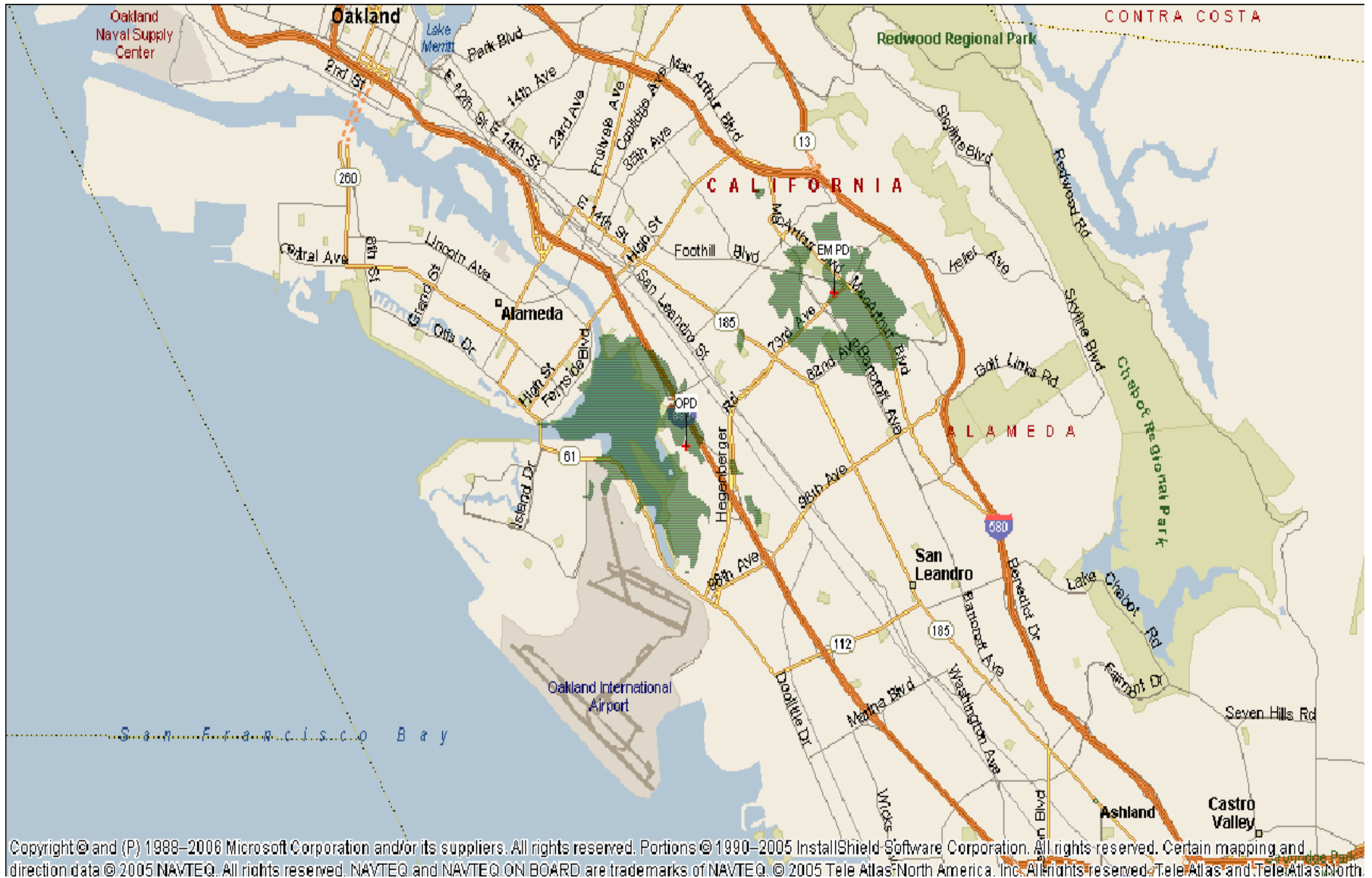
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# FS 28 - 2.4 GHz





# OPD - 2.4 GHz



# Oakland Reference Architecture

Coverage Maps

700 MHz

# 700 MHz Assumptions

- Maps are for informational purposes only.
- Do not assume a particular system design, other than frequency band.
- Maps do not account for subscriber density or multi channel access points.
- Maps are based on Talk Back - Subscriber Unit to Base Station.
- All maps are based upon a reliability of approximately 95% Area Reliability.

## Map Legend – 700 MHz



Mobile Device to Base Station = -95 dBm

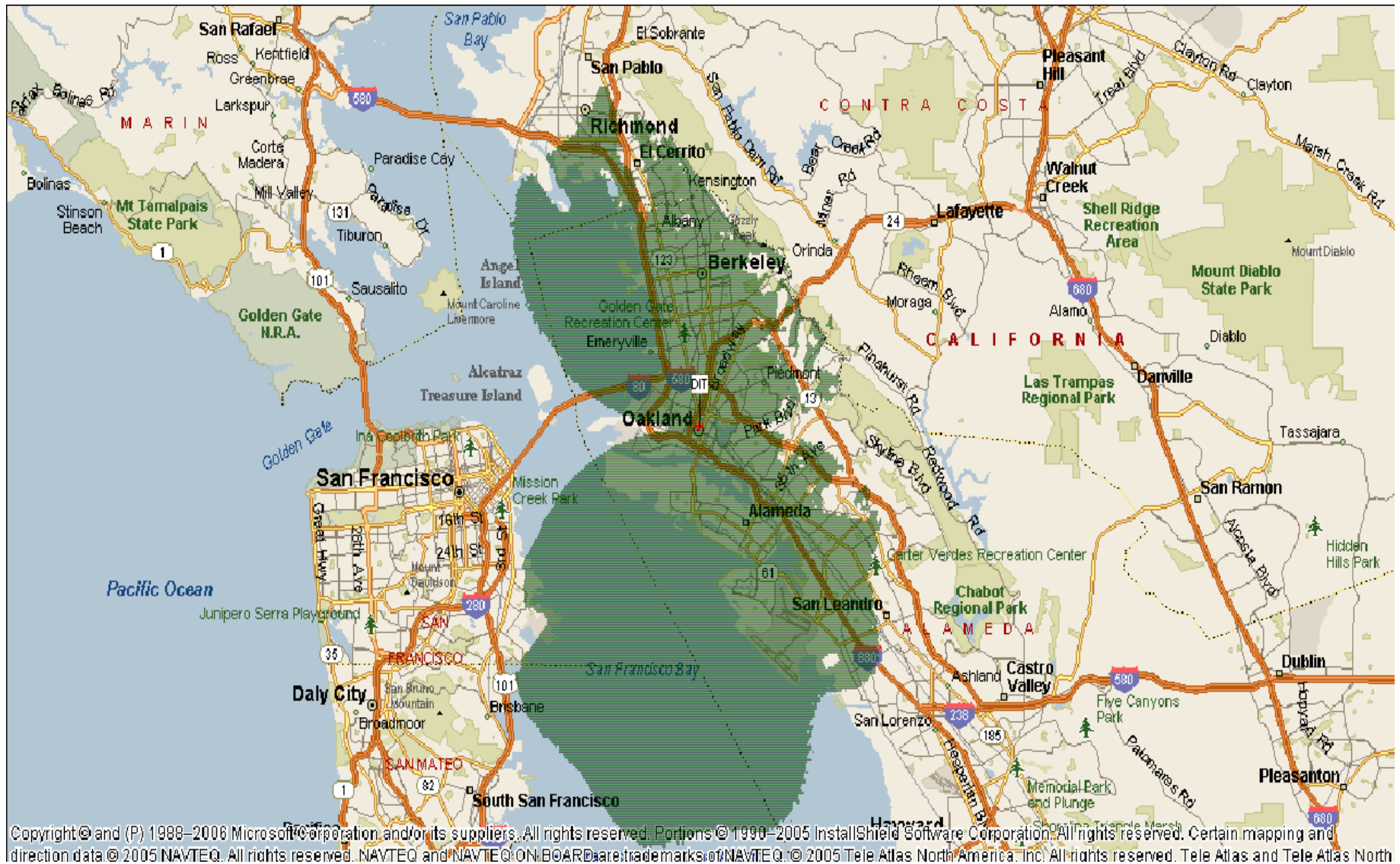
# Composite - 700 MHz



# Gwinnett - 700 MHz



# DIT - 700 MHz



# APL - 700 MHz





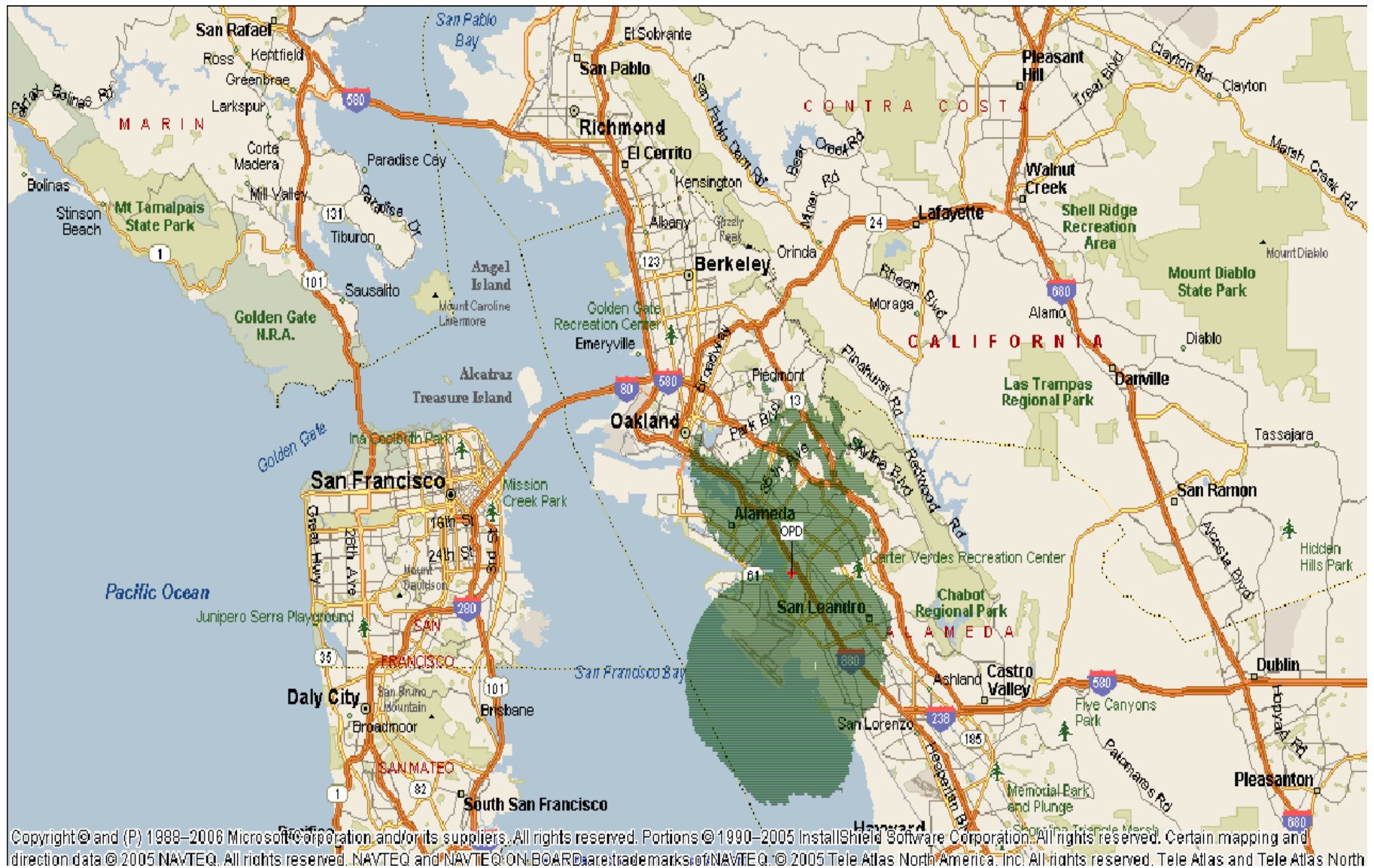
# Seneca - 700 MHz



# FS 28 - 700 MHz



# OPD - 700 MHz



## 10. Appendix C: Spreadsheets

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>Business Model Summary</b>												
<b>Operating Results</b>												
<b>Funding Source</b>												
Backbone Segment (15 Mbps Base)	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728
Public Safety Fixed/Nomadic Segment	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200
<b>Total</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>	<b>\$722,928</b>
<b>Operating Expense</b>												
Backbone Segment (15 Mbps Base)	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145
Backbone Segment (100 Mbps Increment)	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175
Public Safety Fixed/Nomadic Segment	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065
<b>Total</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>	<b>\$292,385</b>
<b>Operating Surplus/(Deficit)</b>												
Backbone Segment (15 Mbps Base)	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583
Backbone Segment (100 Mbps Increment)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)	(\$29,175)
Public Safety Fixed/Nomadic Segment	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135
<b>Total</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>	<b>\$430,543</b>
<b>Capital Expense</b>												
Backbone Segment (15 Mbps Base)	\$1,198,697	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Backbone Segment (100 Mbps Increment)	\$482,998	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Public Safety Fixed/Nomadic Segment	\$1,693,428	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Total</b>	<b>\$3,375,122</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Cash Flow Analysis</b>												
<b>Cumulative</b>												
Backbone Segment (15 Mbps Base)	(\$1,168,113)	(\$1,137,530)	(\$1,106,947)	(\$1,076,364)	(\$1,045,781)	(\$1,015,197)	(\$984,614)	(\$954,031)	(\$923,448)	(\$892,865)	(\$739,949)	(\$587,033)
Backbone Segment (100 Mbps Increment)	(\$481,590)	(\$480,182)	(\$478,774)	(\$477,366)	(\$475,958)	(\$474,551)	(\$473,143)	(\$471,735)	(\$470,327)	(\$468,919)	(\$461,880)	(\$454,841)
Public Safety Fixed/Nomadic Segment	(\$1,264,293)	(\$835,159)	(\$406,024)	\$23,111	\$452,245	\$881,380	\$1,310,515	\$1,739,650	\$2,168,784	\$2,597,919	\$4,743,592	\$6,889,266
<b>Total</b>	<b>(\$2,913,996)</b>	<b>(\$2,452,871)</b>	<b>(\$1,991,745)</b>	<b>(\$1,530,619)</b>	<b>(\$1,069,494)</b>	<b>(\$608,368)</b>	<b>(\$147,242)</b>	<b>\$313,884</b>	<b>\$775,009</b>	<b>\$1,236,135</b>	<b>\$3,541,764</b>	<b>\$5,847,392</b>
Net Present Value	(\$2,775,235)	(\$5,000,061)	(\$6,720,605)	(\$7,979,849)	(\$8,817,825)	(\$9,271,799)	(\$9,376,441)	(\$9,163,992)	(\$8,664,414)	(\$7,905,535)	(\$1,062,547)	\$9,100,705

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>Capital Equipment Replacement</b>												
<b>Accumulated Equipment</b>												
Backbone Segment (15 Mbps Base)	\$557,274	\$557,274	\$557,274	\$557,274	\$557,274	\$557,274	\$557,274	\$557,274	\$557,274	\$557,274	\$557,274	\$557,274
Backbone Segment (100 Mbps Increment)	\$310,778	\$310,778	\$310,778	\$310,778	\$310,778	\$310,778	\$310,778	\$310,778	\$310,778	\$310,778	\$310,778	\$310,778
Public Safety Fixed/Nomadic Segment	\$797,280	\$797,280	\$797,280	\$797,280	\$797,280	\$797,280	\$797,280	\$797,280	\$797,280	\$797,280	\$797,280	\$797,280
<b>Total</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>	<b>\$1,665,332</b>
Accumulated replacement needs	\$166,533	\$333,066	\$499,600	\$666,133	\$832,666	\$999,199	\$1,165,732	\$1,332,266	\$1,498,799	\$1,665,332	\$2,497,998	\$3,330,664
Net Present Value	(\$2,775,235)	(\$5,000,061)	(\$6,720,605)	(\$7,979,849)	(\$8,817,825)	(\$9,271,799)	(\$9,376,441)	(\$9,163,992)	(\$8,664,414)	(\$7,905,535)	(\$1,062,547)	\$9,100,705
Nominal surplus/(deficit)	(\$2,941,768)	(\$5,333,127)	(\$7,220,205)	(\$8,645,982)	(\$9,650,491)	(\$10,270,998)	(\$10,542,174)	(\$10,496,258)	(\$10,163,213)	(\$9,570,867)	(\$3,560,545)	\$5,770,041

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>Cash Flow Analysis Detail</b>												
<b>Backbone Segment (15 Mbps Base)</b>												
Funding Source	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728
Operating Expense	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145	\$85,145
Operating Surplus/(Deficit)	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583
Capital Expense	\$1,198,697	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	(\$1,168,113)	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583
Cumulative Cash Flow	(\$1,168,113)	(\$1,137,530)	(\$1,106,947)	(\$1,076,364)	(\$1,045,781)	(\$1,015,197)	(\$984,614)	(\$954,031)	(\$923,448)	(\$892,865)	(\$739,949)	(\$587,033)
Net Present Value	(\$1,112,489)	(\$1,084,749)	(\$1,058,330)	(\$1,033,169)	(\$1,009,207)	(\$986,385)	(\$964,650)	(\$943,950)	(\$924,236)	(\$905,461)	(\$824,173)	(\$760,482)
<b>Backbone Segment (100 Mbps Increment)</b>												
Base Surplus/(Deficit)	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583	\$30,583
Operating Expense	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175	\$29,175
Operating Surplus/(Deficit)	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408
Capital Expense	\$482,998	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	(\$481,590)	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408	\$1,408
Cumulative Cash Flow	(\$481,590)	(\$480,182)	(\$478,774)	(\$477,366)	(\$475,958)	(\$474,551)	(\$473,143)	(\$471,735)	(\$470,327)	(\$468,919)	(\$461,880)	(\$454,841)
Net Present Value	(\$458,657)	(\$457,380)	(\$456,164)	(\$455,006)	(\$453,902)	(\$452,852)	(\$451,851)	(\$450,898)	(\$449,991)	(\$449,127)	(\$445,385)	(\$442,453)
<b>Public Safety Fixed/Nomadic Segment</b>												
Funding Source	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200
Operating Expense	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065	\$178,065
Operating Surplus/(Deficit)	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135
Capital Expense	\$1,693,428	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	(\$1,264,293)	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135	\$429,135
Cumulative Cash Flow	(\$1,264,293)	(\$835,159)	(\$406,024)	\$23,111	\$452,245	\$881,380	\$1,310,515	\$1,739,650	\$2,168,784	\$2,597,919	\$4,743,592	\$6,889,266
Net Present Value	(\$1,204,089)	(\$814,851)	(\$444,148)	(\$91,098)	\$245,140	\$565,367	\$870,345	\$1,160,800	\$1,437,424	\$1,700,876	\$2,841,483	\$3,735,178

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>Operating Results Detail</b>												
<b>Backbone Segment (15 Mbps Base)</b>												
<b>Funding Source</b>												
Commercial carrier cost offsets	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728	\$115,728
<b>Total</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>	<b>\$115,728</b>
<b>Operating Expense</b>												
Equipment maintenance	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385
Site support & power	\$3,680	\$3,680	\$3,680	\$3,680	\$3,680	\$3,680	\$3,680	\$3,680	\$3,680	\$3,680	\$3,680	\$3,680
NOC operations	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385	\$11,385
IT support services	\$3,795	\$3,795	\$3,795	\$3,795	\$3,795	\$3,795	\$3,795	\$3,795	\$3,795	\$3,795	\$3,795	\$3,795
Engineering support	\$1,518	\$1,518	\$1,518	\$1,518	\$1,518	\$1,518	\$1,518	\$1,518	\$1,518	\$1,518	\$1,518	\$1,518
Legal & regulatory	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759
General & administrative	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759	\$759
Equipment replacement	\$47,264	\$47,264	\$47,264	\$47,264	\$47,264	\$47,264	\$47,264	\$47,264	\$47,264	\$47,264	\$47,264	\$47,264
Software upgrades & licensing	\$4,600	\$4,600	\$4,600	\$4,600	\$4,600	\$4,600	\$4,600	\$4,600	\$4,600	\$4,600	\$4,600	\$4,600
<b>Total</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>	<b>\$85,145</b>
<b>Operating Surplus/(Deficit)</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>	<b>\$30,583</b>
<b>Backbone Segment (100 Mbps Increment)</b>												
<b>Operating Expense</b>												
Equipment maintenance	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863
Site support & power	\$575	\$575	\$575	\$575	\$575	\$575	\$575	\$575	\$575	\$575	\$575	\$575
NOC operations	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863	\$863
IT support services	\$288	\$288	\$288	\$288	\$288	\$288	\$288	\$288	\$288	\$288	\$288	\$288
Engineering support	\$115	\$115	\$115	\$115	\$115	\$115	\$115	\$115	\$115	\$115	\$115	\$115
Legal & regulatory	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58
General & administrative	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58	\$58
Equipment replacement	\$26,358	\$26,358	\$26,358	\$26,358	\$26,358	\$26,358	\$26,358	\$26,358	\$26,358	\$26,358	\$26,358	\$26,358
Software upgrades & licensing	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Total</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>	<b>\$29,175</b>
<b>Operating Surplus/(Deficit)</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>	<b>\$1,408</b>



Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>Public Safety Fixed/Nomadic Segment</b>												
<b>Funding Source</b>												
Commercial carrier cost offsets	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200	\$607,200
<b>Total</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>	<b>\$607,200</b>
<b>Operating Expense</b>												
Equipment maintenance	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810
Site support & power	\$22,540	\$22,540	\$22,540	\$22,540	\$22,540	\$22,540	\$22,540	\$22,540	\$22,540	\$22,540	\$22,540	\$22,540
NOC operations	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810	\$33,810
IT support services	\$11,270	\$11,270	\$11,270	\$11,270	\$11,270	\$11,270	\$11,270	\$11,270	\$11,270	\$11,270	\$11,270	\$11,270
Engineering support	\$4,508	\$4,508	\$4,508	\$4,508	\$4,508	\$4,508	\$4,508	\$4,508	\$4,508	\$4,508	\$4,508	\$4,508
Legal & regulatory	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254
General & administrative	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254	\$2,254
Equipment replacement	\$67,619	\$67,619	\$67,619	\$67,619	\$67,619	\$67,619	\$67,619	\$67,619	\$67,619	\$67,619	\$67,619	\$67,619
<b>Total</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>	<b>\$178,065</b>
<b>Operating Surplus/(Deficit)</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>	<b>\$429,135</b>

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>General Government Alternatives</b>												
<b>Funding Source</b>												
General Government Fixed Segment	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019
General Government Nomadic Segment	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866
<b>Total</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>	<b>\$5,370,885</b>
<b>Operating Expense</b>												
General Government Fixed Segment	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967
General Government Nomadic Segment	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529
<b>Total</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>	<b>\$307,496</b>
<b>Operating Surplus/(Deficit)</b>												
General Government Fixed Segment	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052
General Government Nomadic Segment	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337
<b>Total</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>	<b>\$5,063,389</b>
<b>Capital Expense</b>												
General Government Fixed Segment	\$1,966,369	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
General Government Nomadic Segment	\$751,113	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Total</b>	<b>\$2,717,482</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Cash Flow Analysis</b>												
General Government Fixed Segment	(\$1,565,316)	(\$1,164,264)	(\$763,212)	(\$362,160)	\$38,893	\$439,945	\$840,997	\$1,242,050	\$1,643,102	\$2,044,154	\$4,049,416	\$6,054,677
General Government Nomadic Segment	\$3,911,223	\$8,573,560	\$13,235,897	\$17,898,234	\$22,560,570	\$27,222,907	\$31,885,244	\$36,547,581	\$41,209,917	\$45,872,254	\$69,183,938	\$92,495,621
<b>Total</b>	<b>\$2,345,907</b>	<b>\$7,409,296</b>	<b>\$12,472,685</b>	<b>\$17,536,074</b>	<b>\$22,599,463</b>	<b>\$27,662,852</b>	<b>\$32,726,241</b>	<b>\$37,789,630</b>	<b>\$42,853,019</b>	<b>\$47,916,408</b>	<b>\$73,233,353</b>	<b>\$98,550,298</b>
Net present value	\$2,234,197	\$8,954,647	\$19,729,022	\$34,155,993	\$51,863,264	\$72,505,710	\$95,763,639	\$121,341,148	\$148,964,586	\$178,381,104	\$344,801,636	\$527,920,340
<b>Cash Flow Analysis Detail</b>												
<b>General Government Fixed Segment</b>												
Funding Source	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019
Operating Expense	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967
Operating Surplus/(Deficit)	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052
Capital Expense	\$1,966,369	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Total</b>	<b>(\$1,565,316)</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>	<b>\$401,052</b>
Cumulative Cash Flow	(\$1,565,316)	(\$1,164,264)	(\$763,212)	(\$362,160)	\$38,893	\$439,945	\$840,997	\$1,242,050	\$1,643,102	\$2,044,154	\$4,049,416	\$6,054,677
Net Present Value	(\$1,490,778)	(\$1,127,011)	(\$780,567)	(\$450,621)	(\$136,386)	\$162,886	\$447,906	\$719,354	\$977,876	\$1,224,087	\$2,290,054	\$3,125,266

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>General Government Nomadic Segment</b>												
Funding Source	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866	\$4,746,866
Operating Expense	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529	\$84,529
Operating Surplus/(Deficit)	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337
Capital Expense	\$751,113	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$3,911,223	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337	\$4,662,337
Cumulative Cash Flow	\$3,911,223	\$8,573,560	\$13,235,897	\$17,898,234	\$22,560,570	\$27,222,907	\$31,885,244	\$36,547,581	\$41,209,917	\$45,872,254	\$69,183,938	\$92,495,621
Net Present Value	\$3,724,975	\$7,953,852	\$11,981,353	\$15,817,069	\$19,470,132	\$22,949,240	\$26,262,675	\$29,418,328	\$32,423,712	\$35,285,982	\$47,678,115	\$57,387,675
<b>Operating Results Detail</b>												
<b>General Government Fixed Segment</b>												
<b>Funding Source</b>												
Commercial carrier cost offsets	\$88,981	\$88,981	\$88,981	\$88,981	\$88,981	\$88,981	\$88,981	\$88,981	\$88,981	\$88,981	\$88,981	\$88,981
Market value of new facilities	\$230,124	\$230,124	\$230,124	\$230,124	\$230,124	\$230,124	\$230,124	\$230,124	\$230,124	\$230,124	\$230,124	\$230,124
Performance measure & efficiency gains	\$304,914	\$304,914	\$304,914	\$304,914	\$304,914	\$304,914	\$304,914	\$304,914	\$304,914	\$304,914	\$304,914	\$304,914
<b>Total</b>	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019	\$624,019
<b>Operating Expense</b>												
Equipment maintenance	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923
Site support & power	\$34,615	\$34,615	\$34,615	\$34,615	\$34,615	\$34,615	\$34,615	\$34,615	\$34,615	\$34,615	\$34,615	\$34,615
NOC operations	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923	\$51,923
IT support services	\$17,308	\$17,308	\$17,308	\$17,308	\$17,308	\$17,308	\$17,308	\$17,308	\$17,308	\$17,308	\$17,308	\$17,308
Engineering support	\$6,923	\$6,923	\$6,923	\$6,923	\$6,923	\$6,923	\$6,923	\$6,923	\$6,923	\$6,923	\$6,923	\$6,923
Legal & regulatory	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462
General & administrative	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462	\$3,462
Equipment replacement	\$53,353	\$53,353	\$53,353	\$53,353	\$53,353	\$53,353	\$53,353	\$53,353	\$53,353	\$53,353	\$53,353	\$53,353
<b>Total</b>	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967	\$222,967
<b>Operating Surplus/(Deficit)</b>	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052	\$401,052

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>General Government Nomadic Segment</b>												
<b>Funding Source</b>												
Market value of new facilities	\$53,400	\$53,400	\$53,400	\$53,400	\$53,400	\$53,400	\$53,400	\$53,400	\$53,400	\$53,400	\$53,400	\$53,400
Tax revenue enhancement	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252	\$2,504,252
Performance measure & efficiency gains	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214	\$2,189,214
<b>Total</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>	<b>\$4,746,866</b>
<b>Operating Expense</b>												
Equipment maintenance	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835
Site support & power	\$9,890	\$9,890	\$9,890	\$9,890	\$9,890	\$9,890	\$9,890	\$9,890	\$9,890	\$9,890	\$9,890	\$9,890
NOC operations	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835	\$14,835
IT support services	\$4,945	\$4,945	\$4,945	\$4,945	\$4,945	\$4,945	\$4,945	\$4,945	\$4,945	\$4,945	\$4,945	\$4,945
Engineering support	\$1,978	\$1,978	\$1,978	\$1,978	\$1,978	\$1,978	\$1,978	\$1,978	\$1,978	\$1,978	\$1,978	\$1,978
Legal & regulatory	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989
General & administrative	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989	\$989
Equipment replacement	\$36,068	\$36,068	\$36,068	\$36,068	\$36,068	\$36,068	\$36,068	\$36,068	\$36,068	\$36,068	\$36,068	\$36,068
	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>	<b>\$84,529</b>
<b>Operating Surplus/(Deficit)</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>	<b>\$4,662,337</b>

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>BayRICS 700 MHz Scenarios</b>												
Total network operating surplus/deficit	\$430,543	\$430,543	\$430,543	\$430,543	\$430,543	\$430,543	\$430,543	\$430,543	\$430,543	\$430,543	\$430,543	\$430,543
Operating Expense	\$55,032	\$55,032	\$55,032	\$55,032	\$55,032	\$55,032	\$55,032	\$55,032	\$55,032	\$55,032	\$55,032	\$55,032
Operating Surplus/(Deficit)	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511
Total network capex	\$3,375,122	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
BayRICS 700 MHz scenario capex	\$934,275	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total capex	\$4,309,397	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	(\$3,933,886)	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511	\$375,511
Cumulative Cash Flow	(\$3,933,886)	(\$3,558,376)	(\$3,182,865)	(\$2,807,354)	(\$2,431,844)	(\$2,056,333)	(\$1,680,822)	(\$1,305,311)	(\$929,801)	(\$554,290)	\$1,323,264	\$3,200,817
Net Present Value	(\$3,746,559)	(\$3,405,959)	(\$3,081,579)	(\$2,772,645)	(\$2,478,423)	(\$2,198,211)	(\$1,931,343)	(\$1,677,182)	(\$1,435,125)	(\$1,204,594)	(\$206,515)	\$575,506
<b>Business &amp; Entrepreneurship Scenario</b>												
<b>Business and Entrepreneurship Opportunities</b>												
Wholesale service income	\$108,000	\$108,000	\$108,000	\$108,000	\$108,000	\$108,000	\$108,000	\$108,000	\$108,000	\$108,000	\$108,000	\$108,000
Operating Expense	\$94,209	\$94,209	\$94,209	\$94,209	\$94,209	\$94,209	\$94,209	\$94,209	\$94,209	\$94,209	\$94,209	\$94,209
Operating Surplus/(Deficit)	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791
BEO capex	\$129,164	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	(\$115,373)	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791	\$13,791
Cumulative Cash Flow	(\$115,373)	(\$101,582)	(\$87,792)	(\$74,001)	(\$60,210)	(\$46,420)	(\$32,629)	(\$18,838)	(\$5,048)	\$8,743	\$77,696	\$146,650
Net Present Value	(\$109,879)	(\$97,371)	(\$85,458)	(\$74,112)	(\$63,307)	(\$53,016)	(\$43,215)	(\$33,881)	(\$24,991)	(\$16,525)	\$20,129	\$48,849

Oakland Business Model Summary

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20
<b>Public Access Scenarios</b>												
<b>Drinking Fountain Model 1</b>												
Discounted Market Value of New Facilities E	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400
Operating Expense	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059
Operating Surplus/(Deficit)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)
DFM capex	\$593,193	\$790,924	\$593,193	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	(\$628,852)	(\$826,583)	(\$628,852)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)
Cumulative Cash Flow	(\$628,852)	(\$1,455,435)	(\$2,084,287)	(\$2,119,946)	(\$2,155,605)	(\$2,191,264)	(\$2,226,923)	(\$2,262,581)	(\$2,298,240)	(\$2,333,899)	(\$2,512,194)	(\$2,690,488)
Net Present Value	(\$598,907)	(\$1,348,642)	(\$1,891,868)	(\$1,921,205)	(\$1,949,144)	(\$1,975,753)	(\$2,001,095)	(\$2,025,231)	(\$2,048,217)	(\$2,070,108)	(\$2,164,887)	(\$2,239,148)
<b>Drinking Fountain Model 2</b>												
Discounted Market Value of New Facilities E	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400	\$752,400
Operating Expense	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059	\$788,059
Operating Surplus/(Deficit)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)
DFM capex	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)	(\$35,659)
Cumulative Cash Flow	(\$35,659)	(\$71,318)	(\$106,977)	(\$142,635)	(\$178,294)	(\$213,953)	(\$249,612)	(\$285,271)	(\$320,930)	(\$356,589)	(\$534,883)	(\$713,177)
Net Present Value	(\$33,961)	(\$66,304)	(\$97,108)	(\$126,445)	(\$154,384)	(\$180,993)	(\$206,336)	(\$230,471)	(\$253,457)	(\$275,348)	(\$370,127)	(\$444,388)

Oakland Business Model Expense Worksheet

**Expense Summary**

**Capital Expense**

**Core Segments**

	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
Backbone Segment (15 Mbps Base)	66	\$613,267	\$157,680	\$74,400	35	\$77,438	\$31,500	\$208,713	\$35,700	\$1,198,697
Backbone Segment (100 Mbps Increment)	41	\$367,685	\$0	\$0	0	\$0	\$0	\$90,713	\$24,600	\$482,998
4.9 GHz Public Safety Fixed/Nomadic Segment	196	\$1,175,988	\$282,240	\$235,200	0	\$0	\$0	\$0	\$0	\$1,693,428

**Scenarios & alternatives**

General Government Fixed Segment	301	\$682,294	\$435,600	\$190,800	111	\$245,588	\$99,900	\$245,588	\$66,600	\$1,966,369
General Government Nomadic Segment	86	\$627,273	\$123,840	\$0	0	\$0	\$0	\$0	\$0	\$751,113
BayRICS 700 MHz Scenario	6	\$885,000	\$18,000	\$14,400	0	\$0	\$0	\$13,275	\$3,600	\$934,275
Business and Entrepreneurship Opportunities	32	\$83,084	\$46,080	\$0	0	\$0	\$0	\$0	\$0	\$129,164
Drinking Fountain Model Public Access	647	\$927,130	\$931,680	\$0	20	\$44,250	\$18,000	\$44,250	\$12,000	\$1,977,310
<b>Total</b>	<b>1,375</b>	<b>\$5,361,721</b>	<b>\$1,995,120</b>	<b>\$514,800</b>	<b>166</b>	<b>\$367,275</b>	<b>\$149,400</b>	<b>\$602,538</b>	<b>\$142,500</b>	<b>\$9,133,353</b>

**Operating Expense**

**Core Segments**

**Annual**

Backbone Segment (15 Mbps Base)	\$85,145
Backbone Segment (100 Mbps Increment)	\$29,175
4.9 GHz Public Safety Fixed/Nomadic Segment	\$178,065

**Scenarios & alternatives**

General Government Fixed Segment	\$222,967
General Government Nomadic Segment	\$84,529
BayRICS 700 MHz Scenario	\$55,032
Business and Entrepreneurship Opportunities	\$94,209
Drinking Fountain Model Public Access	\$788,059
<b>Total</b>	<b>\$1,537,181</b>

Oakland Business Model Expense Worksheet

**Backbone Segment (15 Mbps Base)**

Point 1	Point 2	Bandwidth	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
DIT	APL	108	1	\$14,642	\$3,000	\$2,000	2	\$3,000	\$1,500	\$1,500	\$500	\$26,142
DIT	Gwinett	108	1	\$14,642	\$3,000	\$2,000	2	\$3,000	\$1,500	\$1,500	\$500	\$26,142
DIT	Seneca	108	1	\$14,642	\$3,000	\$2,000	2	\$3,000	\$1,500	\$1,500	\$500	\$26,142
DIT	FS-28	108	1	\$14,642	\$3,000	\$2,000	2	\$3,000	\$1,500	\$1,500	\$500	\$26,142
DIT	Edgewater	108	1	\$14,642	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$23,892
DIT	Eastmont PD	108	1	\$14,642	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$23,892
DIT	FS-1/EOC	108	1	\$14,642	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$23,892
APL	Station 2	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
APL	Station 3	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
APL	Station 4	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
APL	Station 5	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
APL	Station 12	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
APL	Station 15	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
APL	Station 16	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Gwinett	Station 6	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Gwinett	Station 7	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Gwinett	Station 8	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Gwinett	Station 10	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Gwinett	Station 19	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Gwinett	Station 24	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Gwinett	Station 25	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Seneca	Station 13	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Seneca	Station 17	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Seneca	Station 18	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Seneca	Station 20	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Seneca	Station 22	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Seneca	Station 23	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
FS-28	Station 21	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
FS-28	Station 26	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
FS-28	Station 27	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
FS-28	Station 29	15	1	\$6,460	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$15,710
Backbone WiFi access	2.4 GHz - access point		32	\$158,240	\$38,400	\$0	0	\$0	\$0	\$0	\$0	\$196,640
NOC hardware	Terminals & networking		1							\$55,000	\$2,750	\$57,750
NOC software	OSS		1							\$10,000	\$10,000	\$20,000
Test equipment	Test equipment		1							\$30,000	\$1,500	\$31,500
												\$0
<b>Sub-total</b>		1,116	66	\$415,774	\$131,400	\$62,000	35	\$52,500	\$26,250	\$141,500	\$29,750	\$859,174
Furnish				\$20,789				\$2,625		\$7,075		\$30,489
Engineering design				\$41,577				\$5,250		\$14,150		\$60,977
Project management				\$41,577	\$13,140	\$6,200		\$5,250	\$2,625	\$14,150	\$2,975	\$85,917
Acceptance & documentation				\$51,972				\$6,563		\$17,688		\$76,222
Security				\$41,577	\$13,140	\$6,200		\$5,250	\$2,625	\$14,150	\$2,975	\$85,917
<b>Total</b>		1,116	66	\$613,267	\$157,680	\$74,400	35	\$77,438	\$31,500	\$208,713	\$35,700	\$1,198,697



Oakland Business Model Expense Worksheet

**Backbone Segment (100 Mbps Increment)**

	Bandwidth	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
Option key upgrade (existing)	311	7	\$7,000	\$0	\$0	0	\$0	\$0	\$10,500	\$3,500	\$21,000
Hardware upgrade (to 108)	108	24	\$196,368	\$0	\$0	0	\$0	\$0	\$36,000	\$12,000	\$244,368
New radios (108)	108	5	\$40,910	\$0	\$0	0	\$0	\$0	\$7,500	\$2,500	\$50,910
Option key upgrade (new)	311	5	\$5,000	\$0	\$0	0	\$0	\$0	\$7,500	\$2,500	\$15,000
Other	0	0	\$0	\$0	\$0	0	\$0	\$0	\$0	\$0	\$0
Other	0	0	\$0	\$0	\$0	0	\$0	\$0	\$0	\$0	\$0
<b>Sub-total</b>		41	\$249,278	\$0	\$0	0	\$0	\$0	\$61,500	\$20,500	\$331,278
Furnish			\$12,464				\$0		\$3,075		\$15,539
Engineering design			\$24,928				\$0		\$6,150		\$31,078
Project management			\$24,928	\$0	\$0		\$0	\$0	\$6,150	\$2,050	\$33,128
Acceptance & documentation			\$31,160				\$0		\$7,688		\$38,847
Security			\$24,928	\$0	\$0		\$0	\$0	\$6,150	\$2,050	\$33,128
<b>Total</b>		41	\$367,685	\$0	\$0	0	\$0	\$0	\$90,713	\$24,600	\$482,998

Oakland Business Model Expense Worksheet

**4.9 GHz Public Safety Fixed/Nomadic Segment**

Location	Type	Bandwidth	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
DIT	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
APL	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Gwinett	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Seneca	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
FS-28	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Edgewater	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Eastmont PD	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
FS-1/EOC	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 2	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 3	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 4	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 5	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 6	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 7	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 8	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 10	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 12	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 13	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 15	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 16	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 17	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 18	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 19	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 20	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 21	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 22	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 23	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 24	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 25	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 26	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 27	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Station 29	4.9 GHz - Base station		3	\$17,790	\$3,600	\$3,000	0	\$0	\$0	\$0	\$0	\$24,390
Vehicle-mounted units	4.9 GHz - Nomadic Sub Units		100	\$228,000	\$120,000	\$100,000	0	\$0	\$0	\$0	\$0	\$448,000
Security monitoring sites	4.9 GHz - Outdoor CPE		0	\$0	\$0	\$0	0	\$0	\$0	\$0	\$0	\$0
<b>Sub-total</b>			196	\$797,280	\$235,200	\$196,000	0	\$0	\$0	\$0	\$0	\$1,228,480
Furnish				\$39,864				\$0		\$0		\$39,864
Engineering design				\$79,728				\$0		\$0		\$79,728
Project management				\$79,728	\$23,520	\$19,600		\$0	\$0	\$0	\$0	\$122,848
Acceptance & documentation				\$99,660				\$0		\$0		\$99,660
Security				\$79,728	\$23,520	\$19,600		\$0	\$0	\$0	\$0	\$122,848
<b>Total</b>			196	\$1,175,988	\$282,240	\$235,200	0	\$0	\$0	\$0	\$0	\$1,693,428

Oakland Business Model Expense Worksheet

**General Government Fixed Segment**

Location(s)	Type	Bandwidth	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
DIT-Main Library DS-3	18 GHz - 108 Mbps	108	1	\$14,642	\$3,000	\$2,000	1	\$1,500	\$750	\$1,500	\$500	\$23,892
Security monitoring sites	4.9 GHz - Outdoor CPE		157	\$177,253	\$188,400	\$157,000	0	\$0	\$0	\$0	\$0	\$522,653
Base stations	3.65 GHz - Access point		33	\$179,487	\$39,600	\$0	0	\$0	\$0	\$0	\$0	\$219,087
Library - T1 replacement	3.65 GHz - Outdoor CPE		16	\$13,264	\$19,200	\$0	16	\$24,000	\$12,000	\$24,000	\$8,000	\$100,464
Other - T1 replacement	3.65 GHz - Outdoor CPE		25	\$20,725	\$30,000	\$0	25	\$37,500	\$18,750	\$37,500	\$12,500	\$156,975
Parks & Rec - T1 replacement	3.65 GHz - Outdoor CPE		6	\$4,974	\$7,200	\$0	6	\$9,000	\$4,500	\$9,000	\$3,000	\$37,674
Parks & Rec unwired sites	3.65 GHz - Outdoor CPE		32	\$26,528	\$38,400	\$0	32	\$48,000	\$24,000	\$48,000	\$16,000	\$200,928
Human Services unwired sites	3.65 GHz - Outdoor CPE		31	\$25,699	\$37,200	\$0	31	\$46,500	\$23,250	\$46,500	\$15,500	\$194,649
<b>Sub-total</b>			301	\$462,572	\$363,000	\$159,000	111	\$166,500	\$83,250	\$166,500	\$55,500	\$1,456,322
Furnish				\$23,129				\$8,325		\$8,325		\$39,779
Engineering design				\$46,257				\$16,650		\$16,650		\$79,557
Project management				\$46,257	\$36,300	\$15,900		\$16,650	\$8,325	\$16,650	\$5,550	\$145,632
Acceptance & documentation				\$57,822				\$20,813		\$20,813		\$99,447
Security				\$46,257	\$36,300	\$15,900		\$16,650	\$8,325	\$16,650	\$5,550	\$145,632
<b>Total</b>			301	\$682,294	\$435,600	\$190,800	111	\$245,588	\$99,900	\$245,588	\$66,600	\$1,966,369

**General Government Nomadic Segment**

Location(s)	Type	Bandwidth	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
Library network sites	2.4 GHz - access point		17	\$84,065	\$20,400	\$0	0	\$0	\$0	\$0	\$0	\$104,465
Parks & Rec sites	2.4 GHz - access point		38	\$187,910	\$45,600	\$0	0	\$0	\$0	\$0	\$0	\$233,510
Human Services sites	2.4 GHz - access point		31	\$153,295	\$37,200	\$0	0	\$0	\$0	\$0	\$0	\$190,495
<b>Sub-total</b>			86	\$425,270	\$103,200	\$0	0	\$0	\$0	\$0	\$0	\$528,470
Furnish				\$21,264				\$0		\$0		\$21,264
Engineering design				\$42,527				\$0		\$0		\$42,527
Project management				\$42,527	\$10,320	\$0		\$0	\$0	\$0	\$0	\$52,847
Acceptance & documentation				\$53,159				\$0		\$0		\$53,159
Security				\$42,527	\$10,320	\$0		\$0	\$0	\$0	\$0	\$52,847
<b>Total</b>			86	\$627,273	\$123,840	\$0	0	\$0	\$0	\$0	\$0	\$751,113

**BayRICS 700 MHz Scenario**

Location(s)	Type	Bandwidth	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
Hub locations	700 MHz - base station		6	\$600,000	\$15,000	\$12,000	0	\$0	\$0	\$9,000	\$3,000	\$639,000
	700 MHz - base station		0	\$0	\$0	\$0	0	\$0	\$0	\$0	\$0	\$0
	700 MHz - base station		0	\$0	\$0	\$0	0	\$0	\$0	\$0	\$0	\$0
	700 MHz - base station		0	\$0	\$0	\$0	0	\$0	\$0	\$0	\$0	\$0
<b>Sub-total</b>			6	\$600,000	\$15,000	\$12,000	0	\$0	\$0	\$9,000	\$3,000	\$639,000
Furnish				\$30,000				\$0		\$450		\$30,450
Engineering design				\$60,000				\$0		\$900		\$60,900
Project management				\$60,000	\$1,500	\$1,200		\$0	\$0	\$900	\$300	\$63,900
Acceptance & documentation				\$75,000				\$0		\$1,125		\$76,125
Security				\$60,000	\$1,500	\$1,200		\$0	\$0	\$900	\$300	\$63,900
<b>Total</b>			6	\$885,000	\$18,000	\$14,400	0	\$0	\$0	\$13,275	\$3,600	\$934,275

Oakland Business Model Expense Worksheet

**Business and Entrepreneurship Opportunities**

Location(s)	Type	Bandwidth	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
Hub facility	3.65 GHz - Access point		2	\$10,878	\$2,400	\$0	0	\$0	\$0	\$0	\$0	\$13,278
T-1 equivalent business circuit	3.65 GHz - Outdoor CPE		5	\$20,725	\$30,000	\$0	0	\$0	\$0	\$0	\$0	\$50,725
Hotspot service	2.4 GHz - access point		5	\$24,725	\$6,000	\$0	0	\$0	\$0	\$0	\$0	\$30,725
<b>Sub-total</b>			32	\$56,328	\$38,400	\$0	0	\$0	\$0	\$0	\$0	\$94,728
Furnish				\$2,816				\$0		\$0		\$2,816
Engineering design				\$5,633				\$0		\$0		\$5,633
Project management				\$5,633	\$3,840	\$0		\$0	\$0	\$0	\$0	\$9,473
Internet bandwidth												\$0
Acceptance & documentation				\$7,041				\$0		\$0		\$7,041
Security				\$5,633	\$3,840	\$0		\$0	\$0	\$0	\$0	\$9,473
<b>Total</b>			32	\$83,084	\$46,080	\$0	0	\$0	\$0	\$0	\$0	\$129,164

**Drinking Fountain Model Public Access**

Location(s)	Type	Bandwidth	Units	Units Cost	Installation	Licensing	Towers	Tower Cost	installation	Network	Installation	Total
Additional base stations	3.65 GHz - Access point		20	\$108,780	\$24,000	\$0	20	\$30,000	\$15,000	\$30,000	\$10,000	\$217,780
Schools & educational facilities	3.65 GHz - Outdoor CPE		5	\$165,800	\$240,000	\$0	0	\$0	\$0	\$0	\$0	\$405,800
Community organizations	3.65 GHz - Outdoor CPE		5	\$66,320	\$96,000	\$0	0	\$0	\$0	\$0	\$0	\$162,320
Neighborhood partnerships	3.65 GHz - Outdoor CPE		5	\$66,320	\$96,000	\$0	0	\$0	\$0	\$0	\$0	\$162,320
Community housing	3.65 GHz - Outdoor CPE		5	\$221,343	\$320,400	\$0	0	\$0	\$0	\$0	\$0	\$541,743
<b>Sub-total</b>			647	\$628,563	\$776,400	\$0	20	\$30,000	\$15,000	\$30,000	\$10,000	\$1,489,963
Furnish				\$31,428				\$1,500		\$1,500		\$34,428
Engineering design				\$62,856				\$3,000		\$3,000		\$68,856
Project management				\$62,856	\$77,640	\$0		\$3,000	\$1,500	\$3,000	\$1,000	\$148,996
Internet bandwidth												\$0
Acceptance & documentation				\$78,570				\$3,750		\$3,750		\$86,070
Security				\$62,856	\$77,640	\$0		\$3,000	\$1,500	\$3,000	\$1,000	\$148,996
<b>Total</b>			647	\$927,130	\$931,680	\$0	20	\$44,250	\$18,000	\$44,250	\$12,000	\$1,977,310

Oakland Business Model Expense Worksheet

**Capex Data**

	Basic Unit	Antenna	Power Suppl Mount	Cable	Unit Total	Installation	License	
<b>Paired Links (2 points)</b>								
18 GHz - 15 Mbps	\$4,780	\$1,500	\$0	\$125	\$55	\$6,460	\$3,000	\$2,000
18 GHz - 108 Mbps	\$12,056	\$1,526	\$880	\$125	\$55	\$14,642	\$3,000	\$2,000
Option key (311 Mbps)	\$1,000	\$0	\$0	\$0	\$0	\$1,000	\$0	\$0
<b>Single Units (1 point)</b>								
4.9 GHz - Base station	\$5,190	\$560		\$125	\$55	\$5,930	\$1,200	\$1,000
4.9 GHz - Outdoor CPE	\$649	\$300		\$125	\$55	\$1,129	\$1,200	\$1,000
4.9 GHz - Indoor CPE	\$599	\$300		\$125	\$55	\$1,079	\$1,200	\$1,000
4.9 GHz - Nomadic Sub Units	\$1,610	\$490		\$125	\$55	\$2,280	\$1,200	\$1,000
3.65 GHz - Base station	\$5,190	\$560		\$125	\$55	\$5,930	\$1,200	\$0
3.65 GHz - Access point	\$4,699	\$560		\$125	\$55	\$5,439	\$1,200	\$0
3.65 GHz - Outdoor CPE	\$649	\$0		\$125	\$55	\$829	\$1,200	\$0
3.65 GHz - Indoor CPE	\$599	\$0		\$125	\$55	\$779	\$1,200	\$0
3.65 GHz - Nomadic CPE	\$1,610	\$490		\$125	\$55	\$2,280	\$1,200	\$0
3.65 GHz - USB unit	\$500	\$0				\$500	\$0	\$0
2.4 GHz - access point	\$4,595	\$0	\$0	\$250	\$100	\$4,945	\$1,200	\$0
2.4 GHz - mesh access point								
2.4/3.65 GHz - access point								
2.4/4.9 GHz - access point	\$5,595	\$0	\$0	\$250	\$100	\$5,945	\$1,200	\$0
700 MHz - base station	\$100,000	\$0	\$0	\$0	\$0	\$100,000	\$2,500	\$2,000
<b>Towers</b>								
50 foot Rohn 25 g	\$1,500					\$1,500	\$750	\$0
<b>Network</b>								
Cisco switch	\$1,500					\$1,500	\$500	\$0
Network total	\$1,500	\$0	\$0	\$0	\$0	\$1,500	\$500	\$0
<b>NOC &amp; Maintenance</b>								
Terminals & networking	\$50,000				\$5,000	\$55,000	\$2,750	\$0
OSS	\$10,000					\$10,000	\$10,000	\$0
Test equipment	\$30,000					\$30,000	\$1,500	\$0

Oakland Business Model Expense Worksheet

**Other Capex Data**

Furnish & commissioning	5%
Engineering design	10%
Project management	10%
Acceptance & documentation	12.5%
Security	10%

<b>Capital Expense Annual Rollout</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>	<b>Year 6</b>	<b>Year 7</b>	<b>Year 8</b>	<b>Year 9</b>	<b>Year 10</b>
<b>Core Segments</b>										
Backbone Segment (15 Mbps Base)	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Backbone Segment (100 Mbps Increment)	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4.9 GHz Public Safety Fixed/Nomadic Segment	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
General Government Fixed Segment	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
General Government Nomadic Segment	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
<b>Scenarios &amp; alternatives</b>										
BayRICS 700 MHz Scenario	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Business and Entrepreneurship Opportunities	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Drinking Fountain Model Public Access	30%	40%	30%	0%	0%	0%	0%	0%	0%	0%

<b>Capital Equipment Cost</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>	<b>Year 6</b>	<b>Year 7</b>	<b>Year 8</b>	<b>Year 9</b>	<b>Year 10</b>
<b>Core Segments</b>										
Backbone Segment (15 Mbps Base)	\$557,274	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Backbone Segment (100 Mbps Increment)	\$310,778	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
4.9 GHz Public Safety Fixed/Nomadic Segment	\$797,280	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
General Government Fixed Segment	\$629,072	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
General Government Nomadic Segment	\$425,270	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Scenarios &amp; alternatives</b>										
BayRICS 700 MHz Scenario	\$609,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Business and Entrepreneurship Opportunities	\$56,328	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Drinking Fountain Model Public Access	\$197,569	\$263,425	\$197,569	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Cost of Capital	5.0%
Anticipated equipment lifetime (years)	10

Oakland Business Model Expense Worksheet

**Operating Expense**

**Backbone Segment (15 Mbps Base)**

Item	Unit Type	Annual Rate	Units	Unit Cost	Overhead	Total	Annual +
Equipment maintenance	Maintenance per node		66	\$150	15%	\$11,385	0%
Site support & power	Site fee		32	\$100	15%	\$3,680	0%
NOC operations	Op support per node		66	\$150	15%	\$11,385	0%
IT support services	IT per node		66	\$50	15%	\$3,795	0%
Engineering support	Engineering per node		66	\$20	15%	\$1,518	0%
Legal & regulatory	Legal per node		66	\$10	15%	\$759	0%
General & administrative	G&A per node		66	\$10	15%	\$759	0%
Equipment replacement	Percent of hardware capex	5%		\$821,979	15%	\$47,264	0%
Software upgrades & licensing	Percent of software capex	20%		\$20,000	15%	\$4,600	0%
<b>Total</b>						<u>\$85,145</u>	

**Backbone Segment (100 Mbps Increment)**

Item	Unit Type	Annual Rate	Units	Unit Cost	Overhead	Total	Annual +
Equipment maintenance	Maintenance per node		5	\$150	15%	\$863	0%
Site support & power	Site fee		5	\$100	15%	\$575	0%
NOC operations	Op support per node		5	\$150	15%	\$863	0%
IT support services	IT per node		5	\$50	15%	\$288	0%
Engineering support	Engineering per node		5	\$20	15%	\$115	0%
Legal & regulatory	Legal per node		5	\$10	15%	\$58	0%
General & administrative	G&A per node		5	\$10	15%	\$58	0%
Equipment replacement	Percent of hardware capex	5%		\$458,398	15%	\$26,358	0%
Software upgrades & licensing	Percent of software capex	20%		\$0	15%	\$0	0%
<b>Total</b>						<u>\$29,175</u>	

**4.9 GHz Public Safety Fixed/Nomadic Segment**

Item	Unit Type	Annual Rate	Units	Unit Cost	Overhead	Total	Annual +
Equipment maintenance	Maintenance per node		196	\$150	15%	\$33,810	0%
Site support & power	Site fee		196	\$100	15%	\$22,540	0%
NOC operations	Op support per node		196	\$150	15%	\$33,810	0%
IT support services	IT per node		196	\$50	15%	\$11,270	0%
Engineering support	Engineering per node		196	\$20	15%	\$4,508	0%
Legal & regulatory	Legal per node		196	\$10	15%	\$2,254	0%
General & administrative	G&A per node		196	\$10	15%	\$2,254	0%
Equipment replacement	Percent of hardware capex	5%		\$1,175,988	15%	\$67,619	0%
<b>Total</b>						<u>\$178,065</u>	

Oakland Business Model Expense Worksheet

**General Government Fixed Segment**

Item	Unit Type	Annual Rate Units	Unit Cost	Overhead	Total	Annual +
Equipment maintenance	Maintenance per node	301	\$150	15%	\$51,923	0%
Site support & power	Site fee	301	\$100	15%	\$34,615	0%
NOC operations	Op support per node	301	\$150	15%	\$51,923	0%
IT support services	IT per node	301	\$50	15%	\$17,308	0%
Engineering support	Engineering per node	301	\$20	15%	\$6,923	0%
Legal & regulatory	Legal per node	301	\$10	15%	\$3,462	0%
General & administrative	G&A per node	301	\$10	15%	\$3,462	0%
Equipment replacement	Percent of hardware capex	5%	\$927,881	15%	\$53,353	0%
<b>Total</b>					<u>\$222,967</u>	

**General Government Nomadic Segment**

Item	Unit Type	Annual Rate Units	Unit Cost	Overhead	Total	Annual +
Equipment maintenance	Maintenance per node	86	\$150	15%	\$14,835	0%
Site support & power	Site fee	86	\$100	15%	\$9,890	0%
NOC operations	Op support per node	86	\$150	15%	\$14,835	0%
IT support services	IT per node	86	\$50	15%	\$4,945	0%
Engineering support	Engineering per node	86	\$20	15%	\$1,978	0%
Legal & regulatory	Legal per node	86	\$10	15%	\$989	0%
General & administrative	G&A per node	86	\$10	15%	\$989	0%
Equipment replacement	Percent of hardware capex	5%	\$627,273	15%	\$36,068	0%
<b>Total</b>					<u>\$84,529</u>	

**BayRICS 700 MHz Scenario**

Item	Unit Type	Annual Rate Units	Unit Cost	Overhead	Total	Annual +
Equipment maintenance	Maintenance per node	6	\$150	15%	\$1,035	0%
Site support & power	Site fee	6	\$100	15%	\$690	0%
NOC operations	Op support per node	6	\$150	15%	\$1,035	0%
IT support services	IT per node	6	\$50	15%	\$345	0%
Engineering support	Engineering per node	6	\$20	15%	\$138	0%
Legal & regulatory	Legal per node	6	\$10	15%	\$69	0%
General & administrative	G&A per node	6	\$10	15%	\$69	0%
Equipment replacement	Percent of hardware capex	5%	\$898,275	15%	\$51,651	0%
<b>Total</b>	Standard				<u>\$55,032</u>	



Oakland Business Model Expense Worksheet

**Business and Entrepreneurship Opportunities**

Item	Unit Type	Annual Rate	Units	Unit Cost	Overhead	Total	Annual +
Equipment maintenance	Maintenance per node		32	\$150	15%	\$5,520	0%
Site support & power	Site fee		32	\$100	15%	\$3,680	0%
NOC operations	Op support per node		32	\$150	15%	\$5,520	0%
IT support services	IT per node		32	\$50	15%	\$1,840	0%
Engineering support	Engineering per node		32	\$20	15%	\$736	0%
Legal & regulatory	Legal per node		32	\$10	15%	\$368	0%
General & administrative	G&A per node		32	\$10	15%	\$368	0%
Internet bandwidth	DS-3		1	\$60,000	10%	\$66,000	0%
Equipment replacement	Percent of hardware capex	5%		\$83,084	15%	\$4,777	0%
Franchise & facilities fee	Percent of revenue	5%		\$108,000	0%	\$5,400	0%
<b>Total</b>	Standard					<u>\$94,209</u>	0%

**Drinking Fountain Model Public Access**

Item	Unit Type	Annual Rate	Units	Unit Cost	Overhead	Total	Annual +
Equipment maintenance	Maintenance per node		647	\$150	15%	\$111,608	0%
Site support & power	Site fee		647	\$100	15%	\$74,405	0%
NOC operations	Op support per node		647	\$150	15%	\$111,608	0%
IT support services	IT per node		647	\$50	15%	\$37,203	0%
Engineering support	Engineering per node		647	\$20	15%	\$14,881	0%
Legal & regulatory	Legal per node		647	\$10	15%	\$7,441	0%
General & administrative	G&A per node		647	\$10	15%	\$7,441	0%
Internet bandwidth	DS-3		5	\$60,000	10%	\$330,000	0%
Equipment replacement	Percent of hardware capex	5%		\$971,380	15%	\$55,854	0%
Franchise & facilities fee	Percent of revenue	5%		\$752,400	0%	\$37,620	0%
<b>Total</b>	Standard					<u>\$788,059</u>	0%

Oakland Business Model Expense Worksheet

**Opex Data**

	<b>Unit Type</b>	<b>Unit Cost</b>	<b>Overhead</b>	<b>Annual +</b>
Equipment maintenance	Maintenance per node	\$150	15%	0%
Site support & power	Site fee	\$100	15%	0%
NOC operations	Op support per node	\$150	15%	0%
IT support services	IT per node	\$50	15%	0%
Engineering support	Engineering per node	\$20	15%	0%
Legal & regulatory	Legal per node	\$10	15%	0%
General & administrative	G&A per node	\$10	15%	0%
Internet bandwidth	DS-3	\$60,000	10%	0%

		<b>Annual Rate</b>	<b>Overhead</b>	<b>Annual +</b>
Equipment replacement	Percent of hardware capex	5%	15%	0%
Software upgrades & licensing	Percent of software capex	20%	15%	0%
Franchise & facilities fee	Percent of revenue	5%	0%	0%
Totals	Standard		15%	0%

Oakland Business Model Funding Worksheet

**Annual Funding Sources**

**Notes**

**Summary**

	<b>Annual +</b>	<b>Base Annual</b>
<b>Backbone Segment</b>		
Commercial carrier cost offsets	0%	<u>\$115,728</u>
Sub-total		\$115,728
<b>Public Safety Fixed/Nomadic Segment</b>		
Commercial carrier cost offsets	0%	<u>\$607,200</u>
Sub-total		\$607,200
<b>General Government Fixed Segment</b>		
Commercial carrier cost offsets	0%	\$88,981
Market value of new facilities	0%	\$230,124
Performance measure & efficiency gains	0%	<u>\$304,914</u>
Sub-total		\$624,019
<b>General Government Nomadic Segment</b>		
Market value of new facilities	0%	\$53,400
Tax revenue enhancement	0%	\$2,504,252
Performance measure & efficiency gains	0%	<u>\$2,189,214</u>
Sub-total		\$4,746,866
<b>Total Annual Funding</b>		<b>\$6,093,813</b>

**Commercial Carrier Cost Offsets**

**Backbone Segment**

	<b>Units</b>	<b>Monthly</b>	<b>Annual</b>	<b>Total</b>	
Fire Department - T1	26	\$115	\$1,380	\$35,880	DIT
EOC - DS3	1	\$1,424	\$17,088	\$17,088	DIT - EOC to Internet
Police Department - T1	2	\$115	\$1,380	\$2,760	DIT
Police Department - DS3	<u>2</u>	<u>\$2,500</u>	<u>\$30,000</u>	<u>\$60,000</u>	Eastmont & Edgewater to DIT
Total	31			\$115,728	Calc

**General Government Fixed Segment**

	<b>Units</b>	<b>Monthly</b>	<b>Annual</b>	<b>Total</b>	
Library - T1	16	\$115	\$1,380	\$22,080	DIT
Library - DS3	1	\$1,424	\$17,088	\$17,088	DIT - Main Library to Internet
Parks & Rec fixed lines	1	\$1,276	\$15,313	\$15,313	DIT

Oakland Business Model Funding Worksheet

Other - T1	25	\$115	\$1,380	\$34,500	DIT
Other - DS3	<u>0</u>	\$0	\$0	<u>\$0</u>	
Total	43			\$88,981	Calc

**Public Safety Nomadic**

	<b>Units</b>	<b>Monthly</b>	<b>Annual</b>	<b>Total</b>	
Police department - data cards	842	\$50	\$600	\$505,200	DIT
Fire department - data cards	50	\$50	\$600	\$30,000	DIT
Public works - data cards	120	\$50	\$600	<u>\$72,000</u>	DIT
Total				\$607,200	Calc

Oakland Business Model Funding Worksheet

**Market Value of New Facilities Enabled**

**General Government Fixed Segment**

Units	Monthly	Annual	Total		
Unwired Parks & Rec facilities	32	\$115	\$1,380	\$44,160	Reference
Unwired Human Services facilities	31	\$115	\$1,380	\$42,780	
Security monitoring	157	\$76	\$912	\$143,184	DIT data, FY07-09 Budget
			\$0	\$0	
<b>Total</b>				<u>\$230,124</u>	Calc

**General Government Nomadic**

Units	Monthly	Annual	Total		
FMA - parking enforcement	6	\$50	\$600	\$3,600	FY07-09 Budget
FMA - tax auditors & officers	20	\$50	\$600	\$12,000	FY07-09 Budget
Human Services - case workers	16	\$50	\$600	\$9,600	FY07-09 Budget
Human Services - outreach	2	\$50	\$600	\$1,200	FY07-09 Budget
CEDA - field inspectors	45	\$50	\$600	\$27,000	Reference
Other	0	\$50	\$600	\$0	
				<u>\$53,400</u>	

**Tax Revenue Enhancement**

**General Government Nomadic**

Field auditors	26				Calc
Per capita program cost	\$192,635				Reference
Efficiency gain	12.5%				Reference
Budgetary value of efficiency gain	\$626,063				Calc
City Auditor revenue/cost ratio	4				Calc
Tax revenue enhancement				\$2,504,252	Calc

**Performance Measure & Efficiency Gains**

General Government Fixed Sites	Hours/week	FTE	FTE Value		
Parks & Rec locations	32	64	1.6	\$140,451	Calc/reference
Human Services locations	31	62	1.6	\$80,694	Calc/reference
Security monitoring locations	157	39	1.0	\$83,768	Calc/reference
<b>Total</b>				<u>\$304,914</u>	

Oakland Business Model Funding Worksheet

**General Government Nomadic**

**CEDA**

Additional permit inspections	5,625		Calc
Additional code inspections	4,375		Calc
Permit inspector FTE gain	2.8		Calc
Code inspector FTE gain	2.7		Calc
Value of FTE gain		\$678,455	Calc

**Human Services**

Additional clients served	94		Calc
Case manager FTE gain	1.7		Calc
Value of FTE gain		\$87,853	Calc

**PWA**

Per capita personnel cost (overall)	\$94,860		Calc
Personnel with laptops	120		Reference
Value of efficiency gain		<u>\$1,422,906</u>	Calc

Total (general government nomadic)		\$2,189,214	Calc
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**Calculations & Data**

**Efficiency Gain Estimates**

Remote access - average daily ti	1		Estimate
Average work day (hours)	8		Estimate
Efficiency gain	12.5%		Calc

New fixed service - average weel	2		Estimate
Average work week (hours)	40		Estimate
Efficiency gain	5.0%		Calc

New security monitoring - averag	0.25		Estimate
Average work week (hours)	40		Estimate
Efficiency gain	0.6%		Calc

**CEDA - Development Permit & Code Enforcement Inspections**

Permit inspections performed	45,000		FY07-09 Budget
Code inspections performed	35,000		FY07-09 Budget

Inspections/permit inspector	2,000		FY07-09 Budget
Inspections/code inspector	1,600		FY07-09 Budget

Oakland Business Model Funding Worksheet

Permit inspectors	23	Calc
Code inspectors	<u>22</u>	Calc
Total	44	Calc
Total budgeted inspectors	45	FY07-09 Budget
Unfilled inspector positions	10	OSCS report
Personnel budget 08-09	\$9,968,512	FY07-09 Budget
FTE 08-09	81.5	FY07-09 Budget
Average per position	\$122,313	Calc

Oakland Business Model Funding Worksheet

**Human Services**

Case managers	10.5		FY07-09 Budget
Nurse case managers	3		FY07-09 Budget
Case management clients	750		FY07-09 Budget
Clients per case manager	56		Calc
Program personnel budget 08-09	\$5,802,710		FY07-09 Budget
FTE 08-09	111.5		FY07-09 Budget
Average per position	\$52,061		Calc

**Parks & Recreation - Central Administration**

Personnel budget 08-09	\$1,729,307
FTE 08-09	19.7
Average per position	\$87,782

**PWA - Overall**

Personnel budget 08-09	\$65,577,014		FY07-09 Budget
FTE 08-09	691.3		FY07-09 Budget
Field FTE 08-09	400		DIT
Average per position	\$94,860		Calc

**PWA - Facilities & Management**

Personnel budget 08-09	\$13,110,882		FY07-09 Budget
FTE 08-09	153.6		FY07-09 Budget
Average per position	\$85,368		Calc

**Finance & Management Agency - Financial Management Program**

Personnel budget 08-09	\$16,127,420		FY07-09 Budget
FTE 08-09	135.0		FY07-09 Budget
Average per position	\$119,462		Calc

O&M budget 08-09	\$9,878,270		FY07-09 Budget
Average per position	\$73,172		Calc

Total per capita program cost            \$192,635            Calc

Total revenue 08-09            \$512,413,998            FY07-09 Budget

	Rev source	% City rev	
Business license tax 08-09	\$49,139,920	4.6%	FY07-09 Budget
Transient occupancy tax 08-09	\$13,031,524	1.2%	FY07-09 Budget



Oakland Business Model Funding Worksheet

Parking tax 08-09	\$17,695,438	1.7%		FY07-09 Budget
Percent of parking tax from airport			50%	FY07-09 Budget
Non airport parking rev	\$8,847,719	0.8%		Calc
Field-auditable revenue	<u>\$71,019,163</u>	6.6%		Calc
FAR as percent of program	13.9%			Calc
Rev return/audit cost metric:				
FMA	1			FY07-09 Budget
City Auditor	4			FY07-09 Budget

Oakland Business Model Funding Worksheet

**PWA Personnel Summary**

Administration	\$3,698,847
Electrical	\$2,278,790
Environmental	\$706,116
Facilities	\$13,110,882
Fleet	\$6,378,003
Clean	\$10,769,990
Grounds	\$8,310,874
Recycling	\$1,326,975
Safety	\$319,082
Sewer	\$7,958,534
Streets	\$5,351,096
Transportation	\$2,202,446
Trees	\$3,165,379
	<u>\$65,577,014</u>

FY07-09 Budget  
 FY07-09 Budget  
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 FY07-09 Budget  
 FY07-09 Budget  
 FY07-09 Budget  
 FY07-09 Budget  
 Calc

**Business and Entrepreneurship Opportunities**

**Wholesale Services**

	<b>Units</b>	<b>Monthly</b>	<b>Annual</b>	<b>Total</b>
T-1 equivalent business circuit	25	\$300	\$3,600	\$90,000
New installation & maintenance	1	\$500	\$6,000	\$6,000
Hotspot service	5	\$200	\$2,400	\$12,000
<b>Total</b>				<u>\$108,000</u>

Annual + 0%

**Drinking Fountain Model Public Access**

**Discounted Market Value of New Facilities Enabled**

	<b>Units</b>	<b>Monthly</b>	<b>Annual</b>	<b>Total</b>	
Schools & educational facilities	200	\$100	\$1,200	\$240,000	T-1 equivalent service
Community organizations	80	\$100	\$1,200	\$96,000	
Neighborhood partnerships	80	\$100	\$1,200	\$96,000	
Community housing	267	\$100	\$1,200	\$320,400	
<b>Total</b>	<u>627</u>			<u>\$752,400</u>	

Oakland Business Model Facilities Worksheet

**Parks & Recreation**

	<b>Facility</b>	<b>Address</b>	<b>Phone</b>	<b>Lines</b>	<b>Monthly Cos Termination</b>	
<b>Recreation Centers</b>	Allendale Recreation Center	3711 Suter Street	(510) 535-5635			
	Arroyo Viejo Recreation Center	7701 Krause Avenue	(510) 615-5755			
	Brookdale Recreation Center	2535 High Street	(510) 535-5632			
	Bushrod Recreation Center	560 59th Street	(510) 597-5031			
	Carmen Flores	1637 Fruitvale Avenue	(510) 535-5631			
	DeFremery Recreation Center	1651 Adeline Street	(510) 238-7739			
	Dimond Recreation Center	3860 Hanly Road	(510) 482-7831			
	Discovery Center – East	2521 High Street	(510) 535-5657			
	Discovery Center – West	935 Union Street	(510) 832-3314			
	FM Smith Recreation Center	1969 Park Boulevard	(510) 238-7742			
	Franklin Recreation Center	1010 East 15th Street	(510) 238-7741			
	Golden Gate Recreation Center	1075 62nd Street	(510) 597-5032			
	Ira Jinkins Recreation Center	9175 Edes Avenue	(510) 615-5959			
	Lincoln Square Recreation Center	250 10th Street	(510) 238-7738			
	Manzanita Recreation Center	2701 22nd Street	(510) 535-5625			
	Montclair Recreation Center	6300 Moraga Avenue	(510) 482-7812	1	\$210 150 FOP	
	Mosswood Recreation Center	3612 Webster Street	(510) 597-5038			
	Poplar Recreation Center	3131 Union Street	(510) 597-5042			
	Rainbow Recreation Center	5800 International Boulevard	(510) 615-5751	1	\$76 Sonitrol	
	<b>Swimming Pools</b>	Redwood Heights Recreation Center	3883 Aliso Avenue	(510) 482-7827	1	\$210 150 FOP
San Antonio		1701 East 19th Street	(510) 535-5608			
Sheffield Village Recreation Cntr		247 Marlow Drive	(510) 638-7190			
Studio One Arts Center		365 45th Street	(510) 597-5027	2	\$400 150 FOP, Int	
Tassafaronga Recreation Center		975 85th Avenue	(510) 615-5764			
Verdese Carter Recreation Center		9600 Sunnyside Street	(510) 615-5758			
Castlemont		8601 MacArthur Boulevard	(510) 879-3642			
DeFremery		1269 18th Street	(510) 238-2205			
Fremont		4550 Foothill Boulevard	(510) 535-5614			
Lions		3860 Hanly Road	(510) 482-7852	1	\$210 150 FOP	
Live Oak		1055 MacArthur Boulevard	(510) 238-2292			
McClymonds		2607 Myrtle Street	(510) 879-8050			
Temescal		371 45th Street	(510) 597-5013			
<b>Rental Facilities</b>		Joaquin Miller Community Center	3594 Sanborn Drive	(510) 238-3187		
		Lake Merritt Sailboat House	568 Bellevue Avenue	(510) 238-3187	1	\$170 150 FOP
		Leona Lodge	4444 Mountain Boulevard	(510) 238-3187		
		Marsha J. Corprew Garden Center	666 Bellevue Avenue	(510) 238-3187		
		Morcom Rose Garden	700 Jean Street	(510) 238-3187		
		Sequoia Lodge	2666 Mountain Boulevard	(510) 238-3187		
					<hr/>	
				7	\$1,276	

Oakland Business Model Facilities Worksheet

Unwired facilities 32  
Wired facilities 6

**Community Gardens**

Arroyo Viejo	79th Ave & Arthur St cul de sac
Bushrod	584 - 59th Street
Golden Gate	1068 - 62nd Street
Lakeside Kitchen Garden	666 Bellevue Ave
Marston Campbell	Btwn 16th & 18th St. and Market & West St.
Temescal	876 - 47th Street
Verdese Carter	Corner 96th Ave & Bancroft Ave

Oakland Business Model Facilities Worksheet

**Human Services**

	<b>Facility</b>	<b>Address</b>	<b>Phone</b>	<b>Lines</b>	<b>Monthly Cos Termination</b>
<b>Head Start/Early Head Start</b>	85th Avenue	8501 International Blvd.	510-544-3389		
	92nd Avenue	9202 International Blvd.	510-568-1057		
	Arroyo Viejo	7701 Krause Ave.	510-615-5944		
	Brookfield	9600 Edes Ave.	510-615-5736		
	City Towers	1050 7th Street	510-238-5230		
	De Colores	1155 35th Avenue	510-533-1271		
	Eastmont Mall	7200 Bancroft Ave. #203	510-562-1790		
	Fannie Wall	647 55th Street	510-597-5044		
	Foothill Square	10700 MacArthur Blvd #10	510-553-9926		
	Frank G. Mar	274 12th Street	510-832-5042		
	Franklin	1010 E. 15th Street	510-238-1304		
	Manzanita	2701 22nd Ave.	510-535-5624		
	San Antonio CDC	2228 E. 15th Street	510-534-6189		
	San Antonio Park	1701 E. 19th Street	510-535-5609		
	Seminary	5818 International Blvd	510-615-5924		
	Sungate	2563 International Blvd.	510-535-5648		
	Tassafaronga	975 85th Ave.	510-639-0580		
	Thurgood-Marshall	1117 10th Street	510-836-0543		
	Virginia	4335 Virginia Ave.	510-261-1484		
	West Grand	1058 West Grand Avenue	510-238-2267		
<b>Senior Centers</b>	Downtown Oakland Senior Center	200 Grand Avenue	510-238-3284		
	East Oakland Senior Center	9255 Edes Avenue	510-615-5731		
	Fruitvale/San Antonio Senior Center	3301 E. 12th Street	510-535-6123		
	Hong Lok Senior Center	275 7th Street	510-763-9017		
	North Oakland Senior Center	5714 Martin Luther King Jr. Way	510-597-5085		
	West Oakland Senior Center	1724 Adeline Street	510-238-7017		
	Covenant House	2781 Telegraph Ave	510.625.7800		
<b>Shelters</b>	East Oakland Community Project	5725 International Blvd.	510.532.3211		
	Health Care for the Homeless	1900 Fruitvale Ave., Suite 3E	510.533.4663		
	Henry Robinson Multi-Service Center	559 16th St.	510.419.1010		
	Oakland Army Base Temporary Winter Shelter	1145 Midway St.	510.839.8005		
					0
	Unwired facilities			31	
	Wired facilities			0	

Oakland Business Model Facilities Worksheet

**Other**

Public Safety	31
General	43
Total facilities	300
Unaccounted for locations	157

Oakland Business Model Facilities Worksheet

**Oakland Unified School District**

Acorn Woodland Cdc	(510) 879-0861	1029 81st Ave
Acorn Woodland Elementary	(510) 879-0190	1025 81st Ave
Adult Ed - Abe/Ase	510-879-4040	2455 Church Street
Adult Ed - Awd	510-879-4090	920 53rd Street
Adult Ed - Cte	510-879-8620	2455 Church Street, Rm. 106
Adult Ed - EsI	510-879-4020	750 International Blvd
Adult Ed - Oa	510-879-4090	920 53rd Street
Adult Ed - Pfca/Cbet	510-879-2944	750 International Blvd
Adult Education Administrative Office	(510) 879-3036	2607 Myrtle Street
Alice Street Cdc	(510) 879-0856	250 17th Street
Allendale Elementary	(510) 879-1010	3670 Penniman Ave
Alliance Academy	(510) 879-2733	1800 98th Ave
Alternative Learning Community		9736 Lawlor Street
Arroyo Viejo Cdc	(510) 879-0802	1895 78th Avenue
Ascend Elementary	(510) 879-3140	3709 E 12th St
Bella Vista Cdc	(510) 879-1657	2410 10th Avenue
Bella Vista Elementary	(510) 879-1020	1025 E 28th St
Best At Mcclymonds	(510) 879-3030	2607 Myrtle St
Bret Harte Middle School	(510) 879-2060	3700 Coolidge Ave
Bridges Academy At Melrose	(510) 879-1410	1325 53rd Ave
Brookfield Pre-K	(510) 879-0806	401 Jones Avenue
Brookfield Village Elementary	(510) 879-1030	401 Jones Ave
Bunche Academy	(510) 879-1730	1240 18th St
Burckhalter Elementary	(510) 879-1050	3994 Burckhalter Ave
Business & Information Technology High Schor	(510) 879-3010x443	8601 Macarthur Blvd
Carl Munck Elementary	(510) 879-1680	11900 Campus Dr
Castlemont Community Of Small Schools	(510) 879-3010	8601 Macarthur Boulevard
Centro Infantil Annex Cdc	(510) 879-081	314 East 10th Street
Centro Infantil De La Raza Cdc	(510) 879-1521	2660 East 16th Street
Chabot Elementary	(510) 879-1060	6686 Chabot Rd
Claremont Middle School	(510) 879-2010	5750 College Ave
Cleveland Elementary	(510) 879-1080	745 Cleveland St
Cole Middle School	(510) 879-1091	1011 Union St
Coliseum College Prep Academy	(510) 879-2456	1390 66th Ave
College Prep & Architecture Academy	(510) 879-1131	4610 Foothill Blvd
Community Day Hs	(510) 879-8450	4917 Mountain Blvd
Community United Elementary School	(510) 879-1340	6701 International Blvd
Cox Ece Center	(510) 879-0807	9860 Sunnyside Street
Crocker Highlands Elementary	(510) 879-1110	525 Midcrest Rd
Dewey Academy	(510) 879-3100	1111 2nd Avenue
East Oakland Pride		8000 Birch Street



Oakland Business Model Facilities Worksheet

East Oakland School Of The Arts	(510) 879-3010x498	8601 Macarthur Blvd
Edna M Brewer Middle School	(510) 879-2100	3748 13th Ave
Edward Shands Adult Education Center	(510) 879-4040	2455 Church Sreet
Elmhurst Community Prep	(510) 879-2021	1800 98th Ave
Emerson Cdc	(510) 879-0811	4801 Lawton Avenue
Emerson Elementary	(510) 879-1150	4803 Lawton Ave
Encompass Academy	(510) 879-0207	1025 81st Ave
Esperanza Academy	(510) 879-1551	10315 E St.
Excel At Mcclymonds	(510) 879-8490	2607 Myrtle St
Explore College Preparatory Middle	(510) 879-1040	3550 64th Avenue
Far West	(510) 879-1580	5263 Broadway Terrace
Franklin Elementary	(510) 879-1160	915 Foothill Blvd
Fred T. Korematsu Discovery Academy	(510) 879-2795	10315 E St.
Fremont Federation	(510) 879-3020	4610 Foothill Blvd
Frick Middle School	(510) 879-2030	2845 64th Ave
Fruitvale Cdc	(510) 879-2825	3200 Boston Ave.
Fruitvale Elementary	(510) 879-1170	3200 Boston Ave
Futures Elementary		6701 International Blvd
Garfield Elementary	(510) 879-1180	1640 22nd Ave
Glenview Elementary	(510) 879-1190	4215 La Cresta Ave
Global Family School		2035 40th Ave.
Golden Gate Cdc	(510) 879-0814	6232 Herzog Street
Golden Gate Pre-K	(510) 879-0813	6200 San Pablo Avenue
Grass Valley Cdc		4720 Dunkirk Ave.
Grass Valley Elementary	(510) 879-1220	4720 Dunkirk Ave
Greenleaf Elementary		6328 East 17th Street
Harriet R Tubman Cdc	(510) 879-0825	800 33rd Street
Highland Campus	(510) 879-1260	8521 A St
Highland Cdc	(510) 879-0815	1322 86th Avenue
Hillcrest Elementary	(510) 879-1270	30 Marguerite Dr
Hintil Kuu Ka Cdc	(510) 879-0840	11850 Campus Drive
Hoover Elementary	(510) 879-1700	890 Brockhurst St
Horace Mann Elementary	(510) 879-1360	5222 Ygnacio Ave
Howard Cdc	(510) 879-0816	8755 Fontaine Street
Howard Elementary	(510) 879-1660	8755 Fontaine St
International Cdc	(510) 879-4293	2825 International Boulevard
International Comm. Elementary	(510) 879-4286	2825 International Blvd
James Madison Middle School	(510) 879-2150	400 Capistrano Dr
Jefferson Cdc	(510) 879-0817	1975 40th Avenue
Jefferson Elementary	(510) 879-1280	2035 40th Ave
Joaquin Miller Elementary	(510) 879-1420	5525 Ascot Dr
Kaiser Elementary	(510) 549-4900	25 S Hill Ct

Oakland Business Model Facilities Worksheet

La Escuelita Elementary	(510) 879-1210	1100 3rd Ave
Lafayette Elementary	(510) 879-1290	1700 Market St
Lakeview Cdc	(510) 879-0857	746 Grand Avenue
Lakeview Elementary	(510) 879-1300	746 Grand Ave
Laurel Cdc	(510) 879-0820	3825 California Street
Laurel Elementary	(510) 879-1310	3750 Brown Ave
Lazear Elementary	(510) 879-1320	824 29th Ave
Leadership Preparatory High School	(510) 879-3010x457	8610 Macarthur Blvd
Learning Without Limits		2035 40th Ave
Life Academy	(510) 534-0282	2101 35th Avenue
Lincoln Elementary	(510) 879-1330	225 11th St
Lockwood Cdc	(510) 879-0823	1125 69th Avenue
Lockwood Elementary	(510) 879-1340	6701 International Blvd
Lockwood School Preschool	(510) 879-0827	6701 E.14th St.
M L King Jr Elementary	(510) 879-1820	960 10th St
Mandela High School	(510) 879-1141	4610 Foothill Blvd
Manzanita Campus	(510) 879-1370	2409 E 27th St
Manzanita Cdc	(510) 879-0829	2618 Grand Vista
Manzanita Community School	(510) 879-1370	2409 E 27th St.
Manzanita Seed	(510) 879-1373	2409 E. 27th St
Markham Elementary	(510) 879-1380	7220 Krause Ave
Marshall Elementary	(510) 879-1740	3400 Malcolm Ave
Maxwell Park Elementary	(510) 879-1390	4730 Fleming Ave
Mcclymonds Community Of Small Schools	(510) 879-3030	2607 Myrtle St
Media College Prep	(510) 879-1597	4610 Foothill Blvd
Melrose Leadership Academy	(510) 879-1530	5328 Brann Street
Met West	(510) 879-0235	314 E 10th St
Ml King Cdc	(510) 879-0822	960A 10th Street
Montclair Elementary	(510) 879-1430	1757 Mountain Blvd
Montera Middle School	(510) 879-2110	5555 Ascot Dr
Neighborhood Centers	(510) 879-4020	750 International Blvd
New Highland Academy	(510) 879-1260	8521 A St
Oakland High School	(510) 879-3040	1023 Macarthur Blvd
Oakland International High School		4521 Webster St
Oakland Technical High School	(510) 879-3050	4351 Broadway
Parker Cdc	(510) 879-0828	7901 Ney Avenue
Parker Elementary	(510) 879-1440	7929 Ney Ave
Peralta Cdc	(510) 879-0858	460 63rd Street
Peralta Creek Middle School	(510) 879-8465	2101 35th Ave
Peralta Elementary	(510) 879-1450	460 63rd Street
Piedmont Avenue Cdc	(510) 879-0832	86 Echo Avenue
Piedmont Avenue Elementary	(510) 879-1460	4314 Piedmont Ave

Oakland Business Model Facilities Worksheet

Pleasant Valley Adult School	(510) 879-4090	920 53rd Street
Preparatory Literary Academy Of Cultural Exce	(510) 879-1470	920 Campbell St
Prescott Cdc	(510) 879-0835	800 Campbell Street
Reach Academy	(510) 879-1100	9860 Sunnyside St.
Redwood Heights Elementary	(510) 879-1480	4401 39th Ave
Rise Community School	(510) 879-2553	8521 A St
Robeson School Of Visual & Performing Arts	(510) 879-1237	4610 Foothill Blvd
Roosevelt Middle School	(510) 879-2120	1926 19th Ave
Roots International Academy	(510) 879-2625	1390 66th Ave
Rudsdale Continuation	(510) 879-4237	1180 70th Avenue
Sankofa Academy	(510) 879-1610	581 61st St
Santa Fe Cdc	(510) 879-0837	5380 Adeline Street
Santa Fe Elementary	(510) 879-1500	915 54th St
Sequoia Cdc	(510) 879-0846	3730 Lincoln Avenue
Sequoia Elementary	(510) 879-1510	3730 Lincoln Ave
Skyline High School	(510) 879-3060	12250 Skyline Blvd
Sobrante Park Elementary	(510) 879-1540	470 El Paseo Dr
Sojourner Truth Independent Study	(510) 879-2980	9736 Lawlor St.
Stonehurst Campus	(510) 879-1550	10315 E St
Stonehurst Cdc	(510) 879-0838	901 105th Avenue
Street Academy	(510) 879-3130	417 29th St
Think College Now	(510) 879-1490	2825 International Blvd
Thornhill Elementary	(510) 879-1570	5880 Thornhill Dr
Tilden Elementary	(510) 879-1560	4551 Steele St
Tilden Pre-K	(510) 879-0841	4655 Steele Street
United For Success Academy	(510) 879-1494	2101 35th Ave
Urban Promise Academy	(510) 879-1640	3031 E. 18th Street
Washington Cdc	(510) 879-0839	6097 Racine Street
Webster Academy	(510) 879-1620	8000 Birch St
Webster Academy Ece	(510) 879-0842	7980 Plymouth Street
West Oakland Middle School		991 14th Street
Westlake Middle School	(510) 879-2130	2629 Harrison St
Whittier Elementary	(510) 879-1630	6328 E 17th St
Yes, Youth Empowerment School	(510) 879-8877	8251 Fontaine St
Yuk Yau Cdc	(510) 879-0824	291 10th Street
Yuk Yau-Annex	(510) 879-0821	314 East 10th Street

Oakland Business Model Facilities Worksheet

**Other Schools**

California College of Arts & Crafts  
 California State University, Hayward  
 Holy Names University  
 Mills College  
 Patten University  
 Alameda College  
 Laney College  
 Merritt College  
 Vista College  
 Samuel Merritt College  
 San Francisco State University - Extended Learning  
 Holy Names High School

**City Statistics**

Land area (sq. mi.)	53.8	FY07-09 Budget
Lake area (sq. mil.)	3.5	FY07-09 Budget
Total area	<hr/> 57.3	
Miles of Streets	835.8	FY07-09 Budget
Population	411,600	FY07-09 Budget
Number of businesses	19,720	FY07-09 Budget

**Network Specifications**

Access points/sq. mi.	16	Estimate
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# 11. Appendix D: Communications

## 11.1. Communications Outline

### I. Communications Objectives

- A. Awareness. Build brand public awareness of the Wireless Oakland Initiative (WOI) project in the Oakland Metropolitan Area amongst its diverse population. The goal is to have 60% of the constituent community be aware of the WOI within the first six months.
- B. Education/Buy-in. Educate the public on the key details of the WOI program and the benefits it will provide the citizens of Oakland – both short and long term. The goal w to educate as many people as the budget permits.
- C. Image/Reputation. Increase Oakland’s reputation as a smart, progressive city; one that is on the forefront of technology. Increase favorable image of Oakland as a great place to visit, live and do business.

### II. Key Communications Strategies

- A. A. Positioning. Position the WOI program as a major initiative (versus other City initiatives) by “branding” the program with its own unique image.
- B. Elements of a “Branded Initiative”
  - Name
  - Logo (City of Oakland logo)
  - Positioning
  - Vision
  - Personality
  - Brand promise
  - Value proposition
  - Core brand message
  - Theme (e.g., “Building a Digital Future Today”)
- C. Continuity of Messaging. All initiative messaging should be consistent across all communications channels so they reinforce the key elements of the brand.

### III. Key Communications Tactics


- A. The communications plan will include both an introductory phase (first 90 days) and an ongoing support phase. The plan will use the most cost-effective communication tools available to reach the various target audiences.
- B. The communications tactics recommended are an integrated mix of traditional media, Web media and the new social media.
- C. The current thinking on the elements that should be involved include:
  - 1. Fact sheet (several languages).
  - 2. Q and A document (both printed and online).
  - 3. Community meetings.
  - 4. Presentation to community groups and service clubs.
  - 5. Media Relations Kit: Introductory and Ongoing.
  - 6. A micro-site as part of the City's master Web site.
  - 7. Quarterly e-mail newsletter campaign.
  - 8. A social media presence (blog, Twitter, Facebook) to reach the digital generation.
  - 9. Optional: Special Education and Teaching Module, budget permitting.

## 11.2. Presentation



### Comprehensive assessment of needs, goals & priorities

- Assessment meetings with DIT staff
- Technical survey of city assets & environment
- Workshops for police, fire, emergency services, public works, finance, administration, parks, library, museum, human services
- Workshops for business, education, non-profits, public agencies
- Public focus groups by district
- Town Hall meeting
- Public comment via phone and email



*Study Objective:*  
Conduct the necessary fact finding that will support the establishment of a sound vision for the deployment of an achievable and sustainable wireless broadband network.

Broad, nearly unanimous agreement...


- ✓ Public Internet access via community anchor institutions
- ✓ Pay-as-you-go opportunities for business
- ✗ Wireless Internet service to homes or individuals
- ✗ Widespread financial and technical failure in other cities

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## Needs, goals & priorities led to operational requirements

### Priority Strategic Goals

- 1 Sound financial planning
- 2 Free school access
- 3 Free public access at libraries, community centers, parks, etc.
- 4 Affordable access for the public
- 5 System facilitates improved productivity
- 6 Public project awareness

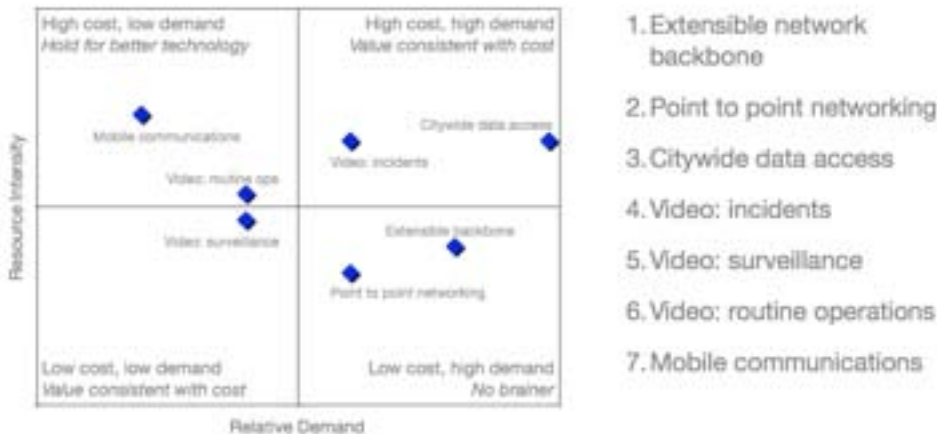


Operational Requirement	Public Safety	Emergency Services	Public Works	Finance & Admin	CEEA	Human Services	Parks & Recreation	Other Agencies	Business	Non-Profit	Public
Citywide data access	X	X	X	X		X	X	X			
Mobile communication	X	X	X	X							
Video: routine operations	X	X	X	X							
Video: incidents & events	X	X	X	X			X	X			
Video: surveillance & monitoring	X		X				X		X		
Point to point networking						X	X	X	X	X	X
Extensible network backbone					X		X	X	X	X	X

Tellus Venture Associates

## Is desire consistent with cost?

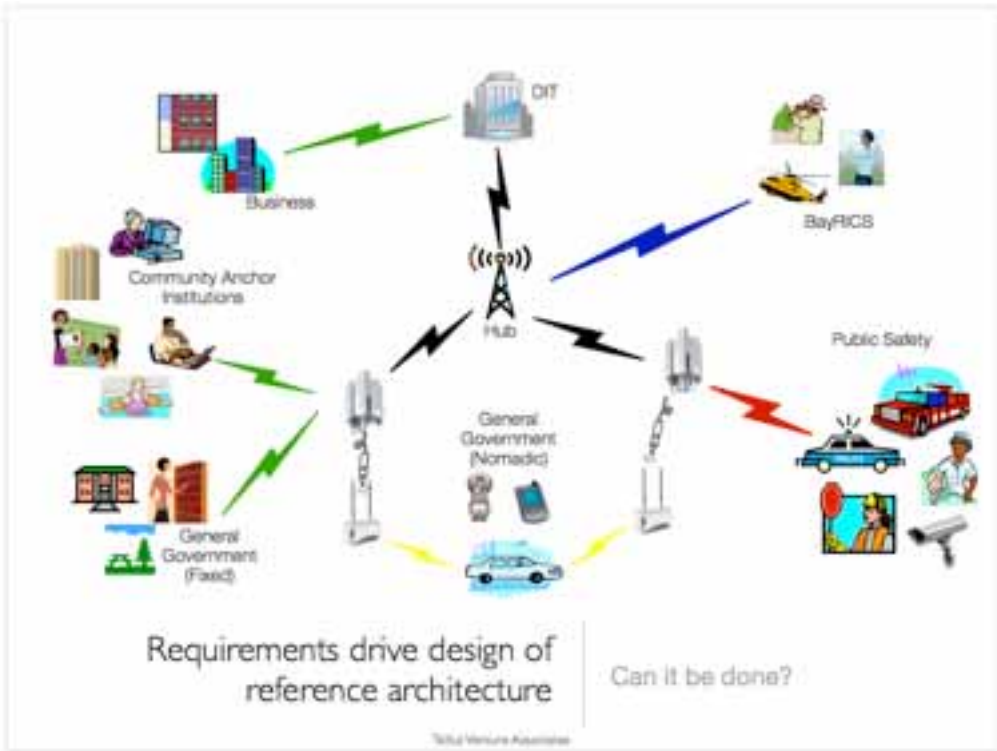
### Setting operational requirement priorities for the City of Oakland

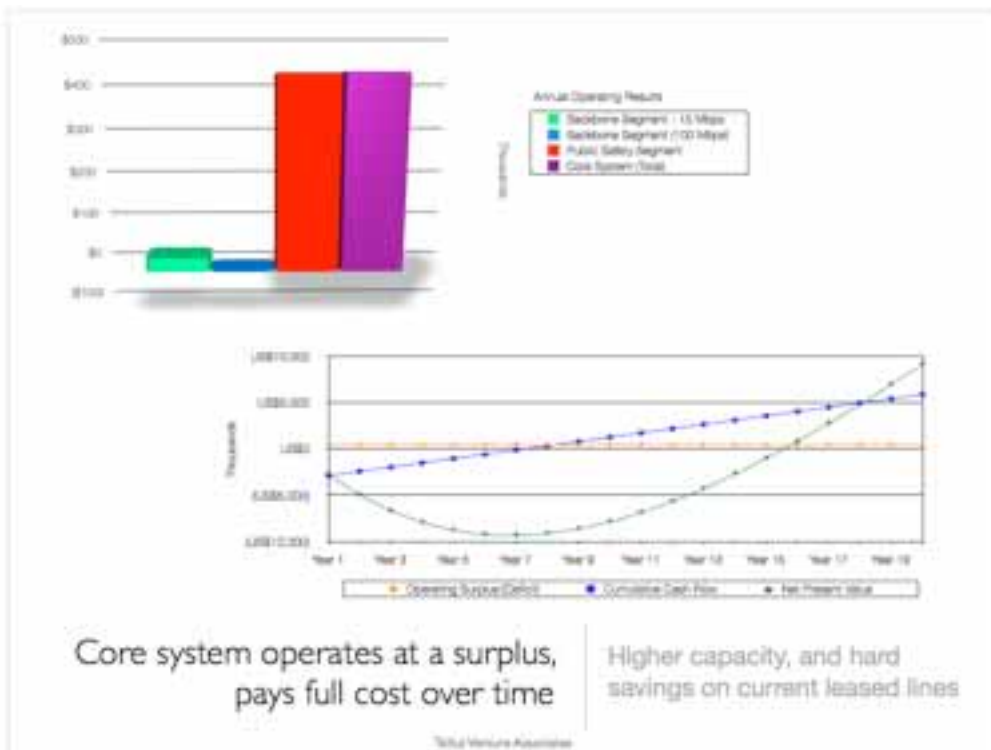
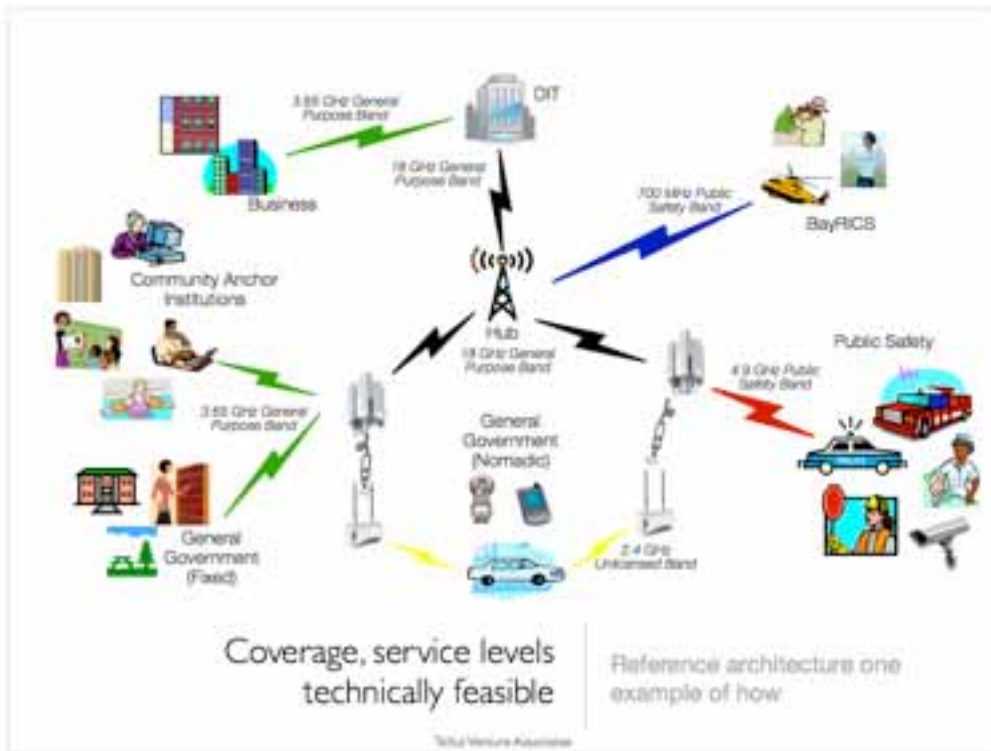


1. Extensible network backbone
2. Point to point networking
3. Citywide data access
4. Video: incidents
5. Video: surveillance
6. Video: routine operations
7. Mobile communications

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## Next steps

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Stimulus program application deadline sets immediate agenda

- Determine which broadband grant programs are available to the City.
- Develop an implementation plan that meets schedule requirements and criteria for "shovel-ready" projects.
- Identify complementary stimulus program-funded projects and potential partners, per applications guidelines.
- Determine the source for the required 20% matching funds, including making any necessary applications to State of California agencies.
- Prepare and submit grant applications covering as many categories as practical by the 14 August 2009 deadline.
- Release an RFP to support the grant applications as soon as possible.

Tellus Venture Associates

Creating and implementing fundable business plans for community broadband projects is a speciality of Tellus Venture Associates.



Since 1996, our clients have built, funded, launched and managed wireless, fiber optic and satellite networks that serve consumers and communities around the world. Our experience includes:

- Financial and technical feasibility studies
- Primary market research to determine demand and community support
- Business case assessment
- Business model and funding development
- Public/private partnerships
- Reference designs
- RFP development and support

Stephen Blum, the president of Tellus Venture Associates, has led many successful projects and served in several senior executive positions on a consulting basis, including...

- Principal consultant for a successful \$5 million grant application for a regional broadband consortium.
- Chief operating officer of a wireless ISP.
- Due diligence lead for an NGO delegation to Angola
- Team leader for an NGO project in the Philippines.
- Principal negotiator for a cable system sale to a top tier MSO.
- Managing consultant for a public/private WiMAX network deployment.
- Principal consultant for comprehensive feasibility studies for municipal wireless broadband systems.
- Management advisor for satellite broadcasting systems in North and South America, Asia, the Pacific Rim, Africa, the Middle East, and Europe, including most recently Italy, Cambodia and New Zealand.

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