Wireless Communications Long-Term Plan

City of San Diego

December 1, 2002

Wireless Communications Long-Term Plan
-IT&C's Introductory Comments-

The Information Technology & Communications (IT&C) Department is responsible for the design, installation and maintenance of the City's wireless communications systems and services. The four major City-owned networks that provide these services are the 800 MHz Radio Network, the Mobile Data Network, the Digital Microwave Network and the Digital Paging Network. These networks and the related systems which make up the City's public safety wireless communications infrastructure are now at, or near, the end of their service and maintenance lifecycle. They must be replaced over the next several years in order to guarantee that the critical communications requirements of our public safety services will be met in the future. The first step in the planning process for replacing and upgrading these systems is the development of the Wireless Communications Long-Term Plan.

Tech/Knowledge, Inc.(T/K), an independent telecommunications and information technology consulting firm, was contracted through a rigorous RFP process to gather and analyze the City's communications systems users' current and future needs and to develop a proposed wireless plan for meeting those requirements. In the development of this wireless plan, T/K also evaluated communications systems and facilities that are closely related to the wireless infrastructure. Examples of related systems include Computer Aided Dispatch (CAD) systems, dispatch equipment and facilities, a 3-1-1 public service answering point and the Emergency Operations Center (EOC).

To develop a comprehensive needs analysis, T/K staff interviewed some 200+ users and stakeholders. The major sources of planning input were as follows:

- Primary user groups including Police, Fire and Life Safety Services, public service departments and other outside public agencies (SD Unified School District, SD Community College District, etc.) which currently contract with the City to share use of the City's wireless systems
- IT&C internal department project committee
- Information Technology Governance Committee (ITGC) and selected members of the Wireless Technology Group and the Information Technology Technical Advisory Committee (IT TAC)
- Executive-level city management (Deputy City Manager & Chief Information Officer)
- The Chief Technology Officer (CTO) of the City's primary Information Technology service provider, the San Diego Data Processing Corporation (SDDPC)

- Major commercial communications system vendors
- A consultant specializing in large wireless systems project funding

After confirming the accuracy of the needs analysis with users and stakeholders, T/K subsequently developed the proposed Wireless Communications Long-Term Plan.

The following should be noted when reviewing the attached document:

1) This plan is the product of Tech/Knowledge, Inc. and was prepared based upon input received from the City and other parties.

2) The plan should not be considered to be either IT&C's or the City's final proposed wireless communications implementation plan. Other subsequent input will contribute to the definition of the specific scope, timing, estimated cost and financing of project(s) to replace the City's aging wireless infrastructure. This input will include further development of detailed system by system requirements, analyses of competing priorities and financing alternatives, suggestions and direction from the IT Governance Committee and the executive-level IT Board and, ultimately, policy direction from the Mayor and City Council.

3) As the following document is a high level plan, it should be noted that additional staff and consultant technical and financial work will be required over the next year+ to develop detailed system by system requirements, bid documents and cost estimates. These additional steps are necessary to implement the specific initiatives described in this plan.

4) The estimated initiative costs reflect the consultant's high level estimate of one time hard costs for each initiative. These estimates do not include consultant costs for detailed systems planning and project management assistance, or the additional internal City staff costs that will be required to implement the major initiatives proposed in the plan.

Our thanks and appreciation to Timothy Peters, President & CEO of Tech/Knowledge, Inc. and his project team for their professionalism and competence in developing a comprehensive proposed Wireless Communications Long-Term Plan. Our thanks also goes to the numerous City staff and other stakeholders for their invaluable input in developing the Needs Analysis document and for analyzing the consultant's subsequent recommendations.

Questions concerning this Plan should be directed to Communications Division Deputy Director Sue Levine or IT&C Director Richard Wilken.

Preface

There have been a number of true technological "paradigm shifts" in Information Technology that have radically impacted how we manage and use information. We number among these the shift from punched cards and printouts to interactive systems, and the subsequent migration from terminal-driven systems to personal computing and network-based access.

Yet, there is a shiny new thing on the horizon that may, in the long run, prove to be as significant as either of those first two developments. That shiny new thing, originally brought to its first productive application by a fellow named Guglielmo Marconi in 1896, is called "wireless". Well, OK, it was first called wireless, then it was called "radio" for a long time, until industry marketers decided that "radio" didn't have a sufficiently high coolness factor to sell the new uses of the technology. So now, here we are again, back with our 106-year-old new thing.

Actually, good old-fashioned voice radio has been -- and will be for the foreseeable future -- a technology that the City simply cannot do without. This technology saves lives every day. Given this incredible importance, the City needs a voice radio system that it truly can depend on. But this isn't news. We've been using wireless two-way voice communications in public safety since before World War II. So what's all the wireless hubbub about? Wireless *data*.

Why is wireless data so significant? Well, a big problem with information technology (IT) has been that in the past, it's only worked in a very limited number of places. Ironically, most of the places where you've been able to use IT aren't the places you really need it. You need IT *at the point of service*, where the information you want to manage is originally created, if IT is to have the greatest beneficial impact on how people work. Wireless access to information lets people spend time doing their jobs in the field, not spending time in the office looking things up.

But there's the rub. We haven't really ever had the tools that would make possible this concept of giving the people in the field the information they need to actually do their jobs -- in the field -- without spending half their day back in their offices. Until now.

In recent years, technologies have been developed that permit the transmission of large amounts of data at high rates of speed, fast enough even to permit users to have the same operational experience with a wirelessly connected device as they would with one conventionally connected. These technologies are becoming more practicably implementable every day. But what are the priorities? How do data and voice wireless communications fit together to address the business needs of the City? And what, exactly, are those needs?

That is what this document intends to address. This document represents the final effort in the development of a Long-Term Wireless Communications Plan that will serve as a sub-plan to the City's overall Information Technology Strategic Plan.

To arrive where we are today, Tech/Knowledge staff have worked with representatives of virtually every department in the City -- at all levels of staff and management -- in an intensive process to identify what the various departments are doing, where they are going from a strategic perspective, and how wireless technology can help them get there. In this process, we so far have conducted over 80 one-on-one or small group meetings, and, in group settings, interviewed over 200. We have also conducted extensive reviews of the City's in-place wireless communications networks, and the systems that support them and their operators.

Acknowledgements

This document could not have been produced without the substantial assistance of the dozens of City staff with whom we have spoken. From directors of departments on down the organization, we always encountered a spirit of assistance and cooperation, and a strong desire to do the right thing for the City.

We thank the members of the Information Technology Governance Committee, all of whom have been giving of their valuable time.

We thank the Department Directors who made themselves and members of their senior staffs available to our team.

From the Information Technology & Communications Department, thanks go to Richard Wilken, Director, and Susan Levine, Deputy Director of the Communications Division, who have been of invaluable service in helping us to understand the City's environment and in the development of the goals and strategies.

I would like to thank Vykki Mende Gray, who arranged the majority of our initial visits to departments and our contacts with senior City management in partnership with Maria Mendoza. I thank Leah Tombleson, who did the heavy lifting in coordinating and arranging our end-user group interview process. Ken Norton in Communications Engineering provided terrific service as our principal source of institutional memory on technical matters, backed up by Kim Andersen. Mike O'Brien, the City's Senior Communications Engineer who joined the City halfway through this process, was an invaluable resource in quantifying costs and determining technical direction.

We thank the City for selecting us to assist them with this process.

Timothy V. Peters
President & Chief Executive Officer/Project Manager
Tech/Knowledge, Inc.

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1. Executive Summary

1.1 Background

The City of San Diego (City) is the seventh largest city in the nation with an approximate population of 1.3 million residents in a 342 square mile area. The City has experienced significant growth especially in the science and technology areas, and has gained the preeminent position of being known as "*Technology's Perfect Climat*e" and in downtown San Diego as "*Bandwidth Ba*y."

In response to the City's growth and its needs to provide more cost-effective government services through various channels, including electronic services delivery, the City embarked on a planning process to address its information technology directions. This process produced the Information Technology Strategic Plan (ITSP). The ITSP is intended to define the City's vision of the future for information technology and the key strategies for achieving this vision. It will provide Citywide guidance and direction for the management and development of IT within the City of San Diego over the next three to five years.

The ITSP recognized that wireless communication technology would significantly impact many aspects of the City's use of information technology, and posed many specific operational and technical issues apart from regular IT strategic planning concerns. Thus, the ITSP called for the development of a long-term plan for the City's use of wireless communications. This long-term plan is intended to provide City-wide guidance and direction for the City's wireless communications programs over the next ten years.

Within the City of San Diego, the Communications Division of the Information Technology and Communications Department (IT&C) provides primary service delivery for wireless communications. Communications Division employs approximately 50 full time staff. IT&C reports to the Office of Technology Services, which has a total staff of 3, headed by the CIO.

IT&C's annual budget as it relates to the City's wireless communications projects and services is approximately $5.1 million. This supports the operational maintenance of the City's wireless communications infrastructure and subscriber equipment, representing over 34,300 devices.

The wireless communications long-term planning process was specifically designed to be inclusive, business-driven and consensus-based, as was the ITSP. The City engaged Tech/Knowledge, Inc., an independent telecommunications and information technology consulting firm to facilitate the planning process and perform required research and discussion in these contexts.

To ensure the planning process properly addressed the needs of the City, extensive participation was sought from City stakeholders, including many end-users of the technology.

The bulk of the input was provided by both internal and external stakeholders, including:

- Departmental Management and Operational Representatives
- San Diego Data Processing Corporation (SDDPC)
- San Diego Unified School District
- San Diego Community College District
- Poway Fire Department

The external agencies were involved in the process as users of the existing City radio system.

Extensive end-user and departmental interviews were held. Approximately 200 City end-users of wireless communications technology were interviewed in group settings. Detailed operational reviews to better understand specific departmental and divisional issues were held with the following City departments and divisions:

- Police
- Fire
- San Diego Medical Services Enterprise
- Lifeguard
- MWWD
- Water
- Environmental Services
- Streets Division
- Park & Recreation
- General Services
- Communications Division

Additional operational reviews were also conducted with each of the non-City users of the existing City radio system.

Wide-ranging technological and industry research into wireless communications technological and market trends was conducted. Leading San Diego-area firms engaged in wireless communications technologies were also contacted for insights.

1.2 Wireless Communications Vision for the Future

The City views information technology in general, and wireless communications in particular, as an enabling tool in achieving its business goals and objectives. Specifically, it is a tool that will facilitate transformation of the City's service delivery model for enhanced services to its citizens, and improve the effectiveness of City operations beyond the levels which can be achieved through wired technology. This improvement is achieved by permitting IT access directly at the point of service.

The wireless communications **Vision** statement drives the long-range plan by describing what the City must achieve to reach its full potential. The Vision articulates a destination for the City and reflects its high ideals as the City looks to the future.

The wireless communications **Mission** statement expresses the City's IT purpose and describes its role, responsibility and commitment in carrying out the Strategic Plan to ensure the realization of the City's wireless communications vision.

City of San Diego Wireless Communications Vision Statement

The City will use state-of-the-art wireless communications technology:

- **To provide the tools required for City employees to ensure the health and safety of the Citizens of San Diego**
- **To enable City employees to provide outstanding customer service to the Citizens by ensuring effective remote access to City information resources, regardless of location**

City of San Diego Wireless Communications Mission Statement

The City will:

- **Effectively manage and creatively use wireless communications resources to support and enable excellent and responsive municipal services**
- **Maximize the ability of City organizations to cooperate in the delivery of services to the Citizens through wireless technology**
- **Provide wireless technology suited to the potential life safety risk of its intended application**

The City's wireless communications infrastructure will:

- **Permit interoperability between the City and other agencies and levels of government**
- **Be adaptable to technological and regulatory changes**
- **Be adaptable to growth and evolving operational needs**
- **Enhance opportunities for partnerships in service delivery**

1.3 Wireless Communications Goals & Objectives

The City has identified the following strategic goals that will help achieve its vision for wireless communications. A more comprehensive description of these goals and their associated objectives and initiatives can be found in Section 5 - Strategic Priorities.

Wireless Technology Goal 1: Enhance dependability of City wireless communications systems and related elements

While the City's wireless communications systems are currently quite reliable, most are no longer supported by the manufacturer and spare parts are becoming more difficult to obtain. Much work will be necessary to ensure they maintain or improve their current levels of dependability. Each of the initiatives planned addresses this key strategic goal.

This goal addresses Strategic Goal 1 of the City's Information Technology Strategic Plan; Improve the delivery and cost-effectiveness of IT services.

Objectives:

- Replace obsolete equipment & technology
- Improve system coverage and penetration
- Reduce interference potential
- Provide enhanced security of communications
- Permit rapid restoration of failed sites
- Ensure critical public safety communications capability inside of structures
- Provide back-up public safety communications facilities

Wireless Technology Goal 2: Ensure adequate system capacity for the timely delivery of information

The evolving demands for mobile access to information will place significant burdens on the City's wireless communications infrastructure. Endeavors such as water system expansion, replacement of existing mobile data networks, and the rollout of automatic vehicle location technology to additional users mandates this expansion.

This goal addresses the following Strategic Goals of the City's Information Technology Strategic Plan:

- ITSP Strategic Goal 1: Improve the delivery and cost-effectiveness of IT services
- ITSP Strategic Goal 3: Establish the technical infrastructure to provide electronic service delivery channels to citizens and facilitate economic growth
- ITSP Strategic Goal 4: Improve internal City operations and management's ability to make informed decisions

Objectives:

- Reduce response times
- Improve flexibility and capacity of radio system control tools
- Increase reliable high-speed fixed data capacity
- Provide reliable, public-safety-grade mobile data capacity to support IP-based applications
- Provide infrastructure which allows new higher-speed paging technology to be rolled out
- Address strategic operational requirements of user departments
- Permit expansion of dynamic dispatch and AVL applications
- Provide additional voice communications user capacity
- Provide high-capacity voice, data and video communications capacity for events

Wireless Technology Goal 3: Provide City field forces access to appropriate City information resources regardless of location

If City staff is provided access to City information resources in the field, significant benefits will accrue. Improvements in both the overall productivity of City staff and in the quality of the services they provide can be expected. While many of these benefits will be cost-saving, as providing water maintenance staff with the exact routing of a water main, many will be life-saving, as providing fire fighters access to hazardous materials usage and pre-fire planning documents.

This goal addresses Strategic Goal 4 of the City's Information Technology Strategic Plan: Improve internal City operations and management's ability to make informed decisions.

Objectives:

- Provide access to City network from off-site locations
- Provide more information at time of initial dispatch

Wireless Technology Goal 4: Provide improved interoperability both between City departments and between City departments and outside agencies

For the City to reach the level of operating efficiency that it seeks, City departments must be able to cooperate effectively in the delivery of services, both on a routine and an emergency basis. Likewise, City departments need to be able to cooperate and interoperate with a wide range of other agencies on a daily basis.

This goal addresses the following Strategic Goals of the City's Information Technology Strategic Plan:

- ITSP Strategic Goal 1: Improve the delivery and cost-effectiveness of IT services
- ITSP Strategic Goal 3: Establish the technical infrastructure to provide electronic service delivery channels to citizens and facilitate economic growth
- ITSP Strategic Goal 4: Improve internal City operations and management's ability to make informed decisions

Objectives:

- Provide appropriate levels of security and privacy of communication
- Address strategic requirements of user departments
- Provide interoperability between Police and Fire/EMS CAD systems
- Provide departmental EOC space for public service departments
- Provide back-up City EOC space away from downtown in event of large-scale emergency
- Provide interdepartmental electronic workflow
- Improve City's ability to respond to large-scale emergencies

Wireless Technology Goal 5: Improve the delivery and end-user value of City wireless communications services

City wireless communications programs touch nearly every City department. Through improving their value, quality and cost-effectiveness, and enabling information access where none was possible before, the City can achieve significant improvements in key areas. Specifically, the quality of services delivered, community responsiveness and overall productivity will increase.

This goal addresses the following Strategic Goals of the City's Information Technology Strategic Plan:

- ITSP Strategic Goal 1: Improve the delivery and cost-effectiveness of IT services
- ITSP Strategic Goal 3: Establish the technical infrastructure to provide electronic service delivery channels to citizens and facilitate economic growth
- ITSP Strategic Goal 4: Improve internal City operations and management's ability to make informed decisions

Objectives:

- Provide a consistent user interface
- Reduce costs of network operation and administration
- Support Mobile 9-1-1 "Phase II" Automatic Location Information
- Replace space-restricted Police & Fire Communications Centers
- Replace space-restricted Station 38 facility
- Provide 3-1-1 call-taking center
- Provide public safety communications training facility
- Address law enforcement radio tracking needs
- Improve quality of end-user communications training on a City-wide basis, thereby increasing the effectiveness and productivity of the City's investment in communications infrastructure
- Decrease stress on first responders, particularly on overnight responses

1.4 Achieving the Wireless Communications Goals and Objectives

In order to achieve the City's wireless communications goals and objectives, initiatives were identified that would address the operational and technical aspects of the City's wireless communications environment. Some of these initiatives are projects that are currently underway; most are planned for phased implementation in the next three to five years. These initiatives are fully described in Section 8 - Implementation Plan. In the listing below, the key strategic initiatives are identified and assigned a priority. This ranking is based upon several criteria including strategic fit, relative urgency, City readiness, opportunity costs, and others.

Ongoing Initiatives

Rank	Initiative	Estimated Cost
1.	Update City Paging System	$300,000
2.	Upgrade & Expand SCADA Networks	$200,000

New Initiatives

Rank	Initiative	Estimated Cost
1.	New Digital Microwave System	$3 Million
2.	New Remote Network Access Methodology	$250,000
3.	New Wide-Area Mobile Data Network	$3-5 Million (Interim) $6-8 Million (Permanent)
4.	New City Radio System & Control Equipment	$60 - 70 Million
5.	New Primary Public Safety Dispatch Facility	$15 - 20 Million
6.	New CAD Systems	$10 - 12 Million
7.	Improve Communications Technical Support Capabilities	$700,000
8.	Improve Communications Training Capabilities	$125,000
9.	New Fire Station Alerting Network/Hardware	$1.5 Million
10.	Convert Existing Fire Comm Center to multi-functional Public Service Comm/3-1-1 call center/Backup Public Safety Comm/Training Facility	$4 - 5 Million

A strategic legislative initiative has also been developed:

1.	Enactment of a Signal Booster Ordinance	None

The ranking for the new initiatives is based on the following reasoning:

The New Digital Microwave System was chosen first, as it is the backbone upon which all of the key City wireless communications system depend. Serious capacity issues exist currently that limit the City's ability to address immediate needs, and this network will need to be updated prior to the implementation of many of the other key initiatives. The exiting microwave network is experiencing loss in reliability due to its age. Spare parts and technical support are becoming more difficult to acquire. This network is no longer supported by the manufacturer. The baseline importance of this initiative to most others drove its top ranking.

The New Remote Access Methodology was chosen second, though this initiative will likely be the first completed. It is a straightforward project that will not require a large capital expenditure, but will provide a platform for several of the initiatives to follow.

The New Wide-Area Mobile Data Network was chosen next due to the criticality of the applications (pivotal to both police and fire dispatch), the severity of the situation of the existing solution, and the impending elimination of the current alternative solution.

The next choice was the New City Radio System & Control Equipment Project, the largest single element of the City's wireless strategy for the next ten years. This ranking

was selected due to the time that would be necessary to develop the funding required for this major, multi-year project.

The choice of ranking of the next two initiatives, the New Primary Public Safety Dispatch Facility and New CAD Systems, is driven largely by the timing for the New City Radio System. These projects should, ideally, come on-line toward the end of the Radio System project. The new facility will likely take longer to complete than the CAD System project, so it has been placed before the CAD System project.

The Improve Communications Technical Support initiative is a supporting item to the previous several initiatives, and is ranked accordingly.

The Improve Communications Training Capabilities initiative is a low-cost program that will be of great importance to the success of the New City Radio System project, and should be completed in time to support that project.

Fire Station Alerting is a longer-term requirement that does not need to be addressed immediately, but should be considered in the CAD System project, and completed in a comparable timeframe with that project.

Conversion of the existing Fire Communications Center to a Public Service Communications Facility must wait until the completion of the new Public Safety Communications Center, and is the longest-term initiative by virtue of this fact.

The Upgrade City Paging System and Upgrade SCADA Networks projects are already underway. The legislative initiative can commence at any time, but should be undertaken sooner than later.

Following is the overall estimated budget for the implementation of the City's strategic initiatives:

- FY 2003: $1.1 - $1.8 Million
- FY 2004: $3.4 - $6.8 Million
- FY 2005: $25 - $29 Million
- FY 2006: $30 - $35 Million
- FY 2007: $30 - $39 Million
- FY 2008: $8.8 - $11 Million
- FY 2009: None Projected
- FY 2010: None Projected
- FY 2011: $2.5 - $3.3 Million
- FY 2012: $1.5 - $2.75 Million
- **Total: $102.3-$128.65 Million**

Funding options for these initiatives are currently under review.

(Continued)

The following schedule is projected for these initiatives:

	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Update City Paging System										
Upgrade & Expand SCADA Networks										
New Digital Microwave System										
New Remote Network Access Methodology										
New Wide-Area Mobile Data Network (Interim)										
New Wide-Area Mobile Data Network (Permanent)										
New City Radio System & Control Equipment										
New Primary Public Safety Dispatch Facility										
New CAD Systems										
Improve Communications Technical Support Capabilities										
Improve Communications Training Capabilities										
New Fire Station Alerting Network/Hardware										
Convert Existing Fire Comm Center to Multi-Functional Public Service Comm/3-1-1 Call Center/Backup Public Safety Comm/Training Facility										

(Continued)

The following operating principles will guide the City in the implementation efforts and decision-making process:

City of San Diego Wireless Communications Operating Principles

Process

- Wireless communications initiatives will be aligned with the City's overall business goals and planned with a Citywide perspective
- A business case methodology will be used to plan for, and determine the business value of, wireless communications investments
- A formal method to gather and define functional requirements and business processes will be utilized in the evaluation and procurement of systems
- Provision will be made in the re-engineering of the City's business processes for integration with wireless communications technology appropriate to the application
- A formal method for the evaluation and acquisition of new technology will be used. This method must consider, at a minimum, impact on the business, total cost of ownership (TCO), vendor stability, technological and standards compliance
- Key performance measures will be defined to manage wireless communications systems and services for providing reliable and effective service
- Requirements for interoperability, both between City organizations and with other agencies at all levels of government, will be evaluated and considered in the design of all wireless communications systems

People

- Desired core competencies for City staff involved in wireless communications deployment and support will be defined and promoted through career paths and skills training
- Initial and ongoing training will be provided for all users of technology

Technology

- Commercial-off-the-shelf (COTS) technology will be the preferred solution. Departments will evaluate COTS technologies to ensure compliance with business processes. The City's Communications Division, and where appropriate, SDDPC, will evaluate COTS products and solutions to ensure compliance with technical standards. Modifications to COTS technology and software will be minimized.
- The selection of technology systems involving single-source and proprietary solutions should be carefully considered, and only implemented if no viable alternative exists

1.5 Critical Success Factors

The City has established a vision for how information and communications technology would enable the City "*worthy of our affection*." In order to achieve this vision and the strategic wireless communications goals and objectives, the following critical success factors were identified:

- Strong executive sponsorship and support from City Council and City executives on the City's Wireless Communications Vision and Mission
- Buy-in from City stakeholders including the various City departments
- Funding and staff resource support to execute the Plan
- Ongoing close communications and teamwork throughout the organization
- Phased implementation strategy based on overall City priorities
- Regular progress assessment and communication of the implementation plan objectives
- Ongoing review process to ensure that the Plan goals and objectives remain consistent with the City's business need
- Resolution of regulatory issues surrounding both the City's current spectrum allocations and proposed expansion at 700 MHz[1]

1.6 Conclusion

The City has long been a leader in the effective application of wireless communications technology. While the existing major systems in use by the City work well, they have reached a significant age and now largely require replacement, which will require a significant investment of approximately $102 to $129 Million Dollars. This situation also presents an opportunity to significantly restructure many of the service delivery methods and practices currently used by the City. Substantial benefits in terms of both the quality of services delivered and improvements in efficiency will accrue from these investments.

In summary, this Wireless Communications Long-Range Plan, as a sub-element of the overall City Information Technology Strategic Plan, provides a roadmap to more effectively leverage the power of information technology to more effectively protect the community, achieve the City's business goals, and truly be a *"City worthy of our affection."*

[1] This issue is a national-level issue beyond the ability of the City to resolve on its own. The City has in the past, and will continue in the future, to aggressively represent its interests before the Federal Communications Commission, local frequency allocation committees and other such bodies involved in spectrum allocation and regulation.

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2. The Long-Term Planning Process

2.1 Background

The City of San Diego (City) is the seventh largest city in the nation with an approximate population of 1.3 million residents in a 342 square mile area. The City has experienced significant growth especially in the science and technology areas, and has gained the preeminent position of being known as "*Technology's Perfect Climat*e" and in downtown San Diego as "*Bandwidth Ba*y."

In response to the City's growth and its needs to provide more cost-effective government services through various channels, including electronic services delivery, the City embarked on a planning process to address its information technology directions. This process produced the Information Technology Strategic Plan (ITSP). The ITSP is intended to define the City's vision of the future for information technology and the key strategies for achieving this vision. It will provide Citywide guidance and direction for the management and development of IT within the City of San Diego over the next three to five years.

The ITSP recognized that wireless communication technology would significantly impact many aspects of the City's use of information technology, and posed many specific operational and technical issues apart from regular IT strategic planning concerns. Thus, the ITSP called for the development of a long-term plan for the City's use of wireless communications. This long-term plan is intended to provide Citywide guidance and direction for the City's wireless communications programs over the next ten years.

2.2 Long-Term Planning Goals and Objectives

The wireless communications long-term planning process was specifically designed to be inclusive, business-driven and consensus-based, as was the ITSP. The City engaged Tech/Knowledge, Inc., an independent telecommunications and information technology consulting firm to facilitate the planning process and perform required research and discussion in these contexts.

The specific goal for this process is:

- To define a phased implementation plan that meets the wireless communications requirements of the City of San Diego in a systematic and cost effective manner. In meeting this goal, consideration shall be given to assure that the City of San Diego is provided with systems that are state-of-the-art technologically.

The following are the City's key planning objectives:

- Develop a technically and operationally sound economic and progressive plan evolving from existing communications systems

and assets to meet service needs and requirement over the next ten (10) years to provide the City of San Diego with State-of-the-Art technology

- Develop and document wireless system needs and requirements for the next ten (10) years as seen by present wireless system users

- Document and evaluate existing radio system problems including reliability, coverage area, interference, interoperability, intermodulation, and channel loading that must be resolved in any new system growth plan

- Position the new radio system configuration to take evolutionary advantage of emerging land-mobile radio technology including digital voice and data, trunked or cellular radio considerations

- Position the new radio system configuration to make sure that interoperability is maintained with the County of San Diego Regional Communications System (RCS), associated users of the RCS and other fire and police mutual aid providers. The study should include all feasible and technological solutions for regionalized communications

- Position the new radio system configuration to include San Diego Unified School District, Poway Fire Department and the San Diego Community College District in the implementation plan. Assess the feasibility of adding other partners

- Assess current wireless initiatives and how they fit into the long-range plan and integrate to new network infrastructure(s) and technologies. The City of San Diego wants to limit the use of resources and technologies that do not fit into this long-range plan

- Expand or replace the existing City-owned and operated microwave network to incorporate radio system control requirements and high-speed digital data transmission capability to minimize exposure to rapidly escalating leased circuit costs

- Expand or replace the existing Police and Fire dispatch console systems and related equipment

- Develop a plan to replace current old and obsolete Police and Fire CAD equipment

- Survey VHF and 800 MHz equipment including mobile data terminals, pagers, radios and leased equipment and services for continued use and/or replacement

- Evaluate the need for special purpose communications equipment

- Study the feasibility of using the 700 MHz public safety spectrum for future system implementation

- Provide recommendations for upgrade and automation of Station 38 Dispatch Center

- Evaluate feasibility of establishing a public service answering point

- Develop a definitive multi-year system concept and implementation plan compatible with current and projected future system user needs, regulatory constraints and evolving 3G and other wireless technologies

- Provide a high level annual cost estimate for the various portions of the project

2.3 Key Stakeholders: End-User & Business Focus

To ensure the planning process properly addressed the needs of the City, extensive participation was sought from City stakeholders, including many end-users of the technology.

Ownership, guidance, and direction of the planning process was provided by the following:

- Information Technology Governance Committee (ITGC) – Comprised of department directors and other executives appointed by the IT Executive Team

- Chief Information Officer (CIO)

- Director, Information Technology and Communications (IT&C) Department -- Executive sponsor of the wireless communications planning process

- Deputy Director, Communications Division - Project Manager

The bulk of the input was provided by both internal and external stakeholders, including:

- Departmental Management and Operational Representatives
- San Diego Data Processing Corporation (SDDPC)
- San Diego Unified School District
- San Diego Community College District
- Poway Fire Department

The external agencies were involved in the process as users of the existing City radio system.

Extensive end-user and departmental interviews were held. Approximately 200 City end-users of wireless communications technology were interviewed in group settings. Detailed operational reviews to better understand specific departmental and divisional issues were held with the following City departments and divisions:

- Police
- Fire
- San Diego Medical Service Enterprise
- Lifeguard
- MWWD
- Water
- Environmental Services
- Streets Division
- Park & Recreation
- General Services
- Communications Division

Additional operational reviews were also conducted with each of the non-City users of the existing City radio system.

Wide-ranging technological and industry research into wireless communications technological and market trends was conducted. Leading San Diego-area firms engaged in the development of wireless communications technologies were also contacted for insights.

The Long-Range Planning Process consisted of the following tasks and sub-tasks:

Task 1: Conduct Orientation and Planning Sessions

- Conduct Initial Planning and Kickoff Session
- Interview & Brief IT Governance Committee
- Develop Strategic Issues List
- Identify Key Managers, Workgroups & Vendors
- Develop Final Project Work plan

Task 2: Perform Detailed Citywide Needs Assessment

- Document and Evaluate Existing City Radio Systems
  - Perform System Coverage Area & Reliability Study
  - Survey Existing VHF & 800 MHz Equipment
  - Quantify Intermodulation & Other Interference Issues
  - Review In-Place Console and Dispatch Systems and Technologies
  - Review Station 38 Operations and Technologies
  - Quantify All Costs of Operation and Ownership, Including Leased Circuit Costs
  - Identify Aging and Obsolete Systems and Equipment
- Identify and Document Existing Problems, Current and Future Needs
  - Interview Key Managers
  - Interview Key Workgroup Representatives
  - Interview System Engineers, Technicians and Managers
  - Interview Key Vendors
  - Review Current Wireless Initiatives
  - Review City Agencies Not Currently Using City Systems
- Expand & Refine Strategic Issues List
- Quantify Interoperability/Regional Communications Requirements and Issues
- Define Secure Communications Requirements
- Define Issues and Requirements for Public Service Answering Point
- Evaluate Issues in Supporting Existing Non-City Partners and Adding New Potential Partners

Task 3: Prioritize Needs & Requirements

- Collate Collected Data
- Identify and Evaluate Solutions and Directions
  - Study Feasibility of 700 MHz Spectrum
    - Evaluate Associated Regulatory Issues
  - Evaluate Technology Options
    - Identify "Bleeding Edge" Emerging Technologies
    - Identify "State-Of-The Art Technologies for:
      Public Safety Mobile Voice Communications
      Non-Public Safety Mobile Voice Communications
      Public Safety Mobile Data Communications
      Non-Public Safety Mobile Data Communications
  - Fixed Wireless Communications
    - Define Backhaul Issues
    - Define Other Fixed-Site Transport Requirements
    - Review Carrier-Provided Service Options
  - Dispatch and Console Systems and Technologies
  - City Paging System
  - Consider Options and Issues Involving Carrier-Provided Services
- Estimate Costs and Benefits

- Evaluate Business Cases
- Work With Staff to Prioritize Business Cases
- Evaluate Real Estate/Site Related Issues
- Quantify Support Issues for Communications Division
  - Network Management
  - Staffing Levels
  - Training
  - Parts
  - Test Equipment
- Analyze How Existing Initiatives Fit Into Developing Environment
- Analyze How To Integrate Existing Components Into New Plan

Task 4: Develop Master Plan

- Review Data Collected and Research Results
- Develop Strategic Vision, Goals and Objectives
- Develop Implementation Plan, Including Schedule
  - Immediate/Near Term Plan
  - Intermediate Term Plan
  - Long Range Plan
- Prepare Cost Estimates for Each Element of the Plan

Task 5: Present and Finalize Plan

- Present Draft Plan for Staff Review
- Gather Staff Review Comments
- Modify Plan as Required
- Present Revised Plan for Staff Review
- Modify Plan if Necessary
- Present Final Plan to IT Governance Committee

3. Business Environment

3.1 City Government

The City government is a large, complex organization that serves a growing, dynamic and diverse set of customers. These customers include the citizens, the business community, and City departments and programs. There are approximately 11,200 employees who provide services to an estimated 1.3 million citizens. These employees are organized into 24 City departments. Of the 24 departments, four are independent departments (i.e., Auditor & Comptroller, City Clerk, Personnel, and Retirement) who report to the City Council, an independent board, or a commission. The City Attorney is an elected official who leads the City Attorney's Office. In addition, there are four departments that generate direct revenues for the City and are primarily funded through "enterprise funds" (i.e., Water, Metropolitan Wastewater, Environmental Services, and Development Services).

Most departments obtain funding primarily from general funds and some, such as Library and Police, also have external funding sources. The City's total combined proposed budget for Fiscal Year 2003 is $2.1 billion, which represents a decrease of $257 million over Fiscal Year 2002. The City's organizational structure is illustrated in Figure 1 and Figure 2 on the following pages.

Within the City of San Diego, the Communications Division of the Information Technology and Communications Department (IT&C) provides primary service delivery for wireless communications. Communications Division employs approximately 51 full time staff. IT&C reports to the Office of Technology Services, which has a total staff of 3, headed by the CIO.

IT&C's FY 03 annual budget as it relates to the City's wireless communications projects and services is approximately $5 million. This supports the operational maintenance of the City's wireless communications infrastructure and subscriber equipment, representing over 34,130 devices.

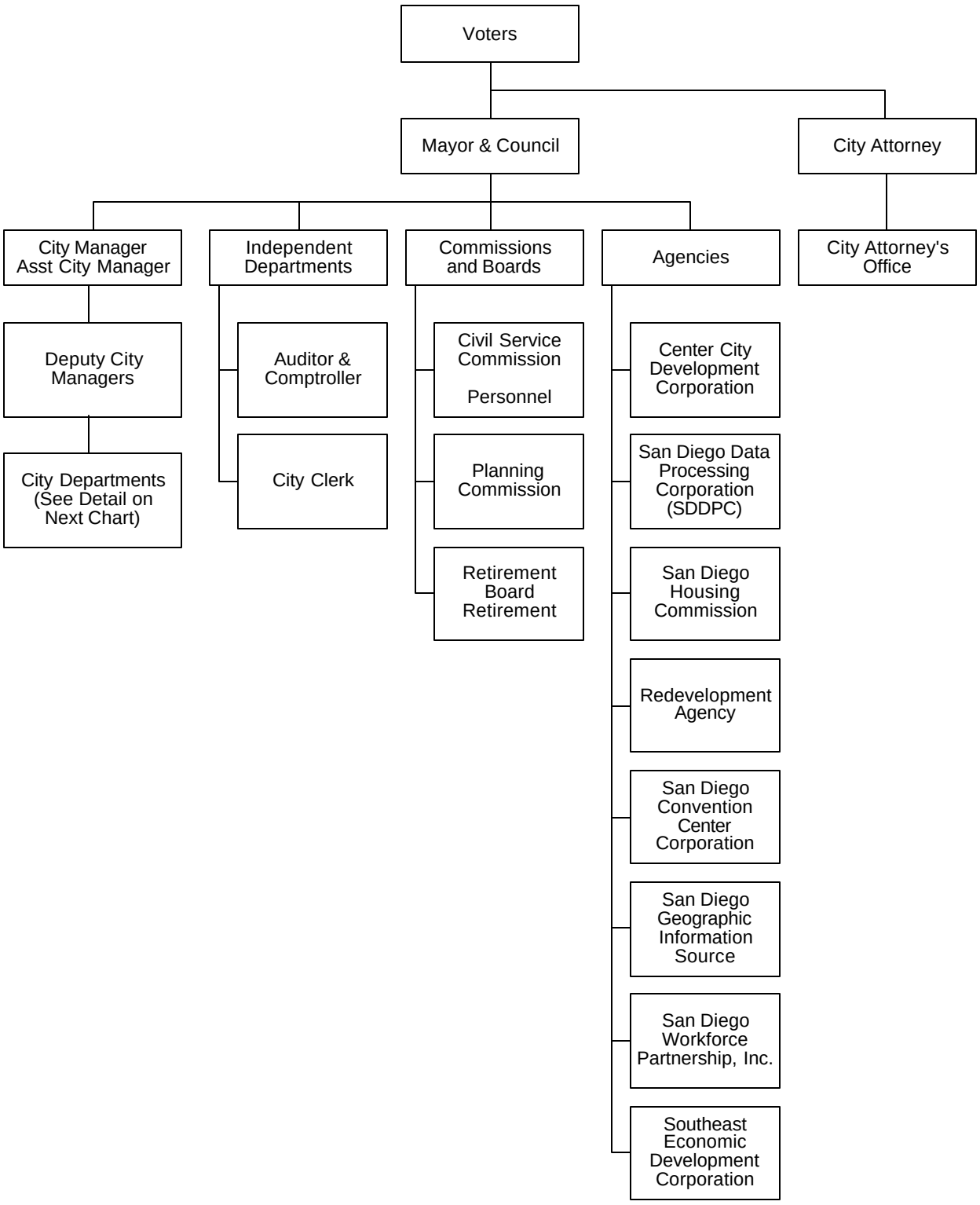

Figure 1. City of San Diego Overall Citywide Organizational Structure

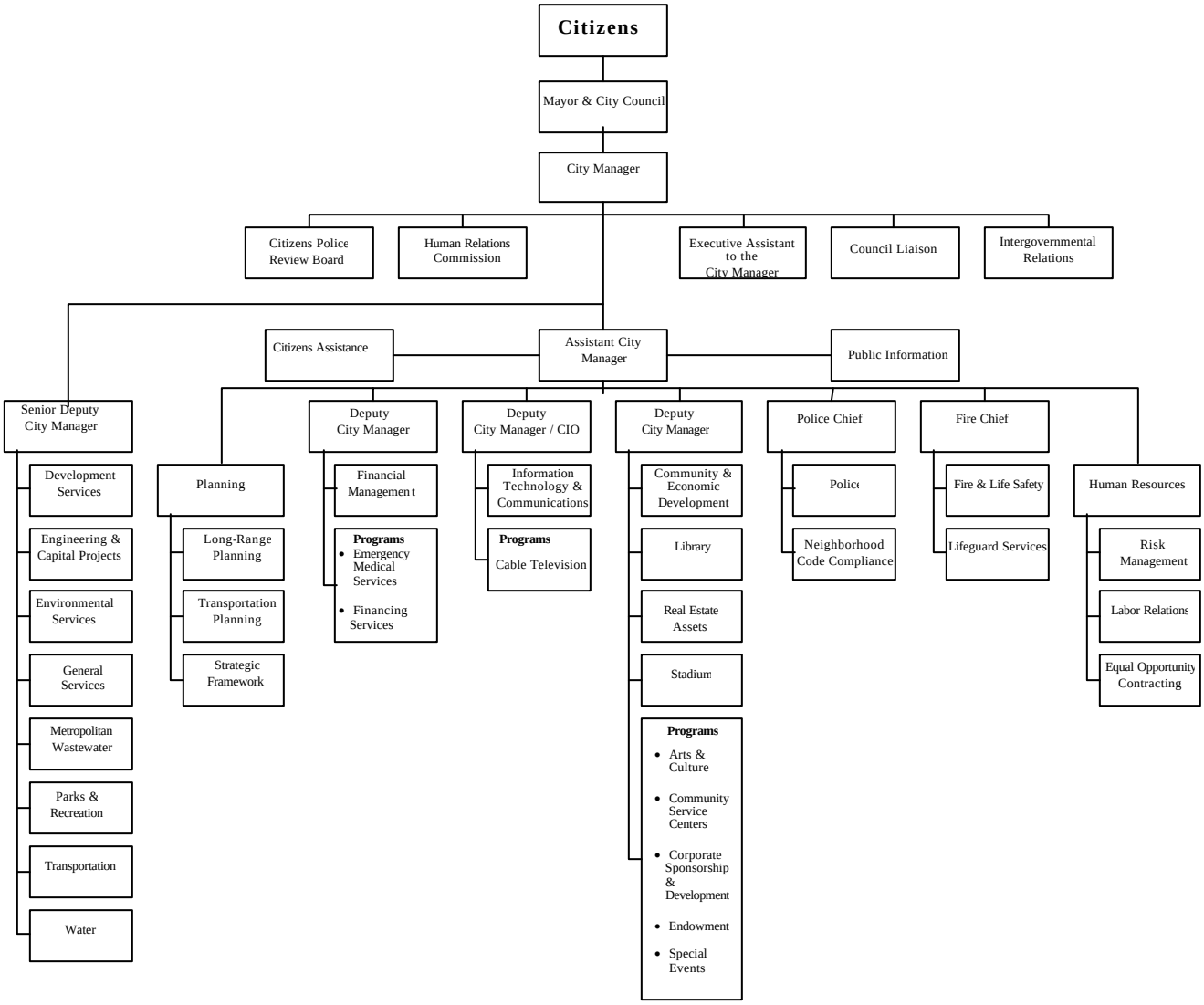

Figure 2. Detail City Departments Organization Under The City Manager

The City's vision, goals, and business drivers are described below.

3.2 City of San Diego Vision

In the State of the City Address on January 8, 2001, the Mayor defined "*A Vision for San Diego in the Year 2020: A City Worthy of Our Affection*." This vision is encapsulated in the Mayor's ten key goals for the City, as follows:

1. Establish an Ethics Commission	**6. Complete the Ballpark**
2. Reduce Traffic Congestion	**7. Build a Library System**
3. Create Neighborhoods We Can Be Proud Of	**8. Make San Diego America's Safest City**
4. Clean Up Our Beaches and Bays	**9. Pursue Energy Independence**
5. Restructure Regional Government/ Construct An Airport	**10. Complete MSCP Open Space Acquisitions**

3.3 Key Business Drivers

The IT Executive Team and IT Governance Committee identified the following six key business drivers that impact the City's IT strategic plan, and thus the Wireless Communications Long-Term Plan:

- **Improve City Services and Cost Effectiveness** – The City needs to continuously provide services in the most cost-effective manner while striving to improve its ability to react and respond to its citizens. These improvements should result in increased worker productivity and enhanced customer satisfaction. With the Mayor calling for San Diego to become a "*City of Villages*," significant investment in the provision of distributed City services will have to be made. Information technology requirements are a key factor to be considered in ensuring the effectiveness of this program. Use of information technology tools, like the provision of services on the Internet would increase the accessibility of City services across all regions.
- **Provide Excellent Citywide Communications Both Internally and Externally** – In the era of the Internet, the City is not only expected to be able to effectively communicate internally but also to facilitate effective communications with its external stakeholders and customers. This means that the City needs a baseline level of technology capabilities that enables seamless communications and ubiquitous access to data. In addition, as the City leads the efforts in restructuring regional government and building a new library system, the ability to effectively communicate and access information across the organization and with external agencies will become critical.
- **Improve Customer Access to City Information and Opportunity to Provide Feedback** – The City's citizens expect the ability to efficiently access City information, as well as provide feedback through different channels of communications (i.e., "high touch" and "high tech"). A recent survey indicated

that residents want the City to provide actual services, in addition to distributing information, via the City's Web site. The services perceived as most useful to be provided on the Web site were the ability to:

  - Request City services such as streetlight repair, road sign repair, or missed trash pick up
  - Check the status of requested services
  - Check water bill or meter reading
  - Access information and services provided by other government agencies, such as the County and state governments
  - Pay bills, fines or taxes

- **Facilitate Economic Development –** The City has successfully established, and will continue to establish strategic partnerships with businesses and the private sector. It will continue to be a business-friendly community and will ensure that the City's technology capabilities reflect the capabilities of the region. The City's technology infrastructure will support electronic commerce and a "one-stop" approach to eliminate any potential barriers to doing business with the City.
- **Accommodate Political Direction and Legislative Mandates –** The City has an obligation not only to its citizens but also to its elected officials to ensure compliance with legislative mandates and political directions. The Mayor is seeking to increase the confidence in City leadership by establishing an ethics commission. Information Technology can play an important role in helping to inform, educate and facilitate communication about ethical issues within the City and with the public.
- **Commitment to Public Health, Safety and Welfare** – The City's primary responsibility is to ensure the health and safety of its citizens. This is reflected by the Mayor's goals for making San Diego America's Safest City and cleaning up the City's beaches and bays. Information technology is crucial for public safety communications and automation of administrative processes. Information technology tools also aid in the tracking and monitoring of environmental pollution.
  - The City must respond to these business drivers with enabling technologies.

The remainder of this Long-Term Plan outlines how wireless communications technology will assist the City in meeting its business goals and objectives. The subsequent sections include the City's wireless communications vision, mission, and operating principles as well as wireless communications strategic goals, objectives, and associated initiatives for the next ten years.

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4. Wireless Communications Vision, Mission, Operating Principles and Business Requirements

4.1 Wireless Communications Vision and Mission

The City views information technology in general, and wireless communications in particular, as an enabling tool in achieving its business goals and objectives. Specifically, it is a tool that will facilitate transformation of the City's service delivery model for enhanced services to its citizens, and improve the effectiveness of City operations beyond the levels which can be achieved through wired technology. This improvement is achieved by permitting IT access directly at the point of service.

The wireless communications **Vision** statement drives the long-range plan by describing what the City must achieve to reach its full potential. The Vision articulates a destination for the City and reflects its high ideals as the City looks to the future.

The wireless communications **Mission** statement expresses the City's IT purpose and describes its role, responsibility and commitment in carrying out the Strategic Plan to ensure the realization of the City's wireless communications vision.

City of San Diego Wireless Communications Vision Statement

The City will use state-of-the-art wireless communications technology:

- **To provide the tools required for City employees to ensure the health and safety of the Citizens of San Diego**
- **To enable City employees to provide outstanding customer service to the Citizens by ensuring effective remote access to City information resources, regardless of location**

City of San Diego Wireless Communications Mission Statement

The City will:

- **Effectively manage and creatively use wireless communications resources to support and enable excellent and responsive municipal services**
- **Maximize the ability of City organizations to cooperate in the delivery of services to the Citizens through wireless technology**
- **Provide wireless technology suited to the potential life safety risk of its intended application**

The City's wireless communications infrastructure will:

- **Permit interoperability between the City and other agencies and levels of government**
- **Be adaptable to technological and regulatory changes**
- **Be adaptable to growth and evolving operational needs**
- **Enhance opportunities for partnerships in service delivery**

4.2 Key Operating Principles

The City will use the following key principles to guide decision making in respect to wireless communications:

City of San Diego Wireless Communications Operating Principles

Process

- Wireless communications initiatives will be aligned with the City's overall business goals and planned with a Citywide perspective
- A business case methodology will be used to plan for, and determine the business value of, wireless communications investments
- A formal method to gather and define functional requirements and business processes will be utilized in the evaluation and procurement of systems
- Provision will be made in the re-engineering of the City's business processes for integration with wireless communications technology appropriate to the application
- A formal method for the evaluation and acquisition of new technology will be used. This method must consider, at a minimum, impact on the business, total cost of ownership (TCO), vendor stability, technological and standards compliance
- Key performance measures will be defined to manage wireless communications systems and services for providing reliable and effective service
- Requirements for interoperability, both between City organizations and with other agencies at all levels of government, will be evaluated and considered in the design of all wireless communications systems

People

- Desired core competencies for City staff involved in wireless communications deployment and support will be defined and promoted through career paths and skills training
- Initial and ongoing training will be provided for all users of technology

Technology

- Commercial-off-the-shelf (COTS) technology will be the preferred solution. Departments will evaluate COTS technologies to ensure compliance with business processes. The City's Communications Division, and where appropriate, SDDPC, will evaluate COTS products and solutions to ensure compliance with technical standards. Modifications to COTS technology and software will be minimized
- The selection of technology systems involving single-source and proprietary solutions should be carefully considered, and only implemented if no viable alternative exists

4.3 High-Level Business Requirements

Extensive research was conducted to develop high-level business requirements that had an impact on the City's wireless communications strategies. This research effort included 24 focus groups with over 200 end users, discussions with each ITGC member, departmental interviews with each City wireless user department, and detailed requirements studies with the 11 key end-user departments. The following requirements provide the consistent themes articulated by City stakeholders in order of commonality among all groups.

a) Improve the City's wireless communications reliability and service

b) Improve trunked radio system coverage

c) Improve interoperability within departments and with outside agencies

d) Develop Virtual Private Network strategy for secure computer network access from remote locations

e) Improve public safety's mobile data network and AVL system

f) Improve dispatch capabilities

g) Increase capacity of microwave back-bone system

h) Improve City-owned paging system coverage and penetration

i) Increase capacity of trunked radio system

j) Develop replacement plans for obsolete wireless communication equipment and technology

k) Enhance each public service department's field response and customer service by providing a mobile data network

l) Establish wireless communication user training program

m) Develop a new joint Police/F&LSS Communications Center

n) Improve emergency operations center (EOC) radio and telephone control systems

o) Develop plan for a 3-1-1 non-emergency centralized call center and public service dispatch facility

p) Enhance disaster recovery by developing and maintaining emergency back-up systems

q) Develop City radio system interference reduction plans

The following section describes the City's key wireless communications strategic goals, objectives and initiatives to achieve the City's business goals and objectives and the vision for wireless communications.

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5. Strategic Priorities

5.1 Strategic Priorities

This section summarizes the City's strategic wireless communications priorities. Wireless communications strategic goals were defined to help achieve the City's Wireless Communications vision, mission, and business drivers. The matrix below summarizes the City's five Wireless Technology Goals and the objectives established to help achieve those goals. Key initiatives, both current and planned, have also been identified and linked with the strategic goals and objectives contained in the Information Technology Strategic Plan. This provides a mechanism for measuring the successful completion of the wireless communications initiatives in meeting the City's strategic goals and objectives. It also provides the City with a strategic framework for evaluating and prioritizing additional wireless communications initiatives in the future.

Wireless Technology Goal 1: Enhance dependability of City wireless communications systems and related elements	
While the City's wireless communications systems are currently quite reliable, most are no longer supported by the manufacturer and spare parts are becoming more difficult to obtain. Much work will be necessary to ensure they maintain or improve their current levels of dependability. Each of the initiatives planned addresses this key strategic goal. This goal addresses Strategic Goal 1 of the City's Information Technology Strategic Plan; Improve the delivery and cost-effectiveness of IT services.	
Objectives	**Initiatives**
1. Replace obsolete equipment & technology	1. Design, acquire and implement new digital microwave radio backbone 2. Update City paging system 3. Utilize state-of-the-art commercial wireless data (short term solution) 4. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 5. Upgrade and expand SCADA networks 6. Design, acquire and implement new City radio system and control equipment 7. Design, acquire and implement new CAD systems 8. Improve communications technical support capabilities 9. Design, acquire and implement new fire station alerting network and hardware

Objectives	Initiatives
2. Improve system coverage and penetration	1. Update City paging system 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Upgrade and expand SCADA networks 5. Design, acquire and implement new City radio system and control equipment 6. Improve communications technical support capabilities 7. Enactment of a signal booster ordinance
3. Reduce interference potential	1. Design, acquire and implement new digital microwave backbone 2. Update City paging system 3. Utilize state-of-the-art commercial wireless data (short term solution) 4. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 5. Upgrade and expand SCADA networks 6. Design, acquire and implement new City radio system and control equipment 7. Improve communications technical support capabilities
4. Provide enhanced security of communications	1. Develop & implement remote network access methodology 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Design, acquire and implement new City radio system and control equipment

Objectives	Initiatives
5. Permit rapid restoration of failed sites	1. Design, acquire and implement new City radio system and control equipment 2. Improve communications technical support capabilities
6. Ensure critical public safety communications capability inside of structures.	1. Update City paging system 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Design, acquire and implement new City radio system and control equipment 5. Enactment of a signal booster ordinance

Wireless Technology Goal 2: Ensure adequate system capacity for the timely delivery of information

The evolving demands for mobile access to information will place significant burdens on the City's wireless communications infrastructure. Endeavors such as water system expansion, replacement of existing mobile data networks, and the rollout of automatic vehicle location technology to additional users mandates this expansion.

This goal addresses the following Strategic Goals of the City's Information Technology Strategic Plan:

- ITSP Strategic Goal 1: Improve the delivery and cost-effectiveness of IT services
- ITSP Strategic Goal 3: Establish the technical infrastructure to provide electronic service delivery channels to citizens and facilitate economic growth
- ITSP Strategic Goal 4: Improve internal City operations and management's ability to make informed decisions

Objectives	Initiatives
1. Increase reliable high-speed fixed data capacity	1. Design, acquire and implement new digital microwave radio backbone 2. Upgrade and expand SCADA networks 3. Improve communications technical support capabilities
2. Provide reliable, public-safety-grade mobile data capacity to support IP-based applications	1. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new City radio system and control equipment 4. Design, acquire and implement new CAD systems & radio consoles 5. Improve communications technical support capabilities
3. Provide infrastructure which allows new higher-speed paging technology to be rolled out	1. Design, acquire and implement new digital microwave backbone 2. Update City paging system
4. Address strategic operational requirements of user departments	1. Design, acquire and implement new digital microwave backbone 2. Develop & implement remote network access methodology 3. Update City paging system

Objectives	Initiatives
4. Address strategic operational requirements of user departments (continued)	4. Utilize state-of-the-art commercial wireless data (short term solution) 5. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 6. Upgrade and expand SCADA networks 7. Design, acquire and implement new City radio system and control equipment 8. Design, acquire and implement new CAD systems & radio consoles 9. Build new Public Safety dispatch facility 10. Convert existing Fire Comm Center to multi-function Public Service Comm/3-1-1 call center/Public Safety training/facility 11. Improve communications technical support capabilities
5. Permit expansion of dynamic dispatch and AVL applications	1. Design, acquire and implement new digital microwave backbone 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Design, acquire and implement new CAD systems & radio consoles
6. Provide additional voice communications user capacity	1. Design, acquire and implement new digital microwave backbone 2. Design, acquire and implement new City radio system and control equipment 3. Design, acquire and implement new CAD systems & radio consoles 4. Build new Public Safety dispatch facility 5. Convert existing Fire Comm Center to multi-function Public Service Comm/3-1-1 call center/Public Safety training/facility 6. Improve communications technical support capabilities
7. Provide high-capacity voice, data and video communications capacity for events	1. Improve communications technical support capabilities

Wireless Technology Goal 3: Provide City field forces access to appropriate City information resources regardless of location

If City staff are provided access to City information resources in the field, significant benefits will accrue. Improvements in both the overall productivity of City staff and in the quality of the services they provide can be expected. While many of these benefits will be cost-saving, as providing water maintenance staff with the exact routing of a water main, many will be life-saving, as providing fire fighters access to hazardous materials usage and pre-fire planning documents.

This goal addresses Strategic Goal 4 of the City's Information Technology Strategic Plan: Improve internal City operations and management's ability to make informed decisions.

Objectives	Initiatives
1. Increase reliable fixed high-speed data capacity	1. Design, acquire and implement new digital microwave radio backbone 2. Improve communications technical support capabilities
2. Provide access to City network from off-site locations	1. Develop & implement remote network access methodology
3. Provide reliable, public-safety-grade mobile data capacity to support IP-based applications	1. Design, acquire and implement new digital microwave backbone 2. Develop & implement remote network access methodology 3. Utilize state-of-the-art commercial wireless data (short term solution) 4. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 5. Design, acquire and implement new CAD systems & radio consoles 6. Improve communications technical support capabilities
4. Provide interdepartmental electronic workflow	1. Convert existing Fire Comm Center to multi-function Public Service Comm/3-1-1 call center/Public Safety training/facility
5. Provide more information at time of initial dispatch	1. Design, acquire and implement new fire station alerting network & hardware 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Design, acquire and implement new CAD systems & radio consoles

Wireless Technology Goal 4: Provide improved interoperability both between City departments and between City departments and outside agencies

For the City to reach the level of operating efficiency that it seeks, City departments must be able to cooperate effectively in the delivery of services, both on a routine and an emergency basis. Likewise, City departments need to be able to cooperate and interoperate with a wide range of other agencies on a daily basis.

This goal addresses the following Strategic Goals of the City's Information Technology Strategic Plan:

- ITSP Strategic Goal 1: Improve the delivery and cost-effectiveness of IT services
- ITSP Strategic Goal 3: Establish the technical infrastructure to provide electronic service delivery channels to citizens & facilitate economic growth
- ITSP Strategic Goal 4: Improve internal City operations and management's ability to make informed decisions

Objectives	Initiatives
1. Provide access to City network from off-site locations	1. Develop & implement remote network access methodology
2. Provide appropriate levels of security and privacy of communication	1. Develop & implement remote network access methodology 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Design, acquire and implement new City radio system and control equipment
3. Provide reliable, public-safety-grade mobile data capacity to support IP-based applications	1. Design, acquire and implement new digital microwave backbone 2. Develop & implement remote network access methodology 3. Utilize state-of-the-art commercial wireless data (short term solution) 4. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 5. Design, acquire and implement new CAD systems & radio consoles 6. Improve communications technical support capabilities

Objectives	Initiatives
4. Address strategic requirements of user departments	1. Design, acquire and implement new digital microwave backbone 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution)
5. Provide interoperability between Police and Fire/EMS CAD systems	1. Design, acquire and implement new CAD systems & radio consoles
6. Provide back-up City EOC space away from downtown in event of large-scale emergency	1. Build new Public Safety dispatch facility
7. Provide interdepartmental electronic workflow	1. Convert existing Fire Comm Center to multi-function Public Service Comm/3-1-1 call center/Public Safety training/facility
8. Improve City's ability to respond to large-scale emergencies	1. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new City radio system and control equipment 4. Design, acquire and implement new CAD systems & radio consoles 5. Build new Public Safety dispatch facility 6. Convert existing Fire Comm Center to multi-function Public Service Comm/ 3-1-1 call center/Public Safety training/facility 7. Improve communications technical support capabilities

Wireless Technology Goal 5: Improve the delivery and end-user value of City wireless communications services

City wireless communications programs touch nearly every City department. Through improving their value, quality and cost-effectiveness, and enabling information access where none was possible before, the City can achieve significant improvements in key areas. Specifically, the quality of services delivered, community responsiveness and overall productivity will increase.

This goal addresses the following Strategic Goals of the City's Information Technology Strategic Plan:

- ITSP Strategic Goal 1: Improve the delivery and cost-effectiveness of IT services
- ITSP Strategic Goal 3: Establish the technical infrastructure to provide electronic service delivery channels to citizens and facilitate economic growth
- ITSP Strategic Goal 4: Improve internal City operations and management's ability to make informed decisions

Objectives	Initiatives
1. Increase reliable high-speed data capacity	1. Design, acquire and implement new digital microwave backbone
2. Provide access to City network from off-site locations	2. Develop & implement remote network access methodology
3. Provide appropriate levels of security and privacy of communication	1. Develop & implement remote network access methodology 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Design, acquire and implement new City radio system and control equipment
4. Provide a consistent user interface	1. Develop & implement remote network access methodology
5. Improve system coverage and penetration	1. Update City paging system 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Upgrade and expand SCADA networks 5. Design, acquire and implement new City radio system and control equipment 6. Improve communications technical support capabilities 7. Enactment of a signal booster ordinance

Objectives	Initiatives
6. Provide reliable, public-safety-grade mobile data capacity to support IP-based applications	1. Design, acquire and implement new digital microwave backbone 2. Develop & implement remote network access methodology 3. Utilize state-of-the-art commercial wireless data (short term solution) 4. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 5. Design, acquire and implement new CAD systems & radio consoles 6. Improve communications technical support capabilities
7. Address strategic requirements of user departments	1. Design, acquire and implement new digital microwave backbone 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution)
8. Reduce interference potential	1. Design, acquire and implement new digital microwave backbone 2. Update City paging system 3. Utilize state-of-the-art commercial wireless data (short term solution) 4. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 5. Upgrade and expand SCADA networks 6. Design, acquire and implement new City radio system and control equipment 7. Improve communications technical support capabilities

Objectives	Initiatives
9. Improve network reliability	1. Design, acquire and implement new digital microwave backbone 2. Update City paging system 3. Utilize state-of-the-art commercial wireless data (short term solution) 4. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 5. Upgrade and expand SCADA networks 6. Design, acquire and implement new City radio system and control equipment 7. Improve communications technical support capabilities
10. Reduce costs of network operation and administration	1. Upgrade and expand SCADA network
11. Permit expansion of dynamic dispatch and AVL applications	1. Design, acquire and implement new digital microwave backbone 2. Utilize state-of-the-art commercial wireless data (short term solution) 3. Design, acquire and implement new public-safety wide area mobile data network (long term solution) 4. Design, acquire and implement new CAD systems & radio consoles
12. Support Mobile 9-1-1 "Phase II" Automatic Location Information 13. Improve flexibility and capacity of radio system control tools 14. Provide interoperability between Police and Fire/EMS CAD systems	1. Design, acquire and implement new CAD systems & radio consoles
15. Replace space-restricted Station 38 facility 16. Provide 3-1-1 call-taking center 17. Provide back-up public safety communications facilities 18. Provide public safety communications training facility	1. Convert existing Fire Comm Center to multi-function Public Service Comm/3-1-1 call center/Public Safety training/facility

Objectives	Initiatives
19. Address law enforcement radio tracking needs 20. Provide high capacity on-site voice, data and video communications capacity for events	1. Improve communications technical support capabilities
21. Improve quality of end-user communications training on a City-wide basis, thereby increasing the effectiveness and productivity of the City's investment in communications infrastructure	1. Improve communications training capabilities
22. Provide more information at time of initial dispatch 23. Decrease stress on first responders, particularly on overnight responses	1. Design, acquire and implement new fire station alerting network and hardware

6. Current Wireless Communications Organizational Environment

6.1 Overview

The vast majority of the City's wireless communications activities are directed by, or coordinated through the Communications Division (Division) of the Information Technology and Communications Department. No other City department maintains any staff whose principal job function entails the management or maintenance of wireless communications infrastructure or subscriber equipment. There are no changes envisioned in this regard throughout the time scale covered by this plan.

6.2 Division Description

The Division is part of the Information Technology and Communications Department. It provides wireless communications services and support to the City of San Diego and other governmental agencies through its extensive microwave network, conventional and trunked two-way radio systems, multiple-address and digital spread-spectrum SCADA telemetry networks, Citywide paging network and a variety of mobile data networks. The Division is responsible for initial design, implementation, and ongoing maintenance of these systems. Staff also performs design, installation, and maintenance on a variety of non-wireless technologies, including audio distribution systems, video systems and overhead paging systems. They also oversee contracts for commercially provided wireless services, including cellular telephones and Cellular Digital Packet Data services (CDPD), as well as other similar services.

The Communications Division consists of three primary operating groups:

1) **Communications Management and Support;** providing Division direction and planning, budget preparation/fiscal management, and clerical support to the entire Division.
2) **Communications Engineering and Support Services;** reviews wireless needs of City, provides system engineering and is primary liaison with Federal Communications Commission for all of the City's radio licenses.
3) **Maintenance of Electronic and Communications Equipment;** provides daily monitoring of communications networks, performs all radio communication equipment installations (mobile and fixed base), performs regular preventive maintenance and repair or coordinate repair of all devices/radios on their networks including remote data systems for SCADA use. Currently, it is estimated that the Division maintains over 34,300 wireless devices.

6.3 Expense Breakdown

Cost Categories	FY 01 Actual	FY 02 Actual	FY 03 Budgeted
Personnel	$3,323,163	$3,581,703	$3,995,598
Non-Personnel	$1,084,141	$1,009,528	1,052,826
TOTAL	**$ 4,407,305**	**$ 4,591,231**	**$ 5,048,424**
Personnel as % of Total	**75.4%**	**78%**	**79.1%**

TABLE 1 - COMMUNICATIONS DIVISION PERSONNEL VS. NON-PERSONNEL COST CATEGORIES

Category	Cost	Percentage
Personnel[1]	$3,323,164	75.2
Miscellaneous	98,816	2.6
DPC (non-phone)	68,447	1.4
Utilities (non-phone)[2]	216,112	4.8
Telephone	37,584	0.9
Motive Equipment	127,782	2.9
Cellular Telephone Related[3]	6,771	0.2
Parts/Sub-Assemblies	255,370	5.8
Outside Services	149,855	3.4
Training/Education	13,523	0.3
Non-Capital Outlay	29,709	0.7
Capital Outlay	57,112	1.3
Master Lease (not radio sites)	23,059	0.5
TOTAL	**$ 4,407,305**	**100%**

TABLE 2 - FY 00-01 COST DETAIL BY CATEGORY

NOTES:

Note 1: The majority of Division costs are personnel, which account for 75% to 80% of the Division total.

Note 2: Significant increase noted in utility costs from previous year (91% increase). This appears to be due to higher energy costs. All other categories and line items (except cellular telephone, see Note 3 below) had either marginal increase, or in some cases, a slight reduction.

Note 3: Costs involving cell phones also increased to $6,771 from Fiscal Year 1999-2000 which is attributed to an increase of cellular telephone use by the Division.

Note 4: Detailed financial information for the current fiscal year was not available.

6.4 Division Staffing

Position Title	FY 02	Budgeted for FY 2003
Account Clerk	1.00	1.00
Senior Management Analyst	1.00	1.00
Associate Communications Engineer	2.00	2.50
Senior Communications Engineer	1.00	1.00
Senior Communications Technician Supervisor	1.00	1.00
Communications Technician	24.30	25.09
Communications Technician Supervisor	4.00	4.00
Equipment Technician I	4.54	4.29
Equipment Technician II	1.00	1.00
Electronics Technician	-	2.00
Payroll Specialist II	1.00	1.00
Senior Communications Technician	7.00	7.00
Executive Secretary	0.01	0.01
Senior Clerk/Typist	1.00	1.00
Department Director	0.50	0.50
Deputy City Manager	0.01	0.01
Deputy Director	1.00	1.00
TOTAL EMPLOYEES (FTE)	**50.36**	**53.40**

TABLE 3 - PERSONNEL POSITIONS AND COST ALLOCATION FOR FY 2002 AND FY 2003

6.5 Facility and Network Ownership

The primary network infrastructure utilizes 20 remote sites, all located on City-owned property in City-owned buildings and tower structures, with the exception of Mount Soledad, Black Mountain and Lyons Peak. Property is leased from the Navy on Mount Soledad, Pacific Bell on Black Mountain, and the United States Department of Agriculture on Lyons Peak. All equipment is fully owned by the City. These three sites are all considered essential to the City's wireless network, and would continue to be required in virtually any conceivable new network design. These costs are contained in the budget category "Outside Services".

Facility	Annual Lease Cost
Mount Soledad	$31,047
Black Mountain	$10,262
Encanto	$3,000
Lyons Peak	$180
TOTAL	**$44,489**

TABLE 4 - ANNUAL LEASE COST ESTIMATE FOR FY 2003

6.6 Use of Leased Circuits

The City utilizes a number of commercially-provided dedicated telephone circuits commonly known as "leased lines." The City microwave network, since its installation, has replaced many of these circuits. However; several circuits remain (a minimum of eight circuits have been identified as being integral to the City's wireless network), including several paths to/from the City Operations Building (COB) for use by the Police and Fire Departments, Lifeguard Headquarters to/from Point Loma Wastewater Treatment Plant for Lifeguard operations, Country Club Heights to/from Mount Soledad, and Chollas to/from Miramar for Environmental Services radio support, etc. The cost to operate leased lines depends on circuit type (dictated by use) and the distance/routing of the circuits. These circuits cost between $ 45-120 per month per circuit. The City's current use of these wireless network related circuits is considered essential and each will be reviewed for potential replacement by a fixed wireless link or microwave path, if cost effective, in future phases of the strategic planning process.

The City also employs several other leased lines (approximately 30) for distribution of City Council meeting audio. A significant dial-access modem pool for to the Citywide paging system also exists. These costs are contained in the budget category "Telephone".

6.7 Cost Allocation

The majority of the expenses related to specific radio systems, engineering projects, and direct maintenance time (such as those relating to the Metropolitan Wastewater Department SCADA system) contained in the Department's budget are subsequently allocated to the appropriate City department.

6.8 Cost/Benefit

The following analysis shows that the Information Technology & Communications Department's internal operations are quite cost-effective when compared to the alternative of using external vendors.

Although there may be other scenarios that show an outsource advantage, the cost issue is arguably secondary when considering the highly life-safety-sensitive nature of many of the systems supported by the Division. Hence, the use of outside vendors and commercially provided networks would need to be carefully weighed against the City's need to maintain primary operational control and accountability for their performance.

The table below provides a rough estimate of the cost to outsource the City's wireless systems support, based on recent vendor pricing.

Equipment Type	Quantity	Typical Unit Monthly Maintenance Cost	Total Annualized Cost
AVL	288	$20	$69,120
Cellular Phones	2,170	1.5	39,060
Fixed Equipment	1,309	45	706,860
MDT's	786	55	518,760
Laptops/MDC's	1,500	75	1,350,000
Mobile Radios	5,172	10.5	651,672
Microwave Equipment	322	110	425,040
Pagers	6,123	1.5	110,214
PA/Sirens	1,960	20	470,400
Portable Radios	7,972	10.5	1,004,472
Other/Misc. Equipment	6,727	10	807,240
Total Cost Before Admin.			**$6,152,838**

Table 5 - Rough Estimated Costs of Outsourcing Wireless System Maintenance

As the above quoted costs do not provide for the costs of system administration, engineering and management that would be required regardless whether or not service was outsourced, it is quite clear that the Communications Division provides cost-effective service to the City at a very favorable cost compared to typical outside vendor pricing.

6.9 Accountability and Fiscal Compliance

Historically, the Division's cost control and fiscal compliance has been very good. Expenses have been consistently within budget.

The Communications Division is not only fiscally accountable to the City and City Council, but it is also accountable to the various departments that utilize the wireless networks they provide (their internal customers). During user and department interviews, all supported departments, agencies and end users were very satisfied with the Division's service and basic system performance.

6.10 Governance Framework

Governance is the institutionalization of a process that guides how individuals and groups cooperate to manage technology. It provides a framework for making wireless communications decisions. The overall objective and role of technology governance is to ensure that the City's technology resources are targeted at and deliver maximum business value.

The management practices utilized by the City for Information Technology (as a whole) and Wireless Communications (as a subset) are exact opposites of each other. Where each department is largely independent in many respects in Information Technology issues, the City's wireless communications services are managed in their essential entirety by the Communications Division.

This centralization mandates a strong customer focus on the part of Communications Division management to ensure the diverse needs of the various City departments are properly addressed.

To help Communications Division management maintain communications with the end-user departments, the "Wireless Technology Group" has been established as a part of the overall City IT governance framework. This group's mission is to review wireless initiatives and ensure proper alignment with departmental needs and general City goals.

Project management issues will generally be addressed within Communications Division, with assistance as required from the City Project Management Office.

7. Current Wireless Communications Technical Environment

7.1 Existing System Overview

7.1.1 Citywide Trunked Radio System

7.1.1.1 General

The primary City radio system is a 19-Channel Motorola Smartnet II Trunked Radio System, utilizing analog transmission on frequencies in the 800 MHz band. This system was initially acquired in October 1990, and first placed into service in September 1992.

The system services over 16,400 radios among 24 user departments and external user groups, and hosts over 385 talkgroups, or virtual channels, on the system. Of these radios, approximately 8,300 are in direct use by City Departments and contract users. The balance are employed for interoperability, and inter-agency communications.

The system operates in simulcast transmit mode from seven sites. These sites are:

- Black Mountain
- City Administration Building
- Cowles Mountain
- Encanto
- Mt. Soledad
- San Ysidro
- Whitman Ranch (North City Site)

All 19 channels are in use at all sites, with the exception of the North City Site, where only 7 channels are in use. No receive-only sites are currently employed. The prime site, home of the system's central controller, is located at Police Headquarters adjacent to the Dispatch Center.

This system serves as the primary public safety radio communications system for the City, serving both Police and Fire & Life Safety Services. Several other City departments depend on the system, including:

- Water
- Metropolitan Wastewater
- Park & Recreation (Park Rangers & Beach Maintenance Only)
- Information Technology & Communications
- Development Services – Building Inspection Division
- Neighborhood Code Compliance

A number of external agencies also contract with the City to use this system as their primary radio communications system. These include:

- San Diego Unified School District (SDUSD)
- San Diego Community College District Police
- City of Poway Fire Department
- San Diego Medical Services Enterprise

7.1.1.2 System Technology

Many of the key components of the system are now technologically obsolete. However, as of this writing, most critical elements are still available from Motorola, and the system is still fully supported by them. Motorola has not announced so-called "end-of-life" plans for the analog Smartnet II technology used in the system, so it cannot be predicted with any accuracy when support of the existing system is likely to become problematic.

7.1.1.3 System Capacity and Traffic

Despite the high number of users per channel, the system traffic levels are not unreasonable. Federal Communication Commission regulations provide for a loading standard per channel for trunked radio systems of 100 users per channel. The City's system has over 415 primary users per channel, by comparison.

Despite these high levels of users per channel, the system provides good service. In 2001 (the most recent year for which data is available), the system carried over 35,590 hours of traffic, while only being completely busy for a total of 3 hours and 7 minutes. On the system's peak traffic day, the system carried 125.5 hours of traffic, while only being busy for 7 minutes and 36 seconds. This is a blockage rate of 0.017%, a very high level of service indeed. For comparison, an E-911 system is designed for 0.1% blockage, the Public Switched Telephone Network is designed for 1% blockage, and most public wireless telephone networks are designed for 5% blockage. This higher rate for the City's system is fully justified by the routinely life-safety-sensitive nature of the communications it carries.

This figure represents only total system channel blockage, and not individual talkgroup activity. For example, the Police "INQUIRY" talkgroup is quite active, and is often tied up with several officers waiting to make inquiries; however, this limitation is imposed by the number of operators available for the task and the number of officers sharing the talkgroup, not radio system capacity. Further, the system may be unable to process every call attempted during peak hours due to system processor capacity. While objective data does not support this concern, some observers suggest that the capacity of the older technology main system processor in use by the City may not be high enough to keep some calls from getting "lost". This is generally not a major problem, as the user need only re-key and will likely be able to talk with only a second or two of delay. This does, however, point up a concern for the long-term capability of the system to support additional traffic (by adding frequencies) or improve system coverage (by adding sites) as either action will only add workload to the main processor.

Further, many of the perceived delays reported in the end-user interviews are due to a large number of users utilizing a single talkgroup, causing a "busy channel" and delaying a user's ability to place a time-sensitive call. While this problem can be easily addressed by dividing up user communities into additional talkgroups, the issue then arises (especially for police) of users needing to scan multiple talkgroups to receive all of the traffic they need to hear to properly respond to incidents in their areas.

While this figure represents that the system provides a high level of service under normal operating conditions, it also raises concerns about the system's ability to perform (from a traffic perspective) in the event of a large-scale, City-wide emergency. The system does provide priority access for public safety, maximizing their ability to obtain quick channel access during busy periods.

7.1.1.4 System Coverage

The topography of the City of San Diego is some of the most challenging in the world to cover successfully with any radio technology. These coverage difficulties led to San Diego being the first large city in the U.S. with extensive cable TV penetration, decades before most other major cities.

When the system was originally planned in the late 1980's, Communications Division undertook a careful design process in conjunction with the system's manufacturer, Motorola, to ensure the system would provide reasonable coverage inside of ordinary structures. Extensive testing by the Communications Division verified that the system coverage met the agreed-upon standards prior to acceptance. However since the system's implementation in 1991, the City has experienced many changes in its appearance through its rapid growth and construction projects. This combined with substantial growth in other nearby 800 MHz radio systems has changed the effectiveness of the system today.

These factors have combined to degrade the overall in-building coverage reliability of the system, a circumstance that can only be successfully addressed in the long term through the addition of sites.

Areas of reported coverage concerns in outdoor areas include the following:

- Monument Road south of Vista Del Estero along the border fence and in the canyons
- Otay Mesa: Spring Canyon, Dillon's Trail west of the following streets; Siempre Viva Road, Cactus Court
- Calle De Linea
- The foot of Ladera Street south to the end of Point Loma

- The vicinity of Fire Station 33 and along the immediate area east of I-15
- Sorrento Valley

- San Pasqual Valley
- North side of Mission Valley
- East County areas East of El Cajon
- Sunset Cliffs
- Torrey Pines City Beach
- From La Jolla Cove south, the small cove areas, close to the cliffs
- Cove pockets on the beach and by the cliffs from Boomer to North Bird Rock
- Marine Beach and Windansea Beach
- Ducting effects around the Children's Pool Lifeguard Station

The system also provides marginal coverage inside many large buildings, and poor coverage in most high-rises; it is infeasible to design a system that guarantees good coverage in such structures. Many below-grade areas, canyons and arroyos are also problematic, due largely to the same issues previously discussed.

7.1.2 Mobile Data Network

7.1.2.1 System Description

The City operates a Mobile Data Network for public safety operations. At the time the system was purchased, it represented the absolute state-of-the-art, highest-performance mobile data system available. However, Motorola, the system's manufacturer, has since discontinued support for the technology in use by the City. This system provides terminal-type access for Police and Fire/EMS personnel to information in the Computer-Assisted Dispatch systems operated by the City. Police personnel are also provided with field access to a variety of law enforcement databases accessible through ARJIS, the Automated Regional Justice Information System. These devices are terminals only; they have no internal processing capability whatsoever.

7.1.2.2 System Technology

The existing City-owned Mobile Data Network utilizes a now-obsolete Motorola proprietary system architecture operating at 4800 bits per second in the 800 MHz band. This system utilizes 7 base stations, each operating on a discrete frequency. These base stations are located on the following sites:

- Black Mountain
- City Administration Building
- Cowles Mountain
- Encanto
- Mt. Soledad
- San Ysidro
- Whitman Ranch (North City Site)

As mobile units move about, they automatically change radio frequencies and seek the best signal as they move between site coverage areas, or as traffic gets too high on a given channel.

7.1.2.3 System Use

There are approximately 850 mobile devices operating on this network. It services the Police Department and the Fire & Life Safety Services Department (F&LSS). No other City departments utilize the system. Traffic is heavy, and users report frequent transmission delays. This is annoying to police officers running a license plate, but is highly problematic for Fire and Life Safety Services. The Fire & Life Safety Services Department utilizes the system to transport Automatic Vehicle Location (AVL) information. With this information being used to make dynamic dispatch decisions regarding what unit to dispatch on a call, these delays could place lives at risk. These delays may contribute to dynamic dispatch processing delays reported by Fire Communications personnel. If this system were to fail completely for any reason, F&LSS would lose their capability to dynamically dispatch.

At the time the system was initially designed and bid, the system serviced only the Police Department. F&LSS users were subsequently added. Finally, the network was used to carry F&LSS AVL transmissions needed to enable dynamic dispatch. Due to a lack of available spectrum in Southern California, it was not possible to add frequencies to support this additional traffic. When the growth of the community and increased demand for services are factored in, it is clear why system performance has degraded to its current level.

7.1.2.4 System Coverage

The system is intended to provide vehicle-based coverage of the entire City. While this is a far easier task than providing portable radio coverage, dead spots still exist.

Reported areas of marginal coverage include the following:

- Otay Mesa: Spring Canyon, Dillon's Trail west of the following streets; Siempre Viva Road, Cactus Court
- The vicinity of Fire Station 33 and along the immediate area east of I-15
- Sorrento Valley
- San Pasqual Valley
- East County areas East of El Cajon

7.1.2.5 Areas of Known Concern

These devices are no longer manufactured or even supported by Motorola. Parts are no longer available from Motorola, as well. The City has been forced to acquire components in the secondary market to keep this system running. This effort has been successful to date, but there is no guarantee of ongoing success.

7.1.3 VHF Radio Systems

7.1.3.1 System Description

The City of San Diego's VHF high band radio systems, at one time the City's primary mobile communications resource, is still quite extensive. Although the majority of the users have migrated to the 800 MHz trunked system, these VHF systems continue to provide highly dependable service despite equipment that is quite old. Consisting of multiple mountain-top and close-in radio sites and a large number of mobile/hand-held radios, the system still supports many City departments including Transportation, Water, Environmental Services, General Services, Park and Recreation (except Park Rangers and Beach Maintenance, who are on the Trunked System), Library, F&LSS, and Police. F&LSS and Police Department now utilize VHF almost exclusively for mutual aid operations.

The primary remote sites for the 800 MHz trunked radio system also use a simplex VHF frequency to override the trunked radio system's controller and provide 800 MHz users backup operation in the event of a major system failure.

7.1.3.2 System Technology

The radio system consists of a wide variety of equipment manufacturers and age. Unlike trunked radio systems, the technology utilized in this system (and most VHF high band radio systems) has not changed rapidly. Older radios can continue to function properly for many years with proper maintenance, although some components are no longer manufactured.

7.1.3.3 System Use

F&LSS operates four simplex VHF frequencies. Two frequencies were previously used as dispatch and tactical channels and are currently used for fire ground and mutual aid. The Governor's Office of Emergency Services (OES) sponsors a statewide VHF simplex mutual aid channel known by most fire fighters as the "White Channel." White 1 is the key communications element of the Fire Mutual Aid Plan, and is used to coordinate fire equipment that has responded from other fire agencies. This frequency is often the only mutual aid channel available, particularly if the responding fire unit was from outside of the county, or is from an agency that operates primarily in the VHF range, such as the California Department of Forestry, the United States Forest Service, or the United States Bureau of Land Management. A fourth frequency is a countywide simplex mutual aid channel known within the county as "Red." These simplex frequencies can be "patched" or connected directly with into the City's 800 MHz trunked radio system as required. F&LSS maintains VHF radios for mutual aid purposes in all suppression and supervision vehicles for mutual aid purposes, in keeping with state-wide FIRESCOPE communications recommendations.

The Police Department mainly uses only one VHF high-band frequency. Known as the California Law Enforcement Mutual Aid Radio System (CLEMARS), CLEMARS is essentially the law enforcement version of Fire White 1. This channel is currently the only tool immediately available to permit City officers and operations to communicate directly with the California Highway Patrol. VHF radios are still installed in supervisors and K-9 units, but are no longer installed in the majority of Police vehicles.

The remaining users of the VHF high band radio system use the various frequencies for basic dispatching and operations within their departments. Street Division and Environmental Services Department operate separate repeaters while the Highway Maintenance operates on one simplex channel. The simplex Local Government channel is used by for Park & Recreation, Library, and General Services Departments.

7.1.3.4 System Coverage

Consisting of five primary radio sites (receive and transmit), five receive-only sites, and one back-up site, the system provides excellent City coverage for both mobiles and portables.

The primary sites are Lyons Peak, Mount Soledad, San Ysidro View Park, Mount Woodson, and the City Operations Building (COB). The receive-only sites are Black Mountain, City Administration Building (CAB), Encanto Communications Site, Cowles Mountain, Country Club Heights, and Point Loma (Point Loma includes CLEMARS transmit capability).

The Chollas Operations Station, situated on a 420-foot ridge centrally located within the City, houses additional VHF receivers, and back-up high band transmitters. This site serves as the system's hub.

The Fire Communications Center also houses backup transmitters and receivers.

7.1.3.5 Areas of Known Concern

Since much of the terrain in San Diego consists of rolling hills and valleys interlaced with sharp canyons, the nature of VHF propagation often provides better coverage in these areas than 800 MHz. In fact, the portable coverage at VHF has far fewer dead zones and weak spots that the 800 MHz system. At the time the City implemented its trunked system, FCC regulations did not permit the use of trunking at VHF frequencies, nor were adequate frequencies available to expand the capacity of the system. The move to 800 MHz was effectively mandated, both by FCC rules and the availability of spectrum.

7.1.4 Paging System

7.1.4.1 System Description

The City operates a large, high-capacity, wide-area radio paging system. The City Paging System is a key strategic tool for Fire and EMS operations that has been embraced by many City operations. Their foremost need is for a paging system that will very quickly notify recipients of messages with a high degree of dependability. This requirement for dependability is the reason commercial paging services cannot meet the needs of F&LSS. Thus, the City will need to continue to provide this service for the foreseeable future. Once the infrastructure has been established, the incremental cost of adding an additional user to the paging system is very low indeed -- essentially the cost of the pager and a few minutes of staff time to program it into the paging system. Given these facts, it is likely that the City will reasonably continue to provide the bulk of its own paging services long into the future. The system operates in the 150 MHz frequency range. There are over 6,000 pagers currently operating on the system.

7.1.4.2 System Technology

The system utilizes Golay Sequential Code (GSC) signaling, which transmits pager addresses, or cap codes, at 300 baud, and message data at 600 baud. This technology was developed in the late 1970's and was first implemented in the early 1980's.

To improve transmission time and ensure simultaneous reception of emergency dispatch pages, Fire and Life Safety Services utilize the "Carbon Copy" feature of the GSC protocol. This feature provides for transmission of the same message to up to 16 pagers at once without repeating the message information, conserving airtime, and permitting the quick delivery of emergency pages to all involved parties simultaneously.

For comparison, a dispatch page sent in a traditional sequential fashion would take as long as 72 seconds to reach 16 parties; with Carbon Copy, it only takes 12 seconds to reach all 16 parties, or only one-sixth the time. It is clear from this performance difference that this capability (or something comparable) must be retained in any system upgrade.

The Golay technology is no longer supported by its creator, Motorola, and the paging equipment industry no longer manufactures pagers which can operate with this format. When replacements are required, the City has no alternative but to purchase reconditioned pagers in the secondary marketplace. The City has had success in locating and procuring used GSC pagers to date.

7.1.4.3 System Use

The City Paging System is seen by the Fire and Life Safety Services Department as a key dispatch notification system. It serves as a hot-backup in the event of transmission issues

with the landline-based station alerting system, and as a primary notification when units are in the field. The system is also available for use by other City departments, with limitations to preserve system capacity and throughput for Fire operations.

7.1.4.4 System Coverage

This system, first implemented in 1986, utilizes a central paging terminal connected (currently) to four transmitters, located at Mt. Woodson, Lyons Peak, Mt. Soledad, and the City Administration Building. Additional transmitter sites are envisioned for the near future. Potential locations include Cowles Mountain, Lake San Marcos, and San Ysidro, as well as other sites.

7.1.4.5 Areas of Known Concern

There have been some concerns expressed regarding coverage in certain buildings, particularly penetration into some hospital areas. A general desire also exists to enhance coverage into Northern and Eastern San Diego County, to enable the system to reach more off-duty personnel.

Given the older technology in use, these pagers are not the very small devices typically seen in today's market. This actually places the devices at increased risk of damage, because the device's greater size makes it easier to catch the device on passing objects or people, and dislodge the pager from the wearer's belt.

Similarly, the City's paging terminal, the device that is the hub of the paging network, is no longer manufactured. This is a critical single-point-of-failure for the entire network, as it controls all paging activity. A backup terminal is currently installed as hot-standby unit, and would be utilized in the event of the failure of the primary device.

7.1.5 Digital Microwave and Fiber Network

7.1.5.1 Digital Point-to-Point Microwave

The City’s microwave network supports public safety and public service data and radio communication systems. This high-speed network is divided into two basic loops and a series of short hop spurs. Each loop is designed to operate at DS-3 capacity of 45 Mb/s (equivalent to 28 DS-1 or T-1 1.544 Mb/s circuits). The loops are identified as the Public Service Loop and the Public Safety Loop with the Chollas Public Service Dispatch Center currently acting as a common central hub. Each loop is protected at the DS-1 level, which provides the required redundancy in the event of a link failure.

The Public Safety Loop largely utilizes Harris Model Number DVM6-45 radios and Siemens multiplexers located at the following facilities:

- Chollas
- San Ysidro View Park
- Encanto
- Mount Soledad
- Black Mountain
- Cowles Mountain
- Police Headquarters
- Fire Dispatch Center
- San Diego Wild Animal Park

All but one of these paths operates in the 6 GHz frequency band. The remaining path operates on 18 GHz Motorola radios. This loop also has five microwave spurs, which provide communications with the following sites:

- Fire Station 38/Black Mountain,
- Black Mountain/Wild Animal Park,
- Wild Animal Park/North City Site (Whitman Ranch),
- City Administration Building/Police Headquarters.

The spurs use Motorola 6 or 18 GHz radios with 4 X DS-1 circuit capacity, with the exception of CAB/Police Headquarters which has DS-3 capacity.

The Public Service Loop covers the following sites:

- Mount Woodson
- Point Loma
- Lyons Peak
- Chollas

This loop primarily operates on Alcatel Model MDR 4000 series radios and multiplexers. Fire Station 21 is considered a spur on the Public Service Loop, utilizing Motorola 18 GHz radios and multiplexers at four X DS-1 bandwidth capacity.

All of these microwave systems use the same type channel bank, Siemens Model Number 9004 PCM series or equivalent.

This system provides the necessary linkage between radio sites, dispatch centers and other City owned facilities supporting the City's VHF radio system, 800 MHz trunked radio system, 800 MHz mobile data terminal radio network, and Water's SCADA radio system.

The system also carries traffic for the San Diego Metropolitan Transit Authority between Point Loma and Mount Woodson.

All City-owned microwave systems are operating within equipment design specifications. However, the Public Safety Loop is near capacity, with only one spare T-1 link available. Any expansion of the City's public safety communications system will require additional microwave capacity.

The Harris radios were manufacture-discontinued effective January 31, 2000. Maintenance support will be available from Harris until January 31, 2010, subject to the availability of parts.

Motorola no longer manufactures microwave radios; these products were sold to Tadiran in the mid-90s, and are no longer manufactured. Formal parts support for these products has also been discontinued.

Alcatel has also placed the radios owned by the City in a "Maintenance Only" status; parts support is scheduled to be terminated in 2005.

The Siemens channel banks are similarly obsolete. These transmission products were sold by Siemens in June 2001 to Link America, a Texas firm specializing in "end-of-product-life" technologies.

7.1.5.2 Fiber Network

The City currently operates several high-capacity fiber optic cable paths. These operate between the following locations. The Department responsible for them is listed in parentheses:

City Operations Building and City Administration Building
8 Multi-Mode Fibers, 1 in use at DS-3 (IT&C)

Police Headquarters and Maintenance Control Center
8 Single-Mode Fibers, 1 in use at DS-3 (IT&C)

Point Loma Wastewater Treatment Plant and Sunset Cliffs Bridge
24 Single-Mode Fibers. This cable is dedicated to the Department's COMNET control systems network (including sludge pipeline valve control). Two strands are provided to SDDPC for City SANNET connectivity. (MWWD)

Sunset Cliffs Bridge and Metro Biosolids Center (MBC)
Continuation of previous 24-strand, Single-Mode cable, plus an additional 8-strand, Single-Mode cable that connects to the final sludge pipeline valve vault before reaching MBC. The separate cable is dedicated to sludge pipeline valve control. The main cable still provides 2 strands to SDDPC for SANNET. (MWWD)

MBC and North City Water Reclamation Plant
24-strand, Single-Mode cable. This cable is dedicated to the Department's COMNET control systems network only. No other users are on this cable. (MWWD)

MBC and Metro Operations Center (MOC)
24-strand, Single-Mode cable. This cable is dedicated to the Department's COMNET control systems network. Two strands are provided to SDDPC for City SANNET connectivity. This cable provides the backbone high-speed connection from Point Loma to MOC, where MWWD's central network hub is located. (MWWD)

The Siemens transmission equipment in use on the IT&C-owned cables is also obsolete; its continued support was also transferred to Link America.

The Metropolitan Wastewater Department has now adopted the practice of installing dark fiber optic cable when it installs new wastewater lines; the Water Department has not yet done the same, but is considering doing so.

7.1.6 SCADA

The City of San Diego operates two fully independent wireless Supervisory Control and Data Acquisition (SCADA) networks.

7.1.6.1 Water Department

The first network was installed in 1997, shortly after the budget was approved for the Water Department. This network was designed around five primary mountaintop locations (Cowles, Black Mountain, Mount Woodson, Mount Soledad, and San Ysidro View Park). Recently additional systems were installed on Encanto and the City Administration Building to improve downtown coverage. Each site employs a Multiple Address System (MAS) master radio, which communicate to the Remote Terminal Units (RTU) in the field.

This system utilizes separate licensed frequency pairs at each site for a total of 14 frequencies. The original frequencies for the initial five-site system are 952/928 MHz MAS pairs, which were obtained in 1994. The last two sites use 941/932 MHz (shared allocation) pairs. Data from these sites are routed through the City's digital microwave network, and then through a dedicated leased line to the Water Department's central SCADA master complex.

The Water Department's SCADA network currently monitors functions and data from several hundred locations and has the capability to control some equipment at several remote facilities. Data acquisition of field data (water levels, water pressure, water flow rates, valve positions, etc.), alarms (malfunctioning equipment, extreme temperatures,

water level set-points, intrusion, etc.), and historic trends are performed at the central SCADA master complex located at the Alvarado Water Treatment facility.

The central SCADA unit consists of two Channel Service Units and Data Service Units (CSU/DSU) that communicate to the Chollas microwave facility through an Advanced Digital Network (ADN) dedicated circuit from Pacific Bell. Chollas utilizes a complementary CSU/DSU with a Time Division Multiplexer (TDM) which converts the data into five separate serial data links which connect through the City's microwave system (through both the public service and public safety loops) to the appropriate MAS master radio.

The Water Department, with the assistance of their consultant, EMA, is planning on expanding the SCADA system by both wireless and fiber-based connections. The recommended expansion requires additional new microwave installations, which will consist mostly of short-hop spurs to specific Water Department sites, as well as significant reinforcement of the existing microwave backbone capacity to carry the traffic from the new spurs.

7.1.6.2 Metropolitan Wastewater Department (MWWD)

A second SCADA network was later installed for the Metropolitan Wastewater Department (MWWD). Since at the time the system was being implemented the City was unable to acquire licensed MAS frequencies, this network currently utilizes non-licensed 900 MHz digital spread-spectrum (DSS) technology.

Similar to the Water Department SCADA system, this network uses mountaintop locations for their master radios. There are six master sites including: Cowles Mountain, San Ysidro View Park, Mount Woodson, Country Club Heights (near Mt. Soledad)[2], Point Loma (City radio site, not the treatment plant), and Black Mountain on five DSS zones. However, unlike Water's SCADA Network, the data from each site directly feeds MWWD's Metropolitan Operations Center II (MOC2), and does not utilize the City's microwave system for backhaul.

MWWD, with the assistance of the Communications Division, is in the process of expanding the network to include several more RTU locations. The primary system can easily be expanded since it has provisions for eight DSS zones with only five zones currently being utilized (Cowles and San Ysidro share one zone). Additional hardware would be required at MOC2 if additional DSS zones were to be employed.

While this technology has worked well so far, it is likely it will become increasingly problematic in the future, especially for longer paths. This is due to the rapidly increasing number of users installing these simple, low-cost, license-free connections.

[2] This site was originally constructed on Mt. Soledad. It was recently re-located to the Country Club Heights location, due to the high level of radio frequency noise associated with the many other radio users located at Mt. Soledad. This "high noise floor" degraded the reliability of communications below an acceptable point.

Communications Division has recently obtained six 941/932 MHz frequency pairs for MWWD, and intends to begin migration to these licensed pairs to maintain system dependability in the near future.

Communications Division not only engineered and installed all communications equipment for both of these wireless SCADA networks (primary sites and all field RTUs), they also continue to monitor operational status and provide maintenance on a daily basis.

7.1.7 Point Loma Trunked Radio System

7.1.7.1 System Description

The Point Loma Wastewater Treatment Plant is located on the west side of the Point Loma peninsula. The location is effectively blocked from most land based radio traffic including most cellular and pager systems. The City's 800 MHz trunked radio system is also non-operational at this location. The Point Loma trunked radio system was installed to provide radio coverage for local wastewater treatment plant traffic as well as to provide limited access (links are only provided on certain MWWD talkgroups) to the Citywide Trunked Radio System.

7.1.7.2 System Technology

The trunked radio system is a five-frequency Motorola SmartWorks system using five Motorola Quantar 800 MHz radios. The system links to the City's Point Loma Radio Site facility via four UHF frequency pairs. Four Motorola 800 MHz Spectra radios (antennas are either dummy loads or magnetic mounted quarter-wave antennas inside the radio vault), each set to a different Point Loma talkgroup, are coupled to a General Electric Phoenix UHF transceiver. At the Point Loma Radio Site, these four links are coupled to four MWWD talkgroups on the main Citywide 800 MHz Trunked Radio System.

At five key locations in the plant requiring system control handset-style remote control units are deployed. These are connected by in-plant cable to Spectra control stations co-located with the other system equipment to provide system control.

The Point Loma Lifeguard 800 MHz conventional repeater is also located in the plant's radio vault.

7.1.7.3 System Use

The trunked radio system has eight primary talkgroups supporting the plant's operations. Most of the systems activity is on their local operations channel known as "ComC", which is their central control facility located at the Metropolitan Operations Complex.

There has not been any problem reported of system "busies" or other channel crowding issues.

7.1.7.4 System Coverage

The plant occupies 40 acres of land. The operating structures are large, mostly subterranean concrete-lined tunnels. The radio vault is located in the warehouse facility, essentially in the center of the plant. The 800 MHz trunked radio system uses separate receive and transmit 3dB gain omni-directional antennas mounted on a 30-foot pole. The system's coverage was reported to be adequate around the plant itself.

Coverage is extended into the plant's extensive network of pipe galleries with a bi-directional amplifier located at one of the tunnel's entrances. This feeds a "leaky coax" distribution system that distributes the signal throughout the galleries.

7.1.7.5 Areas of Known Concern

The existing system will continue to support the plant's operations for many years to come even if staffing or facility requirements are increased.

Due to the elements, a higher level of preventive maintenance is required for outdoor equipment at this site.

7.1.8 Radio Dispatch Centers

The City operates a number of dispatch facilities for the control of its field forces. These are listed and described below:

7.1.8.1 Police Dispatch

The City Police Communications Facility is located in Police Headquarters at 16th & Broadway Streets near Downtown. It operates in purpose-built dedicated space in a multi-story, multi-function building constructed to Essential Facilities Act standards. The facility is operated on a 24-hour basis, and is the City's Primary Public Safety Answering Point (PSAP).

The facility is equipped with 32 telephone call-taking positions, and 12 radio control positions. Three of the radio control positions service lead dispatchers. The 9-1-1 call-taking positions are PEI Vesta, behind a Nortel Networks Meridian 1 Option 61C fully redundant PBX. Radio controls are Centracom II+ CRT-type workstations. All calls are recorded, however some reliability issues have been experienced of late with the recording systems, originally purchased in 1996.

The facility has a total staff of approximately 180, 140 of whom are communicators. Normal shift staffing is 9 radio operators on all shifts, and from 10 to 25 call takers, depending on the time of day, and the day of the week.

A Litton PRC CAD system supports the operation. Each call taker and radio position is equipped with CAD capability. Radio positions have full law enforcement data base access.

If the facility were to become unavailable for any reason, backup services are ostensibly provided at the City Emergency Operations Center, though few services are in fact established at that location. The 9-1-1 backup agency is the San Diego Sheriff's Department, although no facilities exist there to communicate with San Diego City units.

7.1.8.2 Fire Dispatch

The City Fire Communications Center is located in Kearny Villa at a purpose-built dedicated two-story facility constructed to Essential Facilities Act standards. The facility is operated on a 24-hour basis. It is considered a secondary PSAP.

The facility is equipped with 7 call-taking positions, and 9 radio control positions. The 9-1-1 call-taking positions are PEI Vesta, behind a Nortel Networks Meridian 1 Option 61C fully redundant PBX. Radio controls are Centracom II+ CRT-type workstations. All calls are recorded, however some reliability issues have been experienced of late with the recording systems, originally purchased in 1996.

Total staffing of the facility is currently 47: 32 communicators, 8 system status controllers, 4 supervisors and three captains. There are plans to civilianize this operation in the near future.

A TriTech CAD system supports the operation. Each call taker and radio position is equipped with CAD capability. The CAD provides data to dynamically dispatch units (dynamic dispatching means that the physically closest available unit, as determined by an AVL system, is dispatched to each call).

If the facility were to become unavailable for any reason, the EOC located in Downtown would become the destination facility. This facility has no computer service provisions of any kind, and all dispatch operations would revert to completely manual.

7.1.8.3 SDMSE Dispatch

The San Diego Medical Services Enterprise Dispatch Facility is co-located with the Fire Communications Center, but is located on the ground floor of the facility in a separate area from the FCC. This facility addresses non-emergency EMS operations communications requirements, such as inter-facility transports, Basic Life Support (BLS) incidents, wheelchair transports and the like.

It is staffed by Rural/Metro employees. There are 17 total employees; 1 manager, 2 supervisors, and 14 call takers/radio operators. There are 9 operating positions; 6 are used by call takers, 2 are for radio, and one for the supervisor. An additional radio position will be added if call volume continues to increase. The telephones used in this center are Nortel Networks 2616-type sets served by the previously referenced Nortel Option 61 C; the facility is not considered a PSAP, and does not have 9-1-1 equipment per se. The radio controls are provided by Motorola Spectra Control Stations, rather than by consoles.

This facility is served by the same TriTech CAD system that serves the FCC. However, the same dynamic dispatch procedures are not followed. MDT/AVL units are not currently installed on BLS units as they cannot be purchased anymore, and their use has been restricted to ALS and Fire equipment. SDMSE would like to institute the same dynamic dispatch procedure, but doing so would require the implementation of an alternate MDT/AVL technology. If alternate communications technology were available, ALS and BLS units would be identically equipped.

If the facility were to become unavailable, the same emergency procedures in use by the Fire Communications Center would be followed.

7.1.8.4 Lifeguard Dispatch

Lifeguard dispatch operations are based at Lifeguard Headquarters, located at Quivera Basin in the Mission Bay area. This facility is operated on a 24-hour basis.

No dedicated employees provide communications services; the position is rotated among the more senior lifeguards on a daily basis, and shifts (with the exception of graveyard) are short.

The facility is equipped with a single Motorola Centracom II button/LED-type radio control position, and two PEI Vesta 9-1-1 workstations. This facility is considered a secondary PSAP. The facility has law enforcement database access through a single SUN terminal. Two VHF marine radios are also installed to permit the facility to maintain a watch on Marine Channel 16, the international calling and distress frequency, as well as to communicate on another frequency simultaneously.

The facility has no CAD or automated dispatch/records management tools of any kind.

There are no direct backup provisions for this facility.

7.1.8.5 Public Works Dispatch - "Station 38"

The "Station 38" public works dispatch operation is located at the Chollas Operation Station. The facility is operated on a 24-hour basis, acts as the primary dispatch point for several departments, and serves as the primary after-hours answering point for most essential City services. Departments served by this facility include:

Department/Division	Status
Environmental Services	After-Hours
Metropolitan Wastewater	Primary
Park & Recreation	
Park Rangers	Primary
Beach Maintenance	Primary
Transportation	
Street Division	After-Hours
Water	Primary

Station 38 is staffed by a team of 12 employees. There is one full-time supervisor, three full time dispatchers, and 8 other part time/hourly dispatchers. Saturday and Sunday day shifts are covered by two people. Weekend evenings are staffed by one. One person is on graveyard shift regardless of the day of the week.

The facility is equipped with 4 Motorola Centracom II+ CRT-type radio control positions. A call sequencer connected to a PEI key system is used for telephone service and provides for basic queuing of calls. A Motorola Alphamate paging unit is provided at each workstation, as they make extensive use of the City Paging System.

While the facility does not have a CAD system as such, they utilize a number of different work order management systems for a variety of departments. These include:

Department/Division	System
Environmental Services	EPACS
Metropolitan Wastewater	SWIM
Transportation/Street Division	SAP Synergy

The facility has a Dictaphone Reel-To-Reel 30-channel logging recorder. All relevant telephone and radio traffic is recorded.

If the facility were to become unavailable for any reason, backup services are provided at the City Emergency Operations Center, though few of the required services are established at that location.

7.1.8.6 Environmental Services Department Dispatch

This operation is located at the Department's Miramar Operations Facility. The facility operates generally from 6:30 AM - 5:00 PM, Monday through Friday. After-hours services are provided by Station 38. The facility utilizes 2 dispatch personnel. They work staggered hours to provide full day coverage.

The facility is equipped with two Motorola Centracom II+ CRT-type radio control consoles. Telephone service is provided by standard City electronic station sets. A control station radio is provided in event of console or communications link failure. A

portable Nextel unit[3] is provided for the dispatcher's use; Nextel service is heavily used throughout the Department.

The facility has no CAD system per se; rather, the Department's standard service request automation tools are utilized.

7.1.8.7 Street Division Dispatch

Street Division maintains a two-person dispatch operation located in the same building as Station 38. This activity operates only during business hours; after-hours are handled by Station 38. Telephone service is provided with standard City electronic station sets; Radio dispatch access is via hand-held radios.

These personnel use the SAP/Synergy work order management system used by the rest of the Division.

7.1.8.8 Parking Management Division Dispatch

Parking Management Division currently maintains a dispatch operation at their Headquarters at the World Trade Center San Diego. It consists of a single operator using a hand-held radio.

This operation is staffed Monday - Friday from 9:00 AM to 5:30 PM. Outside of these hours, Parking Management staff switch their radios over to the Police INQUIRY talkgroup, and use them as a dispatch and access point.

The dispatcher has two distinct computing tools at their disposal. First is a standard SUN terminal for law enforcement database access, and the second is on the Division's Parking Ticket Management System.

Meter Collection personnel are not on the Trunked Radio System; they utilize the Street Division VHF system, and coordinate with Station 38. The Division wants to provide these 9 individuals with 800 MHz radios as soon as possible to integrate them with the balance of their operation.

7.1.8.9 City Emergency Operations Center Dispatch

The City Emergency Operations Center is located in the City Operations Building in Downtown. It is located in space which formerly housed the Police and Fire communications centers prior to the construction of their current facilities. In addition to its intended emergency role, the space currently serves as the offices of the City's Emergency Management staff on a day-to-day basis.

[3] Nextel offers a control station radio that can be interfaced with the Centracom equipment, if such a connection would be desired.

This facility is intended to act as the backup communications center for most City communications facilities, including:

- Police Communications Facility
- Fire Communications Center
- San Diego Medical Services Enterprise Dispatch Facility
- Station 38 Public Works Communications Center

The facility is divided into a number of physical spaces intended to service specific functions. The largest (formerly housing the Police call-takers) now serves as the operations room of the EOC. Immediately off of this room are three others; one is a media center, and the other two constitute the backup Police Communications Facility. The call-takers sit in one room, and the radio positions are in another.

The large room that housed the former Fire Dispatch Center now serves as the backup facility for Fire, SDMSE, and Station 38. The call-takers and radio positions share common space.

One Centracom II+ CRT-based console is provided for Police use. A second console is planned to be added to accommodate the operational demands of the upcoming Superbowl. All other Trunked Radio System access is provided through a series of 11 Motorola Spectra model control stations connected to DGT-9000 model remote control units dispersed throughout the facility. One of these is dedicated to Station 38; One is dedicated to SDMSE operations. The balance is divided for use between Fire and Police operations.

A 1A2-type key telephone system with 30 button sets provides access to 19 lines dedicated to 9-1-1 access. There are 12 call-taker positions for Police use, and 7 for Fire and EMS. No enhanced 9-1-1 features, such as Automatic Number Identification or Automatic Location Identification, are provided.

No access to Computer-Assisted Dispatch resources of any kind are provided for Police, Fire, EMS or Public Works. No capability for law enforcement data base access could be identified.

Many of the facilities ostensibly provided are not fully operable, and require extensive rehabilitation before they could be placed into service. As currently extant, the conditions at this facility pose serious questions about its adequacy to address the needs of the City.

7.1.9 Police and Fire/EMS CAD Systems

7.1.9.1 General

Computer-Assisted Dispatch systems are the hub for dispatch of the field forces, primarily from the communications/dispatch center, but also may serve command posts or on-site deployments as well. The Motorola Smartnet II technology in use by the City allows voice radios to include digital identification in their transmissions. This identification is often known to the CAD system which allows dispatchers to directly identify the officer to whom the radio was assigned, via an alias.

Voice radio communications have been supplemented by Mobile Computers in the vehicles. This wireless technology allows messages entered at the CAD system to be transmitted digitally to the field unit(s) and vice versa.

At this time, the Police and Fire/EMS operations work completely independently of each other; there is no provision for information sharing between the two systems.

7.1.9.2 Police CAD System

The Police Department has a CAD system from Litton PRC, Inc., now a subsidiary of Northrop Grumman. It was installed in 1990-91 and has undergone several upgrades, most recently to new server hardware. PRC is one of the major suppliers of CAD systems in the USA. The largest set of deficiencies related to the CAD system is related to its age and underlying technology. Support is still available, but all future modifications requested would be custom work, and would not be integrated into a maintenance contract.

Functionally, the system works well, is reliable, and meets the users' current needs, but does not provide a user interface that takes advantage of current technology or ergonomic improvements, nor does it have support for several desired capabilities. The anticipated life span of a CAD system is 12 to 15 years, with some number of upgrades required along the way. Around the twelfth year technology will generally outrun the system's architecture and its ability to keep abreast without an upgrade so major that replacement must be considered as a viable option. The last few years of operation are often simply "make-do" while the replacement process takes place. The Police Department's system is at that point; the current CAD system is reaching the end of its realistic lifespan and the process for its replacement should begin.

The CAD system is integrated with the Voice Radio digital ID and Mobile Computing capabilities, but many of the processes are slower than desired. The radio ID display is a particular irritant as the scrolling process for the display is described as slow and cumbersome. As the radio traffic increases, dispatch is becoming more dependent on the ID display.

The Police Department does not currently have Automatic Vehicle Location (AVL) or Mapping capabilities integrated with the CAD system. AVL is already highly desired from the field perspective. These capabilities will become even more desirable (in fact, likely an absolute necessity) as the Wireless E-911 Phase II changes are implemented, and these calls are sent directly to the "apparent PSAP" for handling. The ability to deploy and monitor "bait vehicles" – cars set out in high-risk areas for auto theft that can be remotely tracked and controlled -- would be greatly improved if the Dispatch Center had AVL/Mapping capabilities. These tasks are currently performed by an outside contractor.

7.1.9.3 Fire/EMS CAD System

F&LSS has a CAD system from TriTech Software Systems that was upgraded as a part of the establishment of the San Diego Medical Services Enterprise partnership with Rural/Metro Corporation. F&LSS actually operates two distinct dispatch operations; the first providing responses to Fire and Emergency Medical incidents and the second providing responses for non-emergent Emergency Medical Services requests. The CAD system serves both operations. The system is relatively full featured, including mapping capabilities, but still has some performance issues at the time of the interviews that the vendor was addressing.

In addition to having the integrated voice and data capabilities similar to the Police Department's CAD system, the Fire system is integrated with a Station Alerting System that alerts the Fire Stations to an incoming call. This system uses a combination of wired and wireless communications.

A key element of the overall alerting network is the City Paging System. Tied to the CAD system, it receives dispatch information via a custom interface, and then transmits it to the appropriate individuals.

The current Mobile Data Terminal (MDT) system is closely tied to the CAD system. The MDTs provide the transmission element for Automatic Vehicle Location information, used by the Fire CAD system to perform dynamic dispatching; the assignment of the physically closest unit to an incident. The current levels of MDT network traffic do not permit the position update rates desired by Fire Dispatch. A major issue impacting Fire Communications and Dispatch operations is the current MDT system. Replacement parts have not been available for several years and the Department is required to cannibalize units to keep others running. At this point the first response units are prioritized for MDT equipment. As necessary other units with MDT equipment have it removed to make it available for the first response units.

7.1.10 AVL System

The City currently utilizes Automatic Vehicle Location (AVL) technology for two groups: Fire and Life Safety Services, and Environmental Services. Neither application utilizes a dedicated network; the Fire network operates through the City's private Mobile Data Network previously described in this document.

The Environmental Services system, used for tracking refuse collection trucks on their routes, utilizes CDPD public network technology provided by AT&T Wireless.

The City does not own a specific communications system dedicated to Automatic Vehicle Location transmission.

7.2 Voice Communications Issues, Goals & Directions

7.2.1 Police Department

Law enforcement activities constitute the largest single function utilizing the City trunked radio system. City Police, School Police, Community College Police, and Park Rangers all combine to make the largest group of users by far on the system. Their needs, in many ways, are the most demanding requirements the system can face. In the review of the system, the consulting team spoke with patrol officers, investigators, supervisors and managers throughout the Department to attempt to develop an accurate set of requirements for a system. Several items stood out. First and foremost was interoperability.

7.2.1.1 Interoperability and Regionalized Communications

Recent major public safety events have highlighted the continued need for radio systems that provide multi-agency interoperability. The implementation of systems that are designed to maximize sharing and interoperability, while keeping up with state-of-the-art technology, provide the greatest enhancement to public safety operations. Public safety workers must be able to communications with each other effectively, efficiently and securely.

7.2.1.1.1 Internal Interoperability

From the internal perspective, existing interoperability is fairly good, though agencies still using the VHF radio systems are at a significant handicap in this respect. There is patching capability in the dispatch consoles that can address this need, however, should it arise. There is a desire to move additional Water Department users to the 800 MHz Trunked Radio System; any actual movement will be driven by available funding. The Environmental Services Department is unlikely to move given funding issues. Streets Division -- the remaining large VHF user -- is also unlikely to relocate soon. Again, this is due to funding.

Currently, there are a number of City-wide talkgroups in use, though there has not been sufficient training in their use, and many potential users are not well acquainted with them. Emphasis should be made in future training efforts regarding these talkgroups and their use.

7.2.1.1.2 External Agency Interoperability

As the seventh largest city in the United States, the City of San Diego has been in the forefront of building interoperable systems that provide public safety workers with effective communications with Federal, State and Local agencies throughout the region. The City's current 800 MHz Radio Network – built in 1991 - was a model by which other 800 MHz systems were designed throughout the world. It was the most technologically

advanced system available at the time it was purchased and installed. The County of San Diego's Regional Communications System was patterned after, and designed to be compatible with, the City's system. Now, as the City of San Diego gets ready to design and build the new 800 MHz network, these same principals must be included in the design of the new network.

From an external agency perspective, there is a long list of other governmental agencies with which the City requires communications on a regular basis. The City has already exchanged trunking system keys with the RCS, and approximately 8,000 RCS units are programmed to operate on the San Diego system. Likewise, many City units are programmed to operate on the RCS.

The RCS is a hybrid digital/analog Motorola Smartnet II system. The RCS has selected digital operation for law enforcement. This means that the City's analog-only radios, purchased when digital technology was not yet available, cannot communicate directly with other agencies on those agencies' regularly used digital talkgroups. They can communicate with RCS agencies, but only on specially-designated analog mutual aid talkgroups. These talkgroups are not routinely monitored, and thus much of the ease of interoperability is lost. Interoperability is possible, but only by special arrangement.

What is desired is that these communications can be arranged on an immediate basis, by the end-user, without dispatcher involvement.

Users reported problems in successfully operating on channels or talkgroups not in the primary zone in the radio. This is often an issue on large incidents, or when interoperation with other agencies or City Departments is required. While it may be possible to resolve this issue through improved user training, we believe the better approach is to remove the complexity from the end user, and move it into the system itself. One direction would be a dynamic regrouping approach with a CAD interface. This technology would permit the dispatcher to dynamically assign users to appropriate tactical or interoperational channels without user action.

Air Patrol feels that for talking to different agencies, the "County RCS radios can do everything that the San Diego City system can do and ten times more." This opinion is probably due to the number of surrounding Cities currently utilizing the RCS. They regularly interact with the Sheriff's Office on RCS, and have a RCS radio in the aircraft, but the Sheriff's Office can't contact them if they need assistance except through Dispatch. We have been so far unable to ascertain if this is a policy issue, or a technical matter. Air Patrol further reported "the County can use the LawAir hailing talk group for their aircraft, and their air units listen to that all the time but because it's on a different system than our system, we can't even scan that channel with our radios. We have talked to them about linking that to one of our channels that isn't used, but so far, nothing has come of it." There is no technical prohibition for this problem, so this could be accomplished by dispatch via current patching capabilities.

7.2.1.1.3 Potential City RCS Participation

We have reviewed the potential for City participation in the Regional Communications System. Certainly the City has cooperated with the RCS, and many positive and effective steps have been taken to work with the RCS. Our review of Communications Division operations has not identified any additional steps that we would recommend to improve cooperation with the RCS.

The City of San Diego has significant and intensive radio infrastructure needs. The current radio network supports over 16,000 users serving 12 agencies as primary users. In addition, users are made up of the County of San Diego and surrounding city's public safety users for mutual aid purposes to provide interoperability and redundancy in communications. Should a failure occur with the City of San Diego radio network, then the County's RCS is available as a backup and vice versa. This level of redundancy is extremely beneficial to the local public safety community.

The County's RCS cannot support the number of users that the City's network has nor the quantity of radio traffic generated by those users. An almost complete re-design of the RCS would have to take place in order to accommodate the City of San Diego's radio needs. The cost of such an undertaking would be high – and it is uncertain that any significant benefit would be obtained for the effort and expense.

Further, the existing technology used by the RCS is proprietary to a single vendor, as is the City's current system. A replacement system based upon newer, "open" technologies, like APCO Project 25 (that did not exist at the time of implementation of either system) will prevent the City from being locked into a single vendor solution, and allow the forces of the market to work in the City's interest. Also, the manufacturer's stated product direction for the technology used in the RCS makes it likely that well within the planning horizon of this document, the RCS will migrate to APCO Project 25-compatible equipment that would be fully interoperable with a new City system.

Therefore, it is not recommended that the City of San Diego join the RCS for these reasons. It is recommended that the City and County continue to maintain and strengthen cooperative and interoperable ties, including the potential of linking the systems to provide direct interoperability.

7.2.1.2 Secure Communications

One of the most commonly stated needs for voice communications is for secure communications. The existing system does not provide for generally secure communications, as it is analog in nature. The system has been equipped with limited secure communications capability, however users must check out special radios to utilize the capability. Few do so. Only the most sensitive operations bother, and then, infrequently.

This requirement extends not just to Police users; F&LSS, Park Rangers and MWWD reported needs for secure communications.

Most communications that require privacy are currently conducted over the cell phone or Nextel. Of course, these communications are not secure, in the sense that they can be readily received by an experienced individual with ordinary communications test equipment. The communications can also be monitored by the carrier's staff at their switching office. Notwithstanding these limitations, these communications still afford a fair degree of privacy, especially in comparison to the City's current radio system. Further, few individuals possess the expensive test equipment needed to monitor cell phone traffic, and carriers have policies to minimize unauthorized employee monitoring.

APCO Project 25 standards[4] for public safety radios (developed considerably after the City implemented its network) contain provisions for the robust encryption of traffic, while maintaining the ability to securely interoperate with other agencies. Many modern public safety communications systems (Orange County, for example) run all law enforcement traffic encrypted, but all fire and local government traffic in the "clear". These strong encryption capabilities are available as standard options of most radios that are likely candidates for use by law enforcement on an updated City radio system.

Regardless of the specific system that San Diego chooses to replace the existing network, it will be technically feasible to encrypt all law enforcement communications; in fact, it will probably be technically feasible to encrypt most communications on the system[5].

Jurisdictions have taken a variety of approaches concerning the public's right to know. Some have provided audio feeds on the Internet for ordinary dispatch talkgroups. Some have permitted the media (and anyone else who cares to pay for it) to purchase radios on the system, programmed for receive-only operation on selected talkgroups. Others have elected to shut out the media and the public entirely, and provide no access whatsoever. The City of San Diego will determine which method will be most effective based upon the design of the new radio infrastructure.

7.2.1.3 System Traffic and Access Issues

Channel loading was also a particular concern. Many users reported "delays in accessing the system," but it is unclear from their comments if those delays were due to system busies, or a busy talkgroup. Casual monitoring of the system suggests the latter, and this opinion is supported by the system statistics that show total system busy time of less than two-one hundredths of a percent.

[4] APCO Project 25 provided consensus standards for manufacturers of digital radio equipment. These standards allow for improved interoperability by addressing channel bandwidth, bit rate and access and modulation methods.

[5] We say "most", because non-public safety users may opt for lower-cost radios without encryption capability. If cost were not an object, and one elected to purchase all radios with encryption, then all system communications could be encrypted.

7.2.1.4 Improved System Coverage

Users complained about the poor coverage of the system outside of the City. With the frequency reuse requirements with which we must contend here in Southern California, it would be difficult to directly solve this problem. For mutual aid purposes, current capability exists to program interoperable RCS talkgroups into Police Department radios to assist with this issue. Improved training in the use of the 800 MHz International Public Safety Mutual Aid frequencies would provide some functionality in even more distant locales.

Police users also complained about poor coverage *inside* the City -- inside buildings. Since the system provides little direct radio-to-radio simplex operation (and the users are not well-trained in its operation, either), users are effectively dependent on being able to reach the system to communicate with anyone, even their partner just outside a hundred feet away. While not as vociferous about this issue as the Fire & Life Safety users discussed later in this document, they were still very concerned about the problem. All had encountered situations where their personal safety was in immediate jeopardy because of an inability to communicate effectively from inside a building.

7.2.2 Fire & Life Safety Services Department

The Fire and Life Safety Services Department has three complementary principal branches, each with its own unique requirements.

- **Emergency Services**, which carries out a traditional fire suppression and EMS first-response role.
- **San Diego Medical Service Enterprise**, a joint venture with Rural/Metro Corporation that provides ALS and BLS transport services.
- **Lifeguard Services**, responsible for a wide range of water safety and rescue activities at the City's beaches and coastal waters, as well as marine patrol in the Mission Bay area, among other missions.

In reviewing the needs of the F&LSS operations, the Department's greatest concern is justifiably focused on the existing MDT system, which is discussed in detail in Section 2.2 of this report. Still, several issues came to the forefront as drivers for any new or revised voice communications system.

7.2.2.1 Improved System Coverage

For F&LSS[6], the greatest single concern expressed was for improved Trunked System coverage. This overall need has several faces. First, the existing system does not provide effective in-building radio coverage. Particular complaint was made regarding the Convention Center, high-rise buildings, and hospitals. Lifeguards reported very poor coverage along the coast north of Mission Beach.

This is a complex and difficult issue to address. It will not be feasible to provide "anytime, anyplace" coverage in a city of the size and geographic complexity of San Diego. The commercial network providers such as Verizon, AT&T Wireless, Sprint, Nextel and so on each have spent mid-to-high-eight-figure sums on system infrastructure to cover the City to the extent they have today, and even at that level of expense, such flawless coverage eludes them.

As a general matter, measures to improve coverage in the City, such as adding additional receive-only sites to the Trunked Radio System, should be evaluated.

Currently, most fireground communications operate entirely through the Trunked Radio System, and only very occasional use of simplex, or direct radio-to-radio communications are made. It may be necessary to revisit this stance for several reasons. First, a stated desire of many firefighters interviewed for this project was for "an emergency button that would always get through." This would be a "last ditch"

[6] A reference to "Fire" or "F&LSS" should be construed to apply not just to the Fire Service, but also to the EMS and Lifeguard operations of the Department, unless otherwise noted.

communications tool, one that can always be depended upon, and one that any firefighter with a radio in the area would have a high likelihood of hearing.

The other face of system coverage is the amount of geography outside the City limits covered by the system. Under frequency coordination rules, an agency is supposed to engineer its system in such a manner that it does not provide substantial coverage more than four miles beyond the jurisdictional boundaries of that agency. This restriction conflicts directly with the desires of the Fire Service. Fire units often respond on mutual aid calls outside of the City, and the responding units want to be able to use their radio system. The solution to this quandary is to ensure more effective system sharing and interoperability links with adjoining jurisdictions, as well as enhanced education and improved procedures regarding the use of mutual aid channels.

7.2.2.2 Interoperability Issues

As suggested in the previous section, Fire regularly operates with many other adjoining agencies on a full range of response scales, from a single engine response to a campaign fire. Effective communications with these other agencies on these incidents is a must.

An obvious solution is, as stated above, more effective system sharing and interoperability links with other agencies, notably the RCS. However, while the RCS provides reasonably good coverage over most of the County -- even in unpopulated and rural areas -- it does not provide much capacity for simultaneous conversations. Generally, rural sites are covered by only one or two frequencies, so once multiple talkgroups are brought into use, system busies become the order of the day. This is a not an issue that can be fixed quickly or easily, though the RCS is already considering potential solutions.

The City continues to install VHF radios in its fire apparatus; this practice should continue. It is called for under the FIRESCOPE Communications Plan, and provides City equipment and personnel with the necessary tools to interoperate effectively with resources of the United States Forest Service, the California Department of Forestry and Fire Protection, and any other agencies abiding by the FIRESCOPE Plan. The City's VHF radio systems are likely to be the tool used to manage responding distant mutual aid resources if a major disaster were to strike the City.

7.2.2.3 Improved Subscriber Equipment

A number of specific requests for improvements and modifications to the portable and mobile radio equipment were made. These are described in detail in Section 7.5 of this report, “Subscriber Equipment”.

7.2.2.4 Lifeguard Service-Specific Issues

For the Lifeguards, system coverage is the greatest issue. The coastal terrain in which they operate is the most challenging in which to provide dependable radio coverage in the City. In many places, portable radios cannot hear the system at all, and only simplex communications can function. This same coverage challenge also impacts Police, Fire and EMS resources responding to assist in a Lifeguard incident.

The Lifeguard Service would like to move away from wireline-based communications technology for its Mission Bay operations. Maintenance of the in-place cabling and distribution terminals is a problem, and has led to serious safety concerns.

Even in a wireless scenario, it is important to be able to identify when a Lifeguard has gone out on a rescue to ensure backup. The addition of both Unit ID display and instant recall recorders at both Dispatch and Main Tower locations would be invaluable.

7.2.2.5 Contract Dispatching Services

Fire & Life Safety Services currently provides contract dispatching services for one customer: the Poway Fire Department. There is interest on the part of the Department in expanding this service to include additional jurisdictions.

As all of the other potential customer agencies use the RCS for their communications, it will be necessary to improve the Fire Communications Center's capabilities in regards to RCS operation. This required connectivity can be accomplished for the lowest possible cost through the installation of control stations programmed for the RCS, or with the highest degree of functionality by implementing direct console connection to the RCS. Additional interfaces for recording would also be required.

Mobile and fixed data connectivity would be required for these agencies to permit their proper integration into the routine dispatch process. This would be problematic in the current mobile data environment due to the lack of available equipment.

7.2.3 Water Department

Interviews with the Water Department personnel -- both staff and management -- did not identify much in the way of unmet needs. From a simple voice communications perspective, they are largely happy with the existing trunked radio system, and only desire to migrate additional units to it.

On a general basis, their concerns and issues were consistent with those of the Police and Fire Departments: Battery management and coverage issues were the greatest concerns noted. It is likely that the system and equipment improvements needed to support Fire and Police will probably sufficiently address their needs as well.

As noted with all departments, extensive use is made of public network devices and services for voice communications.

Many needs and concerns regarding mobile data communications were addressed; these are discussed later in this document.

Several of the Department's personnel associated with their reservoirs/lakes and recreation programs on the east side of the City (and beyond) use Globalstar satellite phones. It is hoped by the Water Department that improvement of the 800 MHz trunked radio system will eventually eliminate the need for these devices, which are costly to operate and do not interoperate with City radios directly.

7.2.4 Metropolitan Wastewater Department (MWWD)

The Metropolitan Wastewater Department (MWWD) is a significant user of the City Trunked Radio System, and of City-issue Verizon cellular telephones.

The primary concern noted was system coverage. MWWD has many equipment locations -- notably pumping stations -- that by their nature tend to be located in the bottoms of canyons and other such low points. The existing system does not provide reliable portable radio coverage in these locations; in fact, there are many sites from which vehicle-mounted mobile radios cannot communicate.

By the heavy concrete-and-steel nature of their construction, many of the Department's operating facilities are very difficult to cover with ordinary radio systems, and require special designs to provide effective communications. The efforts so far have been quite successful, but need to continue as the Department upgrades its facilities.

In addition to the mobile and portable units operating on the Citywide system, the Department operates a 5-channel single-site standalone trunking system at its Point Loma Wastewater Reclamation Facility. This system has only very limited capacity to intertie with the larger City network, and this issue is problematic. Operators at the plant cannot easily communicate with workers at upstream facilities.

In general, with the above-noted exceptions, the Trunked Radio System is addressing the needs of the Department effectively.

7.2.5 General Services Department

The General Services Department has not been a major user of City-owned radio systems, aside from their operation of the Station 38 dispatch facility. General Services is responsible for a wide range of concerns, including:

- Central Stores/Print Shop

- Equipment Maintenance
- Facilities Maintenance
- Purchasing
- Storm Water Pollution Prevention

Most of the field communications carried out by these functions are performed by staff using a mix of Nextel devices and Verizon cellular telephones, an arrangement which seems satisfactory to the users. They also have pagers on the City Paging System.

It is a concern from an emergency management perspective that so few of this Department's many vehicles are equipped with City radios. In responding to a large-scale emergency, the efforts of these individuals will be among the most important to coordinate; as logistics troops, they must be able to function effectively to permit the operations staff to work at all, in many cases. Yet, in an emergency, this group will be completely dependent on the availability of commercial services for its communications.
This concern also extends to a cost-effectiveness perspective; it is likely that many individuals who are currently equipped with cellular telephones or Nextel devices may be mostly being called and calling back to a single location for coordination of their efforts.

It is not unusual today to see significant numbers of public network devices in use instead of private network devices. Public network devices are inexpensive to purchase, and obtaining service is administratively trivial; Private network devices are several times more costly to purchase, require the use of scarce capital dollars (cellphones are often acquired on supply budgets as expendables), and must be planned for a year or more ahead. Yet, in most cases, ultimately, the private network device will provide the lower cost of operation over the long term.

7.2.6 Transportation Department

7.2.6.1 Street Division

The Street Division, commonly referred to as “Streets”, employs over 340 people. This division maintains streets, sidewalks, storm drains, street signs, traffic signals, street lights, bridges, fences, alleys and several dirt roads. Some of their services include street sweeping, tree trimming, tree planting, pothole repair, road resurfacing, routine repair and emergency repair, all requiring constant communications between crews/supervisors and dispatch.

The Chollas Operations Station is the location of their headquarters and main dispatch. Street Division Dispatch currently operates during business hours with two dispatchers, and are located in the same building as Station 38. After-hours operations are handled by Station 38. The Street Division dispatchers use two hand-held radios instead of radio consoles.

The Division uses one VHF high-band repeater channel and one VHF high-band simplex channel. The repeater channel is used as the primary dispatch and the simplex channel is mostly used by highway/road maintenance crews only. Both systems utilize several receive sites and several transmitter sites. Receiver voting is performed at the Chollas facility.

Many City employees have personal cell phones and use them to communicate on City business in preference to using their City radio, or because the cell phone is just easier and allows a two-way conversation.

Personnel interviewed expressed a desire to migrate to the 800 MHz system, provided it would provide comparable coverage. The Department has many functions and activities that do not relate directly to each other, and would benefit from being separated into talkgroups.

In emergencies, the Division frequently coordinates along cross-functional lines; the ability to "regroup" radios into appropriate talk groups by area would also be of significant value.

7.2.6.2 Parking Management Division

Parking Management Division is responsible for parking enforcement, impounding of vehicles and parking meters. This Division largely operates on the Citywide 800 MHz Trunked Radio System using three talkgroups.

The Division also has a staff of 9 meter collectors who operate on the Street Division VHF system. The Division is very desirous of bringing these people over to the 800 MHz system with the rest of their operation to simplify coordination, as their dispatch operation cannot be reached by these users.

7.2.7 Park & Recreation Department

The Park and Recreation Department operations are divided into five divisions. Three are based on geographic location (Coastal, Metro and Inland Parks) and two are function-specific (open space management and golf course operations). The Department also has a Park Planning Division and Administrative Services Division.

7.2.7.1 Parks

The Coastal Parks, Metro Parks, and Inland Parks Divisions daily maintain all park and recreation facilities within the given boundaries. Many parks have Park Rangers for enforcement of City park rules and regulations (not for police patrolling).

7.2.7.2 Open Space Division

The Open Space Division (also known as "Northern Parks") manages the City's Maintenance Assessment Districts (MADs). This includes several open space parks along with the responsibility of complying with the Multiple Species Conservation Program. This Division regularly coordinates with other departments and non-City agencies, and requires the ability to interoperate with them.

7.2.7.3 Radio Usage

The majority of the Department operates on the City's Local Government VHF high-band simplex frequency. This Department has the greatest number of VHF high-band handheld radios, which operate adequately from person-to-person at any given park. However, this form of communication isn't always sufficient for communications with off-site supervisors, or other parks.

Many Park and Recreation personnel use personal cellular telephones to supplement their communications. When required to report an emergency they often use cellular telephones due to concerns of privacy and premature media notification.

Park personnel also need the ability to communicate directly with many of the other departments: particularly Police and Fire. Two talkgroups on the City-wide 800 MHz Trunked Radio System have been set aside for use by Park Rangers. Beach Maintenance also utilizes the trunked system, which has worked well for them. It appears that the Department would benefit from a migration to the Trunked System, though the costs of such a move will have to be carefully considered.

7.2.8 Environmental Services Department

This Department operates several divisions: Refuse Disposal, Energy Conservation and Management, Environmental Programs, Environmental Protection, Resource Management, and Collection Services.

7.2.8.1 Collection Services

This division is probably the most visible of all the Department's divisions. It has the responsibility of weekly residential and commercial refuse collection throughout all areas of the City. This division communicates primarily on one VHF high-band repeater channel. They are dispatched from their Miramar facility, called "Station 31". The collection trucks are also equipped with GPS and CDPD radio/modems for AVL and dynamic dispatching.

7.2.8.2 Environmental Programs

The Environmental Programs Division is responsible for the enforcement of the Solid Waste Code, removal of illegal dumping and litter, dead animal collection, and oversight of the City's recycling programs involving the public including education. This division primarily uses the Local Government VHF high-band simplex frequency to talk to Station 38 since they often interact with many of the other Public Service departments. Their supervisors use Nextel Direct Connect for their primary communications.

7.2.8.3 Radio Usage

The Department (including the other divisions not discussed above) operates on several radio systems, largely the VHF Local Government channel and Environmental Services Dispatch channel. Significant use is also made of Nextel devices. Several groups have shown an interest in being able to communicate with other divisions directly without having to go through their dispatchers. For example, refuse collection trucks need to talk to Station 38 and Environmental Programs often need to speak to Station 31.

7.2.9 Information Technology & Communications Department

IT&C Communications Division is, of course, the "owner" of the Trunked Radio System, and they operate several talkgroups on the system for their own use.

The Division also has most staff equipped with pagers on the City System.

No express new requirements for wireless voice communications were identified during the interview process.

7.2.10 Non-City System Users

The City has three external "customers" who currently utilize the City Trunked Radio System as their primary communications network.

These are the City of Poway Fire Department, which also contracts with F&LSS to provide dispatch services; the San Diego Unified School District, which operates a fleet of more than 550 buses and its own Police Department; and the San Diego Community College District, who utilize the system both for maintenance operations as well as their own Police force.

7.2.10.1 Poway Fire Department

The Poway Fire Department, while being in general quite happy with the current arrangements in which the City Fire Department provides contract dispatch and communications services, still had clear opinions, concerns and desires for the future.

Interoperability ranks as a major concern. Interoperability issues between the City Radio System and the RCS have led Poway to install both City and RCS radios in their units. Now that they have two radios in each unit, they would ultimately like to have both radios capable of the same functions, instead of having to use them to accomplish differing functions.

They are concerned about an inability to talk directly to units without "going through a dispatcher". This concern extends to the perception that the system has no room for "chat channels"; those that can be readily used for simple intra-company operations.

While they find general system coverage adequate, they have also expressed concern about the poor in-building coverage provided.

They also expressed concern about potential delays in the 9-1-1 call handling process. The concern was not for the processing time for calls received at the Fire Com Center; the concern was for delays incurred prior to the call reaching the secondary PSAP. The City of Poway contracts with the San Diego County Sheriff's Department for law enforcement, and so the Sheriff provides Poway's primary PSAP. A review of this operation is beyond the scope of this project.

The Mobile Data system issues impacting City users also impact them; they have no MDTs in their staff vehicles, as they have had to reserve them for use in line fire apparatus. Their data communications concerns are identical to those expressed by the City Fire Department, discussed later in this document, notably in such areas as Company inspection tools and EMS reporting.

They would like to see a CAD-field intertie developed to simplify personnel accountability issues at large incidents.

7.2.10.2 San Diego Unified School District

The San Diego Unified School District is the largest non-City user of the City Radio System. They operate over 20 talkgroups on the system, including their own Police Department and over 550 radios in school buses. Radios are also located at all school campuses for emergency/disaster use.

Their greatest concern was coverage. They expressed concern about poor in-building coverage system-wide, and poor hand-held radio coverage, even outside, in the Paradise Hills area. They also indicated the system had poor coverage in El Cajon, and did not address their need to communicate along the route buses take to their Camp located near Mt. Palomar.

They indicated a desire to be able to regroup bus radios in an emergency to an emergency only-talkgroup that would allow Police to communicate directly (and with some degree of privacy) directly with the bus involved in the emergency.

They desire the ability to more simply reconfigure their dispatch consoles, notably the ability to add user-programmable aliases to the consoles. They would also like the ability to send text messages to the radios, as this would enable them to eliminate many pagers.

The District is currently implementing an IP-based video monitoring network. They would like to be able to transmit pictures from that system to units in the field, as a long-range goal. Initially, they expect to provide access to this network for their Police units through the use of 802.11b wireless LAN "hotspots" at each school.

7.2.10.3 San Diego Community College District

The San Diego Community College District operates 4 colleges located throughout the City, and at a large number of remote sites throughout the County. They use seven talkgroups on the 800 MHz system, for both law enforcement and maintenance staff.

Their concern is system coverage; the system does not provide in-building coverage, and even outdoor coverage is poor at their Miramar College site -- ironically, the site of the City Police Academy. Outdoor coverage is poor at their headquarters. They also need to cover sites beyond the City limits in eastern areas of the County that are not well covered by the City system.

The District operates a complete dispatch facility at its headquarters in Mission Valley, with full CLETS access and its own CAD/RMS system. A new CAD/RMS system is currently being implemented.

They are currently using Mobile Data Computers in their patrol units, with CDPD-based access to their system.

7.2.11 Interference

The City of San Diego trunked radio system has had several instances of interference: 1) Nextel sites, and 2) local non-City Bi-Directional Amplifier (BDA) systems, used to provide coverage into structures, going into self-oscillation.

For the VHF systems, there is still some interference coming from Mexico, from both adjacent channel and co-channel operations.

On the 800 MHz voice system, at least ten Nextel sites have been identified as interference sources. The problems are greatest along the Northern beach coast where there is some terrain shielding from the simulcast sites and the City signal strength is low. Much of the problem is overload of the City radio front ends. As these sites have been identified and Nextel notified, the carrier has been cooperative in turning down the power or revamping the frequency matrix for each identified site.

There have been some instances, particularly in the downtown area where a broad-band interfering signal source has caused problems. These have been traced to non-City BDA systems used for in-building signal reinforcement. These can go into self-oscillation if there is not enough isolation between donor site antenna and in-building antennas, and if BDA gain is set too high. These are easy to adjust, once their location has been determined.

7.3 Data Communications Issues, Goals & Directions

7.3.1 General

It is generally considered that the "gold standard" for mobile and portable data communications is to be able to do anything (from a network perspective) from the field that one can accomplish sitting at a desk. This is an achievable goal over the planning horizon of this study.

This target is technologically achievable well within the mid-term (5-year) set of goals for the City. Efforts beyond that point should be focused on improving technology penetration throughout City operations, and in improving system performance and increasing throughput.

The review of City operations indicates that effective field data communications for City staff is strategic. There are many departments within the City that will be able to present excellent business cases for making the investment required to achieve our previously described "gold standard" of connectivity. However, the size and scope of City public safety operations require a certain amount of *absolutely dependable* data communications; notably for Automatic Vehicle Location applications (which drive dynamic dispatching, the assignment of the closest unit to an emergency), and for the receipt of dispatch information in field units generated by the Computer-Assisted Dispatch systems.

The systems used by the City for these vital life-safety communications should be owned, operated and maintained by the City. This is necessary for the following reasons: 1) to maximize the likelihood of their availability by restricting access from non-City users; 2) that restoration priorities in the event of failures are the City's; and, 3) that the City can decide the level of effort and extent of resources needed to restore service. If a non-City-owned solution were to seem attractive for some reason, these three concerns would need to be reasonably addressed as part of the review of the option. If these issues could be resolved in the City's favor, then a vendor-based solution could be of value.

Applications other than AVL and Dispatch information do not have the same degree of time-sensitivity. Even most other uses by public safety personnel are not as critical. Thus, it is appropriate to consider the large-scale use of vendor-provided services for these less-sensitive applications.

This presents a quandary, however. The most advanced technology (of which we are aware) that is currently under development for public safety application will provide, at most, 460 Kilobits per second (Kb/S) in a 150 KHz channel in the 764-776/794-806 MHz bands. While higher speeds may be possible in other recently allocated bands, notably 4.9 GHz, the FCC is still deciding how these bands will be used, and no equipment will exist until this regulatory picture stabilizes.

Thus a quandary: The public safety users, who require the greatest bandwidth, are limited to the lowest performing network option. Fortunately, there is a solution. Products and devices exist that permit a computer to operate over two (or more) different communications networks transparently to the operator. If the high-speed, vendor-owned network is available (and works where the user is located), then the transmission will use the high-speed vendor network. If it is not, it can use the more moderate-speed City network without any operator involvement. This capability will be useful to the City when making the transition from vendor provided service to City-owned and operated service.

7.3.2 Access Technologies

In the past, most information technology systems utilized a dedicated terminal approach, such as the IBM 3270 technology. While many mainframe-based systems still exist, both within the City and with partner agencies, these systems have been converted for access over a modern TCP/IP-based network, such as is now utilized throughout the City.

When describing the manner of access desired for mobile workers, the departmental IT staffs interviewed by the consulting team said -- without exception -- "we need network access." There was little focus on specific applications, other than to note which might be of value to field forces; very few applications were not identified as valuable. Thus, as a general matter, the City's long-term mobile data/computing requirements are clearly a generalized NETWORK access need, rather than only for certain data in certain applications.

7.3.3 Police Department

7.3.3.1 Mobile Data Computers/Field Data Access

In the world of Law Enforcement, transparent, high-speed access in the field to all the data you can access by going back to your station is surely considered a "holy grail". Technology has now reached the point where such access is now feasible.

Information resources to which field personnel desire access in the field include:

- DMV records & photos
- Mug shots /CalPhoto access
- Ability to upload digital photos from the field
- Ability to upload instant street maps and tactical assignments
- ARJIS
- Crime trends and analytical information
- CAD historical data
- Easier review of prior incidents
- Building diagrams, particularly apartment buildings

- Real-time video
- Other GIS data
- On-line manuals, including schools information, such as contact numbers, maps, aerial photos, etc.

The existing mobile data network is incapable of addressing most of these requirements. The utility of the current CDPD interim solution is restricted by its relatively low speed of 19.2 Kb/s. Higher speed transmission alternatives will be needed to address these requirements in the long run.

7.3.3.2 Automatic Vehicle Location/Global Positioning System Use

Automatic Vehicle Location (AVL) technology has two perspectives. The first view permits dispatchers to know where the field forces are; the second permits the field forces to navigate more effectively toward the scene of an incident.

Fire has used AVL technology effectively for several years now to perform dynamic dispatching. Police desire the same capability. This technology is also an important tool for officer safety. With AVL, the location of the officer in trouble is known within a high degree of accuracy, and help can be quickly routed.

Now the second perspective: navigation. Fire, EMS, Police and Public Works personnel all requested a vehicular mapping system, with an automatic routing capability. Such a device would advise the shortest route for responding equipment to take to the scene of a call. This is of great potential utility, especially given the dynamic dispatch operation, where a crew can easily find themselves on a run in a part of the City that is far from their regular district, or an officer is assigned a call in a different Division. Such routing technology could easily save lives on critical responses.

7.3.3.3 Related Concerns

Officers interviewed also made a specific request that system maintenance be performed at a time other than the current 3 AM to 4 AM, given the high level of patrol field activity during those hours. An update time of between 7 AM and 8 AM was suggested as being more appropriate based on typical activity levels.

7.3.4 Fire & Life Safety Services Department

The City's Fire & Life Safety Services Department has been among the leaders in the City in the early integration and subsequent strategic application of mobile data communications technology. These technologies will only grow in importance in the future, serving to reduce response times and improve both the quality and effectiveness of the vital services this Department provides to the people of San Diego.

7.3.4.1 Response Technologies

Fire/EMS dispatch operations are aided by TriTech's Computer Aided Dispatch (CAD) software, Trimble's GPS-based Automatic Vehicle Location (AVL) system, and Motorola's Mobile Data Terminal (MDT) technology. Wireless alerts for fire/rescue response are sent via the City-owned paging network, the City-owned MDT network, and a limited number via the Palm.Net (Cingular/RAM) network.

The use of pagers for this Department has been very successful. Currently only a company's captain and engineer have pagers. Several requests have come to light for firefighters to also be equipped with pagers. Doing so would provide greater redundancy (if a pager malfunctioned or if a person was away from the rest of the crew) and would alert all members simultaneously, potentially improving initial response time.

Fire crews use pre-written fire plans which are housed in their vehicles for review and guidance during a response. Each set of pre-fire plans is written specifically for each response district. However, F&LSS dynamically dispatches, utilizing the AVL information to respond the closest unit regardless of regular assignment. With no access to this vital response data, the responding unit is at a serious disadvantage. In an ideal environment, all pre-fire plans, response routing information, access codes for private communities, etc. should be available to all field units.

Field access to web based programs could provide access to their CAD system, improve speed in identifying hazardous materials, paramedic reports, and more timely access to E-mail, including a capacity for vehicle to vehicle text messaging.

Access to the extensive City GIS resources by field responders and commanders was also identified as being of great tactical value. However, such access would require a network of significantly higher speed than those generally available in the market today to function well.

7.3.4.2 Reporting Technologies

The Department also sees significant advantage in being able to access their RMS in the field. Such access will enable companies to write their response reports in the field as well as input inspection data when originally generated. This speed-up in the reporting process is likely to improve the quality of field reports. Being able to access historical

information interactively -- such as a given location's previous inspection records -- was also identified as having substantial value.

The State Emergency Medical Services Authority (EMSA) is considering implementing a formal program to adopt a standard format for the creation and transmission of Electronic Field Patient Care Records. Once such a standard is developed and promulgated, commercial equipment to meet this need should become available.

7.3.4.3 Mobile Data Terminals/Field Data Access

The Department's AVL system requires that to maintain positional updates, the equipment's MDT must remain powered on. This eliminates the ability to track equipment that is currently not in service. Ideally, the AVL system needs to operate without the engine running and/or MDT turned on.

It has been reported by many that the current City-owned MDT units are difficult to read during responses, the text is often garbled, response time is slow, and the units are poorly maintained with keys often missing or broken.

F&LSS has been actively seeking funding to augment (or even replace) their existing mobile data equipment with commercially provided technology, as the Police Department has begun to do. The use of this technology would provide a substantial improvement in speed; however the bandwidth would still be inadequate for applications such as GIS, Internet access, and interfacing with the Department's RMS program, or to directly display most modern applications. The ideal solution would be a Mobile Data Computer (MDC) providing a graphical user interface (GUI), connected to a high-speed wireless network for transmission.

Lifeguards also require AVL and mobile network access; their very low staffing levels mean that resources must be leveraged to the greatest extent feasible.

The use of MDCs open up a wide range of otherwise difficult or impossible services such as field-initiated paging, intelligent forms for a variety of reporting applications, GIS applications, reading/sending attachments to E-mail, etc.

7.3.4.4 Other Technologies

There is also a great deal of interest in Automatic Personnel Location Systems (APLS) which would not only determine a person's location geographically (latitude and longitude), but also have the ability to determine which floor they are on. This "third dimension" requirement creates several problems, the least of which is it needs to function indoors away from standard GPS satellite coverage. This type of technology is currently not commercially available.

7.3.5 Water Department

As one of the City's leading "enterprise departments" that touches every San Diegan, the Water Department has significant data communications requirements that extend throughout the Department. Recently, the Water Department engaged the consulting firm of EMA, Inc. to prepare planning efforts related to the Department's needs in Local and Wide Area Networks, and the Department's SCADA system.

7.3.5.1 Fixed Wireless Data

7.3.5.1.1 LAN/WAN

In summary, the EMA report divides the Department's networking requirements into two primary networking environments; Enterprise Business WAN, and Operations, SCADA & Control System WAN. They recommend the implementation of a new high capacity subsystem of the existing City microwave network, structured to address the Department's requirements as developed in the report.

7.3.5.1.2 SCADA

The Water Department currently utilizes a wireless Supervisory Control and Data Acquisition (SCADA) system that operates on five discrete 900 MHz licensed channel pairs. Approximately 70 remote sites report to five mountaintop sites (Mt. Soledad, Cowles Mountain, Mt. Woodson, Black Mt., and San Ysidro View Park). This installation of the original phase of this system was completed in 1999. The implementation required extensive engineering and support efforts from IT&C Communications Division. These SCADA systems primarily support monitoring and basic control of pumping stations, pipelines, and other remote locations.

They are in the process of expanding the SCADA system with the guidance of their consultant, EMA, who recently developed their Information Systems Master Plan. A considerable amount of the future SCADA expansion will center around the requirements of the new Alvarado Plant.

The Department also remotely monitors the amount of external corrosion on pipelines at approximately 80 locations throughout the City using AT&T's CDPD wireless network. This corrosion control process does not require much data bandwidth; in fact these remote sites are typically only accessed once a week.

7.3.5.2 Mobile Wireless Data

Project-related information is entered in the field, and is later uploaded into their database at the end of the day when the work crew returns to their shop. Ideally, all customer service work orders should be fully accessible and modifiable directly in the field. Such access would allow the field crews to remain in the field longer providing better customer service, and making more calls each day.

The Department's water conservation field investigators regularly communicate with their office and report on their findings. These field survey crews also require information to be looked up on a regular basis. All such lookups are currently performed manually.

Many crews may also benefit by having current GIS mapping information available to them in the field. Current locations of pipelines, valves, and covered or difficult to find manholes are just a few items that field crews may need to identify directly in the field.

An integrated wireless network could provide field access to all Department databases, all necessary email services and access the Internet.

Meter reading crews also utilize an Itron hand-held device for collecting meter data. The information is stored in the device, and at the end of the day the data is uploaded from the devices when they are placed in their battery chargers. Water is currently investigating the cost effectiveness of utilizing Automated Meter Reading (AMR) technology.

7.3.5.3 GPS/AVL

The use of GPS for field crews, water conservation crews, and meter reading crews would enhance the accuracy of address data and provide documentation of work performed, particularly where address data is otherwise not available. GPS data is also valuable when updating or adding information into GIS. Automatic Vehicle Location technology has also been identified as a desirable technology for use by the Department.

7.3.6 Metropolitan Wastewater Department

MWWD operates a wireless eight-zone digital spread-spectrum (non-licensed) SCADA network. Currently the system is configured to operate only on five of these zones. Data is gathered from six data collection hubs located at Cowles Mountain, San Ysidro View Park, Mt. Woodson, Country Club Heights, Point Loma, and Black Mountain. This system monitors flow and level conditions at several of their facilities (water reclamation, bio-solids processing, treatment plants, etc.), pipelines and drainage systems. The majority of the system is used to transmit alarm type conditions (flow rate too high or low, levels too high, etc.) to their Metro Operations Center (MOC) "ComC" facility.

MWWD also maintains a dial-up data acquisition system that supports approximately 150 additional remote data sensors. The system polls the remote sensors several times a day. Each remote sensor has a separate phone line attached, making this system an ideal candidate for replacement with wireless technology providing a lower long-term cost of operation.

Currently, they do not have the ability to detect pipeline leakage. It is our understanding that given the combination of new, recently released software, and the expansion of the

SCADA network to include all critical locations, this type of leak detection would be possible.

Their field crews use a work-order system similar to other departments. They have been investigating "pen based" systems such as ruggedized PDAs (with Blackberry/Motient or CDPD connection) or some form of Palm/telephone combination unit. This again is another ideal application for a City-wide wireless mobile data network. The ability to add GPS and access GIS data is critical, since the majority of their pipelines are not easily found on a standard map.

MWWD is currently sponsoring a pilot project called "Canyon Overflow Prevention System" (COPS). The water levels at nine critical locations are being monitored to prevent flooding in canyons and easements around the City. These COPS systems monitor two trigger points and manhole cover position (to detect intruders). A Globalstar or similar satellite-based interface is used to communicate this data back to their operations center. If this pilot program is successful, the Department plans on their expanding their COPS network. They estimate over 5,500 citizens could be served by the early flood warning system provided by this network. If an alternative transmission method were in place, this network could be operated over City-owned facilities.

The Department also operates a Remotely Operated Vehicle (ROV) that is used to inspect pipelines and outfall at ocean discharge outlets. The ROV is used throughout San Diego County and sometimes in Mexico however, it is mostly used around Point Loma. The ROV is typically controlled from a boat; at times they would like to be able to provide a video feed to the shore.

7.3.7 General Services Department

7.3.7.1 Equipment Division

The Equipment Division is responsible for the majority of San Diego's mobile fleet of vehicles and motive equipment. Their operations include not only full service garages; they also have field crews doing emergency road calls. Information is often gathered manually on paper and later, after returning to the yard, entered into their database. This process is cumbersome and often slow if several emergencies happen at one time. A wireless mobile data network would allow for faster response and greater information accuracy.

Also, several of the Division's vehicles are essential to operations or perform special functions that are at times critical. During emergencies or times when these vehicles are urgently needed, the exact location of these vehicles become vital. If they are unattended, or the driver does not respond to their Nextel or cell phones, these vehicles could be located more effectively if they had an Automatic Vehicle Location (AVL) system.

7.3.7.2 Facilities Maintenance Division

The Facilities Maintenance Division is responsible for upkeep and maintenance of more than 1,400 City-owned facilities. The Division provides custodial services, mechanical services (including HVAC), electrical services, engineering services, locksmith services, plumbing services, and all forms of facility construction services.

Many of these facilities have energy management systems for central control. With this system HVAC systems are monitored and adjusted daily. The Division is now interested in having these controls on a wireless network to allow adjustments to be made by field crews.

Due to the large number and variety of buildings in the City, building-related diagrams (schematics, flow charts, parts lists, etc.) and other important documented information typically required for facility maintenance is difficult to access from the field. Having the ability to access up-to-date building information while in the field would save significant time over having to research or locate these documents. The majority of the maintenance supervisors and engineers already utilize laptops. A high-speed wireless network would allow timely adjustments to Heating, Ventilating and Air Conditioning systems (HVAC) and provide access to these robust databases.

Easy access to building plans and other related data would also be helpful to the Fire Department. A one-stop location containing all building-related information could possibly assist a number of other City departments as well.

7.3.7.3 Purchasing Division

The Purchasing Division also has several people in the field handling contract disputes, providing contract negotiations, etc. These people need up-to-the-minute accurate information regarding City inventories, current contracts, vendor information, etc. The approval process also needs to allow for quick field processing, particularly for just-in-time contracts.

7.3.7.4 Storm Water Pollution Prevention Program

This program oversees the storm water management and discharge control compliance for the City. This program consists of seven categories ranging from code enforcement to public education. However, responsibility for daily maintenance of the City's storm water conveyance system is <u>not</u> an element of this program.

The Storm Water Pollution Prevention Program field crews perform surveys, evaluate watersheds, test water quality, and enforce all storm water-related ordinances. These crews have need to access a wide variety of information including data on previous offenders, storm drain locations, contour elevations, previous water quality data, etc.

7.3.7.5 Mobile Wireless Data

The Department's need for wireless access is not much different than other City departments. A high-speed wireless network could provide access to the various City databases and provide access to the Internet and E-mail.

7.3.7.6 GPS/AVL

The use of GPS/AVL would greatly enhance the Equipment Division's ability to locate key motive equipment particularly during an emergency. GPS would also assist in collection of accurate data for the Storm Water Pollution Prevention Program's surveys and enforcement programs.

7.3.8 Transportation Department

7.3.8.1 Parking Management Division

The Parking Management Division is currently considering the implementation of electronic parking citation issuance and management technology. Adapting this to include a real-time (or near real-time) communications element could provide a boon to City policing operations -- as citations are issued, a background process can check for outstanding wants against the vehicle in question, as well as identifying candidates for "booting". Wanted vehicles can then be brought to the immediate attention of law enforcement, rather than noting after the vehicle is long gone that it was, in fact, wanted.

7.3.8.2 Street Division

The Street Division maintains the City's street drains, traffic signs, traffic signals, and the roads themselves. They engage over 200 field crews and receive several hundred work requests every day. In order to more effectively manage this operation, the Division partnered with SAP America, Cybertech Systems and ESRI to develop an Enterprise Resource Planning tool known as the SAP Synergy System. This program integrates several management tools specific to street maintenance with GIS.

The SAP Synergy System contains all of the City's pertinent street information (including an extensive database of all assets, resources, location data, etc.) and currently offers three primary modules: Pavement View, Sweepers and Work Management.

The Pavement View module calculates an Overall Condition Index (OCI) for each road in the City. When combined with other street data (such as inclines, distances, etc.) and the annual budget for street paving, it then can determine what streets need to be paved each year. The program also produces the necessary paperwork used for bid processing.

The Sweepers module creates route maps for the street sweepers. Each sweeper is equipped with a recording GPS unit and the data is uploaded every night and entered into

the Sweepers module. Since the data includes the position of the brushes (up or down), it can determine which routes were done and which ones need to be completed. The City receives a number of complaints when a route or street is not done according to the schedule. The information produced from this program has ultimately reduced the number of citizen complaints. Street Division has identified several benefits to receiving this information in a closer to real-time manner.

The Work Management module is very complex and handles daily asset tracking and service requests. Assignments are distributed on job sheets (or shop papers) where space is provided to "check off" the jobs as they are completed. These job sheets are then returned to their supervisors at the end of the day. The supervisor then enters the data on their PDA and returns them to their office to upload the data to the SAP Synergy System for processing.

In addition to citizen and other City worker-placed service requests, the Division also supports special field crews -- consisting mostly of interns -- that use a voice recognition input device coupled with GPS data to go around the City recording observations of problems and potential issues.

The Division has been investigating several wireless options for field data entry including CDPD, although most solutions tested to date cannot provide the required throughput. The SAP Synergy System is another ideal candidate for operation on a high-speed wireless network. This same software and communications technology could well form the core of more integrated systems solutions across the City.

A web based interface designed for citizens to report road hazards, etc. will go online within a few months. The citizen will receive an automated email response back when the job is completed.

7.3.8.3 Traffic Engineering

The Traffic Engineering Division operates and maintains the City's traffic signals and changeable message signs. They would like the capability to communicate to them via a wireless network for updating programming and change messages when necessary. A future Citywide high-speed wireless network could easily provide this connectivity.

7.3.9 Park & Recreation Department

The Park and Recreation Department has few information technology uses compared to other City departments. This is not due to any lack of potential applications.

The Department has potential for many applications that could serve as force multipliers, permitting scarce administrative resources to operate more efficiently, and field forces to get the information they need quickly to better perform their jobs.

Automatic Vehicle Location would be of significant value, both for Park Rangers (particularly from an officer safety perspective) and for Beach Maintenance (from a performance tracking and operations coordination perspective).

The Department is currently implementing a Park Forestry system; it would be of significant value for staff to be able access this system wirelessly.

Recreation Center sites have a need for high-speed Internet and SANNET access.

Also required is the ability for the Department to send broadcast messages regarding a variety of unusual and emergent situations out to all locations. With more than 80 different field locations to contact, a phone tree simply cannot spread warning messages quickly enough.

7.3.10 Environmental Services Department

Environmental Services operates a fleet of 200 refuse collection trucks equipped with Automatic Vehicle Location (AVL) systems that transmit GPS-derived positioning data. These trucks also have sensors that report whenever the arm is lifted indicating when and where a pick-up was made. This data is reported to the dispatch center via AT&T's CDPD network. Information on truck location allows the dispatchers to "dynamically" dispatch vehicles to provide faster response to complaints of missed trash pick-up and other citizen service requests, which also has the added benefit of minimizing over-time costs.

Environmental Services has been experiencing some difficulty with the CDPD system with some data packets being dropped. They suspect that these dropped packets may be the result of routing difficulties through SANNET. This issue has not yet been resolved as of this writing.

The Department also has a significant number of other employees in the field including hazardous materials personnel, Environmental Services supervisors, and code enforcement officers. Their primary mode of data communication is through E-mail using GroupWise. Some use PDAs for email and data collection, then later upload their files when they return to their office. Many of the supervisors also use Nextel's messaging and E-mail services. Several of the field crews and other staff often require access to large files such as three-dimensional drawings of landfills while they are away from their office. These field personnel could be served with an expansion of their CDPD system with MDC technology or a City-wide high-speed wireless network.

Environmental Services also uses the City-owned paging system. Field personnel often request pages through their dispatcher which can take several minutes. The technology used to expand their wireless network should also include the ability to access the City's paging system.

The Department is currently investigating the use of Sybase's iAnywhere software program to provide connectivity regardless of network or device. They have been looking at developing a wireless LAN using the 802.11b protocol, or potentially newer technology such as 3G when that becomes available

7.3.11 Information Technology &Communications Department

Communications Division's Fixed Maintenance Unit monitors the status and security of all telecommunications facilities. This is done through the City-owned microwave system. The primary control point is located at Communications Division's headquarters at Caminito Centro. Station 38 Dispatch also monitors these conditions and can dispatch appropriate response during evenings and weekends. Currently there are no specific plans to provide this monitoring capability on any wireless network, though such capability would be highly desirable.

The Division's field technicians would be benefited greatly by the ability to access the various system management, diagnostic and monitoring capabilities from remote locations; such access would permit a single technician to troubleshoot problems that would otherwise have required the involvement of several.

As many of the technical staff spends much of their day in the field, wireless access to the City's usual suite of productivity tools would also be of great service.

7.3.12 Other Agencies

Aside from the Poway Fire Department, which utilizes the City's MDT network, neither of the other two voice radio system "customers" utilize the City's data network.

San Diego Unified School District is experimenting with IEEE 802.11b "hotspots" at school sites; San Diego Community College District currently utilizes CDPD service for its Police units.

The District is also beginning to test feeding Closed Circuit Television (security) images back to their headquarters site via their data network. They indicated that it would be very useful to be able to transmit these images to officers in the field.

7.3.13 Interference

No interference complaints have been noted regarding the City's existing data communications network. This does not mean that the problems do not exist; they may merely be masked by the other problems which regularly impact the proper operation of this network.

7.4 Dispatch, Console and Control Systems Issues, Goals & Directions

7.4.1 Police

7.4.1.1 CAD

The overall goals of the City in developing an integrated operational environment are to create a work efficient environment; provide each person with access to the system(s) to the greatest extent possible; reduce the amount of voice radio or hard copy to the minimum required; and designed for growth and extensibility.

There is also a stated long-term desire in the Police Department to perform "dynamic dispatching", where the closest available unit can be sent to the scene of an emergency, potentially improving response times significantly. This functionality cannot be implemented without Automatic Vehicle Location technology, which could not be easily added to the existing data network due to capacity issues.

The Dispatch Center currently has limited capabilities for video transmission/reception from the certain field units engaged in specialized surveillance operations. While there is no short-term plan to expand these capabilities, the capability to receive and distribute in-vehicle video, at least in special circumstances, must be considered in any long term planning.

The Police Department is in the process of implementing a new RMS system, with the intent of integrating Field Reporting into the MDC/laptops used by field personnel. The wireless technology for RMS/Field Reporting is different from that for CAD related interactions. CAD system interaction with mobile computers is primarily short in duration and performed in real time. RMS/Field Reporting involves a longer period for the data entry and generates far larger files for ultimate transmission across the wireless network. It is seldom performed in real time; generally being done when convenient for the officer. The information transfer is often not performed until the officer is at the station. Given the large file sizes, the transfer is also more suited to wireless LAN technology than the CDPD or private radio allocations commonly used for MDC implementations.

There are also deficiencies with the various facilities that the Police Department uses that could be improved by wireless technology. All facilities are wired for Local Area Networks that provide access to the various automated systems. The access is thus limited to only certain physical locations within the facility itself. This results in personnel having to seek out vacant positions to transfer data from their laptop to the systems servers for permanent entry. Wireless communications in the stations proper could greatly simplify this access, and allow the return of officers to the field more quickly.

A final deficiency related to infrastructure that was commonly mentioned is the lack of a consistent security policy for accessing the various networks (both wired and wireless).

7.4.1.2 Police CAD/RMS System Needs

The following specific needs were identified for the Police CAD system. Many of the needs identified are common to both the Police and Fire operations.

- The ability to extend the reach of their CAD/RMS capabilities beyond the stations and vehicles themselves. Currently available technology can extend communications up to 1000 feet from the vehicle

- Data capture/retrieval at the incident site with transmission back to the systems for processing

- Higher wireless bandwidth both for routine communications and to allow integration of field reporting, location/person photo images, fingerprints, voiceprints, and other large file size applications

- Better interfaces with external systems to securely transfer needed information

- A uniform security policy, or at least consistent interpretation of the security policy for networks that allows interfaces to be developed and implemented within the guidelines of the policy

- Upgrades of the Mobile Data communications systems in a manner that fosters regular replacement/upgrade of equipment and the ability to upgrade incrementally to new technologies

- The ability to consolidate data from different sources for analysis and retrieval by field personnel

- The ability to utilize wireless LAN solutions when wired solutions are impractical

- Integration of Automatic Vehicle Location and Mapping capabilities

- The ability to utilize wireless technology to set up temporary command stations

- Improved coordination for major incidents or incidents in areas with access restrictions to improve the ability to move equipment in and out

- Improved cross-agency coordination between Police and Fire systems, including the ability to automatically generate incidents in the other system. For example, a Police call-taker handling an assault call should be able to trigger a Fire/EMS response if needed with a

keystroke, without transferring the call or manually calling the other agency

- Improved Inter-Agency communications capabilities for multi-jurisdiction or mutual aid situations

- The ability to manage radio talkgroup assignments for units in the field

These common needs spawn individual implementation needs within each department, but the underlying infrastructure or capability is the same for each.

7.4.1.3 Radio Control

The Police Communications Center currently utilizes Motorola Centracom II+ CRT-based console for radio control. Our discussion with the dispatch staff revealed some issues with the in-place radio control equipment.

Their greatest complaint focused around the emergency alert trigger function of the radio system. When activated by a field unit, the alarm activates on all consoles in the Center, functionally "locking up" access until the alarm is cleared. By far, the preferred method would be for an activation to go to the "home", or primary, console for the talkgroup in question, instead of tying up all consoles.

The operators also frequently need to patch multiple talkgroups together to permit units to communicate quickly, generally in emergency situations. The dispatch staff indicated a desire to be able to cross-patch more than two talkgroups, a capability which currently exists. Additional training on this functionality seems indicated to permit the operators to make the best use of the available technology.

Dispatch staff also desired the ability to communicate easily and quickly with other agencies, particularly other law enforcement agencies and the Fire Department. Several of the communications staff indicated that hotline intercoms between the centers would simplify and expedite operations.

7.4.2 Fire & Life Safety Services

7.4.2.1 Fire/EMS

7.4.2.1.1 CAD

The Fire Department has a CAD system from TriTech Software Systems that was upgraded at the time of the establishment of the medical services partnership. The Fire and Life Safety Department actually operates three distinct dispatch operations; two are co-located at the Fire Communications Center, and provide responses to Fire incidents and Emergency Medical Services requests, and the third operation is for Lifeguards, who are located at the Lifeguard Operations Facility on Mission Bay. The CAD system serves both operations located at the Fire Communications Center, but do not directly serve the Lifeguard operations. The system is relatively full featured, including mapping capabilities. In addition to having the integrated voice and data capabilities similar to the Police Department's CAD system, the Fire system is integrated with a Station Alerting System that alerts the Fire Stations to an incoming call. This system uses a combination of wired and wireless communications.

One of the largest deficiencies in the Fire Department operations is the current Mobile Data Terminal system which has continued in use well beyond its useful life. Replacement parts have not been available from the manufacturer for several years, and at times the Department is required to cannibalize units to keep others running. At this point, the first response units are prioritized for MDT equipment. As necessary other units with MDT equipment have it removed to make it available for the first response units.

A related deficiency arises from the barriers to expanding the reach of their wired networks. Often these are physical barriers that could easily be overcome with wireless technology. There is a pilot project utilizing Palm Pilots for tracking the treatment for EMS patients. The Palm Pilot's data is handed off with the patient and upon arrival at the hospital transferred to their system. There is, however, no direct link that allow this data to be captured for reporting. The Department still staffs a position at EMS hospitals who acts as the relay point for information between the hospital system and the Fire Department system as security guidelines prevent the direct link between the systems.

The process for collecting and reporting data at fire scenes is pretty much manual and thus one-way. This becomes more so as the MDT unit inventory shrinks.

The Fire Department uses a variety of tools that constitute their RMS system. There has not been a single product available that meets their full needs. The basic tool is now Sunpro Fire RMS. Much of their data still resides on the old mainframe based system because it was not converted and put into the Sunpro system. The CAD data comes across to the Sunpro system electronically. This system is used primarily to provide State reports, but it is intended to expand to inspections. Inspection reporting is considered a

good candidate for wireless technology. Other than the State reports, reporting is a separate function. There are discrepancies in the data collection process that require human intervention to avoid loss of or incorrect reporting of the activities that actually take place. The data required to produce the reports resides in multiple locations, requiring several searches and extraction of data to be consolidated in a front end (such as one built using Microsoft Access or Seagate Crystal Reports) for the report generation process. This process would be considerably more efficient with a consolidated database.

The Department feels there is a significant deficiency in not taking advantage of other potential sources of information that would assist them. Examples are San Diego Gas & Electric for gas entry/exit data, MWWD for drainage considerations, CalTrans street video systems, Public Works data on road maintenance/closures, and the like. The Department would ultimately like to integrate this data into CAD and use to assist in real-time dynamic response planning.

Support for a major fire requires that the on-site commander acquire variety of different types of information. The current process requires multiple queries to multiple sources and is time consuming and inefficient.

7.4.3 Fire/EMS CAD System Needs

Many of the needs related to the use of wireless technology are common to both the Police and Fire operations. These include:

- The ability to extend the reach of their CAD/RMS capabilities beyond the stations and vehicles themselves
- Data capture/retrieval at the incident site with transmission back to the systems for processing
- Higher wireless bandwidth both for routine communications and to allow integration of field reporting, location/person photo images, and other large file size applications
- Better interfaces with external systems to securely transfer needed information
- A uniform security policy or at least consistent interpretation of the security policy for networks that allows interfaces to be developed and implemented within the guidelines of the policy
- Upgrades of their MDT communications systems in a manner that fosters regular replacement/upgrade of equipment and the ability to upgrade incrementally to new technologies
- The ability to consolidate data from different sources for analysis and retrieval by field personnel
- The ability to utilize wireless LAN solutions when wired solutions are impractical

- Integration of Automatic Vehicle Location and Mapping capabilities
- The ability to utilize wireless technology to set up temporary command stations
- Improved coordination for major incidents or incidents in areas with access restrictions to improve the ability to move equipment in and out
- Improved Inter-Agency communications capabilities for multi-jurisdiction or mutual aid situations
- Support for multiple jurisdictions to better enable the Department to provide contract dispatch services

These common needs spawn individual implementation needs within each department, but the underlying infrastructure or capability is the same for each.

7.4.3.1.1 Radio Control

The Fire Communications Center currently utilizes Motorola Centracom II+ CRT-based console for radio control. Interviews with the dispatch staff did not reveal any major concerns focused on the radio control equipment.

The principal concern of the dispatch staff was focused on their ability to communicate easily and quickly with other agencies, particularly the Police Department and adjoining fire agencies. Several of the communications staff indicated that hotline intercoms between the centers would simplify and expedite operations.

If the Department is successful in adding additional contract dispatch agencies, it will be necessary to improve the Fire Communications Center's connectivity to the RCS. This can be accomplished at the lowest cost through the installation of control stations programmed for the RCS, or with the highest degree of functionality by implementing direct console connection to the RCS. Additional interfaces for recording would also be required. The appropriate connection methodology should be selected based upon the needs of the potential contract dispatch client.

7.4.3.1.2 Station Alerting

While the existing methodologies for station alerting using data networking are satisfactory, there is concern for the future because the current devices were custom-made for the City. Such devices are now commercially available from a number of sources, and could be readily engineered into the system if circumstances dictated.

7.4.3.2 Lifeguard

7.4.3.2.1 CAD

At this time, the Lifeguard service has no automated information management tools. All reporting and documentation is fully manual. However, this service would benefit greatly from implementation of these devices. The Lifeguard service is very thinly manned compared to the other emergency response agencies in the City, and "force multiplier" technologies are likely to have substantial beneficial impact when applied to this agency.

7.4.3.2.2 Radio Control

Currently, the radio control system in use is a button/LED-type Motorola Centracom II console. This is being upgraded to a Centracom II+ CRT-based console that will be much simpler to use, and can integrate many of the disparate devices currently present in the Communication Center.

This console will be a remote from the Fire Department system; this technology will permit the installation of intercoms and other tools to enhance coordination between the Lifeguard service and the rest of the F&LSS organization.

Each main tower operates as a mini-dispatch operation for the segment of the water for which they are responsible. When a tower guard goes out on a rescue, they advise the main tower that they are going out. Occasionally, calls are missed. It would be of value for each main tower to be able to identify the radio that is transmitting, to mitigate this loss of data and speed backup response to the rescue.

7.4.4 Station 38

The equipment at the Station 38 facility appears older than it is. The equipment is of the same vintage as the rest of the CRT-based consoles in use throughout the City (most were installed at the time of the Trunked Radio System implementation), but the more industrial environment of the current Chollas facility seems to have been borne harder by the equipment at that site.

The consoles in use are the common Centracom II+ CRT-based systems.

The recording system, while functional, requires special tape that grows harder to find.

The workstations are small, and do not have adequate space for the reference information necessary for their tasks. They do not provide the kinds of ergonomic adjustments and support generally desired for full-time, sit-down dispatch operation.

While the facility has access to the full range of each of the public works department-specific information systems, the widely differing user interfaces are confusing to the staff, and pose an opportunity for the introduction of errors. Most of these systems do not provide CAD system-like features that would simplify the wide range of tasks these operators must perform.

Paging is performed manually, using the now-obsolete Motorola Alphamate paging device.

7.4.5 Emergency Operations Center (EOC)

The existing City EOC serves not only as the EOC, but also as the primary backup communications facility for Police, Fire, EMS and Public Works operations. Our review of the facility indicated that many of the key components that would be required to function in the event the facility was required were not fully operable.

All of the call-taking positions are equipped with obsolete Dictaphone Call-Check instant recall devices, though we could locate none that functioned.

The facility is not ADA-compliant. A long stair climb is required to enter or exit the facility.

A potential concern is the facility's location in the heart of Downtown. Previous recommended practice regarding the placement of EOC facilities has been to place them in or near the geographical and political centers of city operations and staff. In the tragic occurrences of September 11, 2001, New York's two-year-old EOC (located in the 7 World Trade Center Building) was destroyed as a result of the attacks, complicating still further New York's ability to respond to the incredible tragedies of that day. This attack has raised many serious questions about the long-established practice of locating EOC facilities in the center of cities.

Most of the Fire Communications Center staff who are interviewed claimed some knowledge of operational procedures which they would be required to utilize in the event they were required to operate from the EOC. The Public Works communications staff is also largely conceptually aware of what would be required to relocate to the EOC. For Police, only supervisors and managers seemed to be aware of the procedures and practices.

The following steps need to be taken to provide the City with an effective backup communications facility, as well as effective EOC communications.

- Update radio control equipment to Centracom II+ CRT-based consoles to minimize differences between primary and secondary facilities

- Replace obsolete 1A2-type key telephones used for 9-1-1 answering with Nortel/PEI equipment used in other City PSAPs and configure for enhanced 9-1-1 services such as ANI and ALI

- Provide remote access to various required computer systems, such as CAD systems, law enforcement databases for authorized users, and departmental work order management systems

- Provide regular formal training with annual refresher courses on operations in the backup facility

- Perform formal quarterly technology tests to verify proper operation of systems

- Perform yearly operational exercise of operating from backup facility[7]

The need to take these actions is immediate; there are no effective alternatives in place for backup of these critical City dispatch facilities.

7.4.6 Dispatch Facilities

The City's key public safety and service dispatch facilities are all currently at, or nearing, physical capacity. No expansion space is available in the existing Police, Fire/EMS, or Public Service facilities, yet the City expects increases in demand for services and facilities as population increases during the 10-year planning horizon.

No space exists in the current Police and F&LSS dispatch facilities to accommodate the significant amount of equipment that will be required to support a new City Trunked Radio, Microwave and Mobile Data Systems, which will need to be installed in parallel with the existing technology.

Another issue that arose in the review of both Police and Fire/EMS dispatch operations was the lack of adequate backup facilities if the primary facilities were unavailable for any reason. The City EOC clearly lacks the required capability to act as an effective backup. While incoming 9-1-1 calls can be re-routed to non-City facilities, the incoming traffic would quickly swamp the smaller centers currently targeted to receive them. Also, few effective communications facilities exist to dispatch those calls to field forces once they have been received.

[7] The backup facility should be configured so that it can operate in a "load-sharing" mode with each of the primary facilities. If configured in this manner, the backup center can be readily tested without requiring complete, high-risk relocation, and can be used to address unusually high-traffic periods by supplementing the primary facilities. The telephone switches used to support both Police and Fire PSAPs can be readily configured to support this mode of operation.

Training is also a problem, as no space is available at either dispatch facility for off-line training of new communications personnel.

It is apparent that the City requires a multi-function communications facility to address these needs. This facility would provide the following functions:

- 9-1-1 Primary Public Safety Answering Point
- Primary Police Communications Center
- Primary Fire/EMS Communications Center
- Secondary Lifeguard Communications Center
- Backup City Emergency Operations Center
- Prime site for wireless communications network infrastructure

This facility will require a major undertaking for the City. It is estimated that the cost of such a facility will be between $15M and $20M. However, it is essential that the City plan for, and provide space and growth capabilities, for these critical life saving services.

Given the criticality of the public safety communications function, a backup facility is also vital for the City's critical public safety services. Use of the primary facility can be denied by anything that could force an evacuation of the center, such as a hazardous material incident nearby. The backup facility should operate on a "hot-standby" basis, capable of immediate operation.

Ideally, the backup facility will be equipped with the same components in use at the primary facility. This will permit the on-duty staff, upon relocation from the primary site, to immediately resume operations without delay. Further, common equipment will permit the use of the backup facility as a training site for new City dispatch staff, enabling highly realistic training without placing anyone at potential risk.

Providing this facility with City-strategic day-to-day activities, such as the 3-1-1 function, the Station 38 Public Service dispatch operations, and radio operator/call-taker training will ensure that the facility does not fall into disrepair, as is often the case with facilities used only for backup purposes. With proper engineering of the communications systems, the facility could also be used in parallel with the existing facilities, providing supplemental dispatch and call-taking capacity in the event of a large-scale emergency.

The existing Fire Communications Center would be ideal for this purpose, once primary Fire Communications activities relocate to a new center. The existing Police Communications Center and supporting equipment space would be returned to other uses. The existing Station 38 space would be re-purposed as additional communications equipment/technical space.

7.5 Subscriber Equipment

In the end-user interviews, almost all had strongly held opinions regarding some aspect of the communications equipment they use in their daily tasks.

Most of the staff interviewed are tired of carrying around multiple – sometimes up to four – communications devices, some of which are heavy. Everybody wants **one multi-function device**, or perhaps, realizing that not all devices work all the time, two multi-function devices, with ability to send and receive text messages, and ability to use it as a radio and a cell phone.

This desire may not be that difficult to implement. The new XTS 5000 Models II and III handheld radios from Motorola provide a 4 line by 12 character, fully bit-mapped display that supports the Wireless Application Protocol (WAP) standard, and Short Messaging Service (SMS) standard. It can also make telephone calls over an appropriately equipped network. This capability is already extant in the current network, although it is infrequently used to avoid system busies from channels tied up with lengthy telephone interconnect traffic.

The second most-mentioned improvement that respondents want is **hands-free** use of the communications device(s). This is particularly important to firefighters. Similarly, ambulance crews would like voice-activated radio, especially if a paramedic is in the back of an ambulance by themselves. For example, the City of Carlsbad utilizes footswitches on the floor in their ambulances as a solution to this problem.

7.5.1 Portable Radio Equipment

The most common set of complaints from portable radio users involved the radio's battery. These included:

- They become loose and lose the connection
- They don't take a full charge
- It's hard to tell when they are charged

These complaints were very common across the entire base of portable radio users, but were particularly common among 800 MHz users.

Ease of use. Respondents just want to be able to communicate quickly and effectively with the minimum of fiddling with the device. If radios had only two buttons, most respondents would be satisfied.

Specific requests were made during the end-user interview process. While most of the specific requests came from Fire & Life Safety personnel, many of these improvements would address issues faced by other City users as well. These requests include:

- Improved coverage from inside buildings and hospitals
- Additional radios - one for each person
- Improved functional compatibility with breathing apparatus - current audio accessories are not compatible with BAs currently in use
- Bone-conduction microphones & speakers, or radios integrated into their masks, such as are found in Europe (e.g. Inter-Spiro)
- Function Locks for volume and channel settings
- Brighter colors and/or luminescent strip for radio external case – hard to see at night when dropped
- Waterproof to resist both body moisture inside their turnouts and fire-fighting water
- Lighter weight
- Smaller radios
- Larger screen
- Easier navigation features
- Voice indication of talkgroup/channel setting of radio on channel change
- Voice command of radio functions
- Improved inter-department interoperability, particularly between PD, Fire, Lifeguards and Harbor Patrol, without having to switch to SDMA talkgroups that require dispatch interaction
- Universal hailing channel that all radios would scan automatically -- must not require system access to function. An officer/firefighter down in a building may not be able to successfully access the system, but they can probably successfully communicate on-site directly
- Mobile charging capability for portable radios in the unit
- Ability to "chat" easily and quickly within small groups without going through dispatch
- Want to be able to communicate better inside buildings. The signal to alert for a possible building collapse is the air horn, but sometimes firefighters can't hear that in a building

- Would like radios to be able to scan, recognize each other and set appropriate channels/talkgroups automatically
- Need multiple levels of radio cost and sophistication; functionally unnecessary (and fiscally inappropriate) to give maintenance worker the same radio as a police officer or fire fighter

7.5.2 Mobile Radio Equipment

Few users commented on the in-vehicle radios directly; the users' focus was on the portable radio equipment. Certainly, it would be necessary to integrate many of the channel/talkgroup management and scan features described for the portable radios into the vehicular equipment as well to maximize the desired functionality.

The only specific vehicle-focused comment came from the School District, who are quite concerned that any new or revised system be able to accommodate radios with very basic functionality and low acquisition cost, as they had a large fleet of school buses (over 550) that had only the most basic of communications needs. They also have a need for the simple radios to be able to be regrouped dynamically, particularly in an emergency.

7.5.3 Paging Receivers

While users expressed general satisfaction with the paging system, the equipment in use is far from current. This circumstance is mandated by the signaling technology employed by the paging network. This issue is discussed in detail later in this document.

The following concerns were noted regarding the pagers:

- Users strongly desire newer technology, smaller pagers
- The Out-of-Range notification feature, which currently exists, is of great utility
- Improved backlighting of display - too hard to read in low ambient light environments
- Elimination of rechargeable batteries, which require life-cycle management, and moving toward disposable batteries, which do not

7.5.4 Mobile Data Terminals

Many specific comments were received from users regarding the inadequacies of the existing Mobile Data System. However, since the system is obsolete, manufacturer-discontinued, and must be replaced; and, since any more technologically current solution would inherently address the overwhelming majority of the concerns raised, the bulk of these concerns will not be addressed in detail here.

There is one specific issue that merits review -- access to the MDT/MDC from outside of a vehicle. With most current technologies, an officer (or firefighter) must be in their unit to access the system. Often times, the exigencies of a situation prevent a user from waiting in their vehicle for a response from a remote database or for a transmission to execute when the system is busy. Thus, a portable access device is desired that would permit access to the in-vehicle device from the area adjacent to the vehicle.

The following general comments were noted regarding MDT/MDC operation, and merit consideration in planning a new system:

- Trying to read the MDT in a vehicle bouncing down the street is difficult
- Trying to type in a moving vehicle bouncing around is difficult
- It is hard to see the MDT keys at night. Touch-screen technology, like that frequently used in restaurant point-of-sale terminals, might help this problem
- MDT screen blurs from vibration

7.6 Fixed Wireless

The City has substantial needs for fixed, point-to-point wireless communications systems. These are the systems that tie together key points of communications with high-capacity, high reliability links that are be truly dependable.

7.6.1 High Capacity Solutions

A properly engineered (to public safety standards) fixed wireless link is at least 99.999% reliable, which means statistically that the circuit is unavailable less than six seconds in a year. This is the level of dependability the City has received from its currently installed fixed wireless systems.

The City is facing requirements for significant additional transmission capacity. The Water Department desires a network capable of transmitting multiple DS-3s to connect its key facilities. The construction of a new Trunked Radio System would create very significant needs for additional interconnection facilities. The addition of receiver sites will require new spur links to sites not currently served.

The existing backbone network -- while it has served well for many years -- is in need of replacement. Almost all of the current components are no longer manufactured, and parts support will become a long-term challenge. The network is not centrally timed, and so has difficulty supporting sophisticated data applications of the kind desired by City users both today and in the future.

Based on observations and the available data regarding usage projections, the replacement system will require either OC-3 or 3 X DS-3 capacity radios (155 Mb/s) for most backbone locations. The decision regarding the selection of the OC-3 or the 3 X DS-3 capacity would depend on decisions the City made regarding bandwidth management choices, as discussed in the following section.

7.6.1.1 Bandwidth Management

While the scope of this project does not include addressing overall City transmission networks, certainly the City's requirements are substantial. SANNET uses an extensive network of telephone company-provided high-speed circuits to provide services. The needed revisions to the microwave network will provide significant added transmission capacity. However, as the City adds capacity to its networks, the ability to manage and utilize that bandwidth as cost-effectively as possible grows even greater.

One tool that the City can use to more efficiently utilize its transmission capacity is called a Digital Access Cross-Connect System, or DACS. A DACS allows individual DS-0 (64 Kb/s) level channels of a constituent DS-1 (T-1) or higher level signal to be “patched”, or individually cross-connected to each other.

This capability allows a network operator to "groom" the backbone. For example, according to the EMA Network Recommendations Report, the Water Department requires 147 DS-0 circuits for SCADA transmission to the Central Operations Facility. This equates to 6.125 DS-1 circuits. Without a DACS, it would be necessary to provision 7 DS-1 backbone circuits to carry the traffic; the remaining 21 DS-0 circuits would be wasted -- representing a waste of more than 14% of the required bandwidth.

With a DACS, only the 147 DS-0 circuits would be provisioned, and no backbone capacity is wasted.

Management is also simplified. If a route needs to be removed from service for any reason, the network can be quickly reconfigured to switch traffic to alternate routes without having to dispatch a technician to make the changes. The changes are also far faster and less disruptive than with manual methods. Further, provisioning can be done centrally, reducing the amount of work required to implement new service or changes, and minimizing the likelihood of unplanned outages due to field errors.

A DACS solution is the simplest approach to this management; however, it would not be capable of integrating SANNET's carrier-provided ATM-based capacity. Alternatively, more complex cell-relay-based solutions allow transmissions to function at the packet level without requiring partition into traditional DS-0 level channels. This is the most efficient approach to the backbone, and would potentially permit transparent integration of SANNET transmission capacity and City microwave system transmission capacity.

The City should evaluate these issues and develop an integrated bandwidth management strategy to ensure it receives the maximum value for its bandwidth dollar.

7.6.2 Fixed Medium-Capacity Solutions

It is certainly technically possible that the City's high-capacity backbone can provide cost-effective distribution to moderate-size, high-importance facilities such as police area stations and similarly sized facilities. Such service can be provided by the use of a range of products operating on either licensed or non-licensed frequencies, and can be engineered to meet the 99.999% availability standard desired for public safety communications facilities.

While the implementation of such services is not technically challenging, the economics involved are somewhat less transparent. A detailed cost comparison between existing methodologies and a fixed wireless solution will be necessary prior to making specific need statements in this regard.

7.6.3 Wireless LANs

There is a significant pent-up demand among City departments for the implementation of wireless local area networks, in particular for networks which utilize IEEE 802.11b "Wi-Fi" standards.

During initial interviews with ITGC members, upon being asked "What are you looking for from wireless technology for the future?", almost without exception they replied, "wireless LANs", as their first response.

Wireless LANs are very useful. They are also inherently insecure. The integral security capability, the so-called "Wired Equivalent Privacy", is easily defeated with cracking tools generally available on the Internet, even though it uses 128-bit encryption. The built-in security features are worse than worthless -- they provide the user with a false sense of security.

While these networks are not secure, that is not to say that they cannot be *made* secure. The same tools used for Virtual Private Networking (VPN) and remote access work very nicely over wireless LANs to provide a highly secure operating environment.

For any implementation of wireless networking to provide the necessary degree of safety and security for the confidential data used by the City, we must make one basic assumption: the wireless network -- that is to say the transmission medium itself -- is insecure and can never be trusted to provide security.

If we make the assumption that the wireless network -- again, ANY wireless network[8] -- is inherently insecure, we can then take steps *outside* of the transmission chain to render that communication secure. This is the basic presumption of VPN technology.

An effective VPN/Remote Access strategy is ultimately at the heart of any effective wireless data plan for the City. It is with the use of these tools that the City can implement a consistent, reliable, proven and manageable approach to permitting system access from outside the wired environment.

However, the City has not, to date, developed standards and practices for remote access. This is a source of frustration to ITGC members, who, in interviews, reported remote access/VPN as the technology they *second* most desired, after wireless access. Clearly, the City needs to define such standards to provide this highly cost-effective technology.

[8] Multiple independent sources have alleged that several San Diego-area members of the media monitor traffic on the existing City MDT system. There is certainly no technical reason this cannot be so. It requires only a PC with an appropriate sound card (not all will work) and software available for free on the Internet. The putative user must have sufficient technical skill to make a minor modification to their receiver, as processed and recovered audio will not work, and initial alignment requires a minor degree of technical sophistication. Most users are unaware that traffic on the existing system is NOT encrypted. Data is transmitted completely in the clear. System "security" is derived from the obscure modulation methods used by the system.

7.6.3.1 Implementation, Operation and Management Issues

To effectively implement Wireless LAN technology throughout the City will require a combination of skills and expertise.

Wireless LAN equipment manufacturers attempt to simplify the amount of effort required to implement a wireless network from a radio frequency perspective. But like any wireless system, proper attention to engineering considerations will result in a network with higher long-term reliability, generally reduced initial cost, and greatly reduced cost of ownership through reductions in time spent troubleshooting mysterious failures.

Since these technologies operate in frequency bands not exclusive to them, a system operator must be prepared to address highly technical RF interference issues, particularly in an environment as diverse as the City's.

A hybrid effort will be needed for the City to implement these technologies optimally. Clearly, the network design and operations staff from San Diego Data Processing Corporation must address the design of the wired transport elements. This work would include provisioning LAN segments or VLANs to carry the "contaminated" wireless traffic back to the VPN concentrator/access device apart from the trusted wired traffic, and making whatever configuration changes in the City network that may be called for to transport this traffic.

Communications Division will handle the design, construction and operation of the radio frequency elements of the network, including access device placement, coverage design, troubleshooting of RF transport, and interference identification and resolution.

Existing support procedures can be followed. However, front line support personnel will require additional training on the support of the access devices.

7.6.4 SCADA

The Water and Metropolitan Wastewater Departments have made significant investments in the implementation of Supervisory Control and Data Acquisition (SCADA) networks to control and monitor their far-flung resources. The investment made in these networks has been appropriate and highly cost-effective compared to other alternatives, and should be continued. These networks will continue to be expanded to service additional sites and upgraded where necessary.

These networks are of the greatest sensitivity to the proper operation of the water and sewer network of the City; these systems absolutely require public safety-grade dependability.

Any potential use of an improved City wireless data network for these applications must meet the same level of reliability as any public safety application. A thorough program

of testing must be carried out, and pilot implementations performed to verify the results of testing, prior to any large-scale implementation of new technologies in these systems.

7.6.5 Other Applications

Other, lower-bandwidth needs exist for point-to-point wireless communications throughout the City. Potential applications include:

- Irrigation Control
- Park Lighting Control
- Traffic Management
- Message Board Control
- Facility Control (HVAC, Lighting, Security)

For some of these applications that do not require full two-way control or complete assurance that a command was received, paging technology can be utilized to provide a very low cost control capability. A specially modified paging receiver provides control outputs that can be used to control relays connected to a load, or text to a remote display device.

For more demanding applications, it is likely that an improved City data network will be able to cost-effectively meet these requirements. Assuming satisfactory testing, it is possible that F&LSS might eliminate the current carrier-provided T-1 currently provisioned to each fire station to provide network connection and station alerting. Such a move could save hundreds of thousands of dollars annually.

7.7 3-1-1 Issues

The City of San Diego, as one might expect from the nation's seventh largest city, is organizationally complex. It can be difficult for the average citizen to discern which City operation should be contacted to address a particular issue or service requirement.

Many of the individual departments have been quite progressive in their implementation of "customer-friendly" practices, and have implemented effective technology solutions to support those practices.

However, it can still be an exercise in frustration for a citizen to find the correct contact in City Government to address their problem.

This is the promise of the 3-1-1 municipal access number: to provide a single, all-purpose number that citizens can use to provide a single point of entry into the complex municipal environment for non-emergency matters.

Some cities have implemented 3-1-1 operations with a particular focus. For example, Chicago publicizes its system more as the non-emergency access point for police issues, such as cold report calls and noise complaints, as it is staffed by police personnel. San Antonio's focus is more on access to municipal services. Each city's unit, however, provides full access for all callers to any required municipal service.

Because of the highly divergent nature of the various City departmental methods and practices, systems and technologies in use, it is improbable that the City can currently achieve the kind of cost reductions that could be attainable if department call center operations could be centrally combined into a single unit. This is a desirable long-term goal that could be achieved with an intensive, high-level program, focused on the development of enterprise software solutions that would provide a common user interface and integrate databases effectively and transparently.

The long-term directions laid out in the City's Information Technology Strategic Plan of integration and similar systems will go a long way toward achieving this goal.

What is achievable today is an initial single point of contact that can directly address common citizens' issues, ensure callers are routed to the correct location, and reduce the time and frustration level of the community in its efforts to reach its government. This approach is being taken in cities as an immediately implementable approach to enhance service delivery.

The City of San Diego already operates an important resource that can be built upon as the foundation of a sound 3-1-1 operation: the Station 38 Dispatch Center located at the Chollas Operations Center.

One option is to combine this operation with the existing City Information Center function, and give it the charter of ensuring calls are routed to the proper function within the City. As integration of tools and resources between departments improves, the role of this call center can be expanded appropriately over time.

7.8 City-Owned Paging System

7.8.1 General

The City-Owned Paging System provides critical support to the daily operations of the Fire and Life Safety Services Department, as well as other City operations. In the F&LSS application, the City's system cannot be readily replaced by private carrier-provided paging, due to the speed required and criticality of the mission. Therefore, the system will need to continue in operation if, for no other reason, than to support F&LSS needs. Once present, other departments can readily "come along for the ride", (within limits, to ensure airtime for emergency pages) and receive highly dependable paging service for costs competitive with commercial services.

However, it appears the technological obsolescence now requires City to make a major investment in the system. The primary encoding format for the current paging system (Golay Sequential Code, GSC or "Golay") is no longer supported by its creator, Motorola, and the paging equipment industry no longer manufactures pagers which can operate with this format. Similarly, the City's paging terminal is no longer manufactured, and the end of direct support is clearly on the horizon.

Complicating the switch is the F&LSS use of the "Carbon Copy" feature of the GSC protocol. This features provides for the transmission of the same message to up to 16 pagers at once without having to repeat the message information, conserving airtime, and permitting the quick delivery of emergency pages to all involved parties simultaneously.

The paging industry trend had generally been to replace Golay-based systems (which only operate at 300/600 baud) with a UK-developed standard called POCSAG. (Post Office Code Standards Advisory Group) This format operates at speeds of 600, 1200 and even 2400 baud. Unfortunately, this format does not support any functionality similar to the Carbon Copy feature, and even operating at its highest speed, would still require twice the time to alert the same number of pagers. A further disadvantage still is that to achieve this speed, a significant price must be paid in terms of reduced pager sensitivity. Thus, it would be necessary to significantly increase transmitter power and/or the number of sites to achieve the same level of reliability previously enjoyed.

A newer format has been created that is designed to specifically support large, carrier-owned paging systems that has enjoyed wide acceptance in the paging community. This format is called FLEX™.

7.8.2 FLEX™ Technology

Created by Motorola, FLEX technology addresses the paging industry's need to expand beyond the limitations of other paging protocols currently available. In addition, it provides the platform for advanced paging services. The FLEX protocol has become the

worldwide de facto standard for one-way high-speed paging. Since the first shipment of this technology in January 1995, over 35 million FLEX-based paging devices have been shipped. It provides the fastest paging speed available anywhere, quadruples the capacity of existing POCSAG systems and significantly improves paging reliability. It maintains data integrity by providing prudent error protection against multi-path reflections and simulcast interference, and by keeping the pager continuously in synchronization with the paging transmission.

The FLEX protocol enables paging speeds up to 6400 bits per second (bps). This is achieved through multiplexing up to four data streams into one 6400 bps transmission. Each data stream, or phase, operates independently and pagers may decode multiple phases or a single phase; a single phase pager may be less costly and operate with longer battery life.

The FLEX protocol is a fully synchronous multi-speed signaling code that is optimized for throughput, efficiency and flexibility. With its greater reliability, FLEX technology offers improved page delivery. This means that heavy traffic-hour delays are minimized, thus reducing or eliminating redials into the paging terminal and subsequent over-the-air re-transmissions. Not only does this lead to increased user satisfaction, but also ensures more efficient use of infrastructure resources such as telephone inputs and air time.

FLEX technology gives pager users exceptional protection against signal fading, which translates to improved page reliability for all paging services, especially alphanumeric and information services. When there is a variation in signal strength, the FLEX protocol is able to withstand a 10 millisecond fade at all speeds and still accurately decode the information. The FLEX protocol improves reliability through checksum validations (an error detection mechanism); message numbering which allows for missed message retrieval; and positive end of message control (by specifying the length of a message).

In pagers that utilize the synchronous FLEX protocol, a battery can last more than five times longer than in pagers running on POCSAG. The pager works in tandem with the transmitting station and searches for its cap code only a fraction of the time, therefore saving power. This improved battery life allows the use of smaller batteries.

Finally (and possibly the most important), the FLEX protocol provides “dynamic group calling” that is essentially the same functionality as the Golay Carbon Copy. With the use of this feature, and the higher base speed of the FLEX technology, it would be possible to alert 16 pagers of a fire call in 2.5 seconds vs. 12 seconds in the current environment, even at the lowest FLEX speed. Further, the robust encoding of the FLEX protocol makes the signal more likely to be successfully and accurately decoded, even at low signal levels.

The transition to FLEX need not be instantaneous; a phased transition can be made. Both FLEX and Golay pagers can be readily accommodated on the same channel with a new terminal, as described below.

7.8.3 New Technology Will Permit Broader Use of Paging

Many City departments and outside agencies would like to utilize the City system, but report having been discouraged from doing so by cost or usage limitations. There have been concerns regarding long alphanumeric transmissions from other departments and agencies delaying the transmission of life-safety emergency pages that have driven previous administrative decisions regarding acceptable use. A revised paging technology changes this need entirely. Between the higher speed available for the transmission and the priority processing supported by most modern paging terminals, Fire and Life Safety Services can be assured of improved performance compared to the existing system, while allowing other departments to enhance their operations as well.

Many modern paging terminals support priority page processing levels, assigned by cap code. Let us say that six levels are supported in the terminal. (For purposed of discussion, we will number them 1 to 6 in decreasing priority.) For example, Fire pagers would have Level 2 routinely assigned for their personal cap code, and Park and Recreation would have Level 6. On a routine basis, P&R's pages would be queued if any of Fire's pages were in the system, and held until all Fire pages had been sent. However, P&R may have established a cap code that is used to send immediate advisories of missing children. This cap code could be assigned Level 2, so it would be sent with the same priority as a fire call, or it could even be set as a Level 1, and be sent in front of fire calls. Thus, the priority can be established based on the nature of the page, rather than the day-to-day status of the individual pager user.

In considering the delays potentially imposed on lower priority users in a prioritized environment, it should be considered that the total transmission time of a single address, 240 character alphanumeric page in a 1600 bps FLEX system is approximately 1.6 seconds, versus 8.6 seconds in the current Golay system.

With the combination of prioritization and increased transmission speed, the system can be safely opened up to both more users and more uses without negative impact on the most important daily use -- Fire and Life Safety dispatch.

7.8.4 Infrastructure Additions

While users report that the existing system is, as a general matter, reliable, there are a number of areas where system coverage is desired but is not currently provided, and areas where added reliability and building penetration would be of value. Coverage is also needed outside of City Limits to ensure quick staff notifications of emergency situations requiring callback as well as more routine matters.

IT&C Staff envision adding transmitters at three additional sites to improve penetration and reliability. Specific sites under review as of this writing include Cowles Mountain, which will improve coverage in the eastern areas of the City, much of the Mesa, and in Mission Valley; San Ysidro, which will improve coverage in the border areas; and Lake

San Marcos, which will significantly improve coverage throughout the North County area.

An open issue is that of East County coverage. While the population in the area is relatively low, there are a comparatively large number of police officers and fire fighters who live in the East County, and many requests were received to improve coverage in the east. Lyons Peak, in its current configuration, does not provide the needed coverage into this area. This site either needs further development or needs to be supplemented with another site suitable to cover the East County area.

Adding a transmitter on Cuyamaca Peak would certainly enhance the coverage in that area; it would also cover two-thirds of Imperial County (and well into Arizona) with paging-grade signal, as well as putting a very audible signal into much of central and western Orange County and southern Los Angeles County. Since the City is co-channel with the Salton Community Services District in Imperial County and the Midway City Sanitary District in central Orange County, the City of El Monte in Los Angeles County, as well as Cambria CSD and the City of Santa Barbara further north, a more cautious approach to coverage will need to be taken. The State of Arizona also operates a system at its prison in Yuma on this frequency. While other, lower sites may prove viable to address the eastern coverage needs, the City may wish to consider relocating certain of these users to alternate frequencies as another option to permit broader coverage without creating harmful interference.

The paging terminal should be more directly connected to the City's WAN, so that alphanumeric pages can be more readily placed from on-network devices, including mobile devices, reducing the City's dependence on the Alphamate, a now-discontinued paging entry device widely used throughout the City. Elimination of the Alphamates will also permit the elimination of a significant number of analog telephone lines currently dedicated to this task. Departmental paging servers can be established to provide this connection using the Telocator Network Paging Protocol (TNPP).

7.8.5 Advanced Pager Technologies

Many users have indicated a desire for two-way paging, both to send a message in response to a page as well as to simply confirm response. Certainly, it would be of value to be able to positively verify receipt of a dispatch by an EMS crew, or to permit text messages to be sent from the field by a supervisor back to their office.

This capability has grown to become a very important element in carrier-provided paging; more than 40% of all pagers in use today are two-way devices. However, this technology poses challenges for the City's use.

First, the pagers are only currently available to operate in the private carrier band around 900 MHz. There are no such devices that can operate in the spectrum currently in use by the City. Second, it would be necessary to establish a considerable infrastructure to receive the devices' response transmissions, which operate at less than half of a Watt.

The pagers are also considerably more expensive; the lowest cost devices cost $185.00 each in small quantities vs. $81.00 for the top-of-the-line one-way FLEX pager.

With the departure of Motorola from the paging business, many of the companies who were manufacturing products for Motorola have begun to market these products themselves, often at a far lower cost than at which they were sold by Motorola.

7.9 Public Network-Based Systems

There is no question that City employees and operations have grown to become very dependent upon Public Network Systems. These systems and services have formed an important (but not very visible) link in the City's operational backbone. If the City's access to these services were denied for any reason, City operations would sustain a substantial negative impact. This section describes the City's use of the various public systems.

7.9.1 Cellular Telephones/Other Mobile Telephones

The City operates over 2,000 cellular telephones with its primary cellular telephone service provider, Verizon Wireless. Additionally, over 2,000 City employees have personally-owned cellular telephones through an employee service plan. Our end-user interviews disclosed that many of these personally-owned phones are used quite frequently for City business, often by employees who were unable, for a variety of reasons, to obtain a City-provided phone. The City signed this agreement in November, 2000, for an initial period of two years, with three one-year renewal options.

The City also has an agreement with Nextel Communications for services. These devices, which operate in the same radio spectrum as the City's primary radio system[9], are a hybrid device that combines the functions of a portable telephone, pager, and portable two-way radio.[10] The City operates several hundred of these devices. Key user concentrations are in the Police Department, Environmental Services Department, General Services, SDDPC, and among City Public Information Officers. MWWD has expressed a desire to increase their usage of the Nextel devices. These groups have generally selected this technology for the two-way radio functionality it provides.

Additionally, the City has entered into a technology partnership agreement with Verizon Wireless. This agreement provides for the City to have "first look" privileges with new technologies as they are rolled out into the marketplace. The City is now beginning tests on Verizon's higher speed data services, called Verizon Express Network, which are expected to provide transmission speeds as high as 144 Kb/s.

It is unlikely that the City's use of Cellular Mobile Telephones is likely to decrease. Interviews with City staff indicate that many members (regardless of department or

[9] Both the City's system and the Nextel system operate in the 800 MHz band, in some cases on adjacent frequencies. However, the devices are completely non-interoperable; a Nextel device uses a completely different modulation scheme and technology backbone from the City's system. These differences have been the source of significant interference with the City's radio system, and have been the focus of ongoing resolution efforts by IT&C staff for several years. This problem is discussed in more detail in the "Interference" sections of this document.

[10] While the technologies used by the City's radio network and the Nextel system do not permit direct interoperation, it ought to be technically feasible to devise an interface that would permit connectivity between the systems. Such an interface would provide an ability for a Nextel conversation to be heard on the City radio system, and vice versa. This would be potentially useful in several applications to promote both internal and external interoperability, notably with Federal agencies that have made wide use of the Nextel network. This interface is not currently commercially available.

assignment) prefer to use telephone devices over City radio systems. Key factors driving this preference include a full duplex (telephone-style) connection; perceived security of communications; ease of use; size and portability of equipment; and relative ubiquity of service, even inside structures where City radios may not function reliably.

7.9.2 Mobile Data Transmission

For purposes of this plan, we have divided the City's mobile data communications requirements into two principal categories: High-Speed services, namely those that operate at a speed of 64 Kilobits/Second or greater; and Low-Speed services, those that operate below 64 Kilobits/Second.

At this time, a wide variety of vendor-provided services are available that operate at the higher-speeds required to make feasible the deployment of advanced networking technologies to City field forces.

7.9.2.1 Low-Speed Data

7.9.2.1.1 CDPD (Cellular Digital Packet Data)

CDPD is a packet-based data transmission service that operates on idle cellular telephone frequencies. The service is only available in the San Diego area through AT&T Wireless. The City has had extensive experience with this service.

The City has been utilizing these services since 1997, originally to address data transmission needs of the Police Department. As previously documented in this report, the existing City MDT Network is deficient in many regards. It was too slow and equipment was not available to address the needs of the applications desired by the Police Department. This technology has proven itself to be an acceptable alternative to the City MDT Network, and its use has been expanded to other departments.

CDPD technology, with its inherent 19.2 Kb/s speed limit, is not a long-term solution to the City's mobile data transmission requirements. Speeds greater than 400 Kb/s are probably necessary in the long run. CDPD, along with other, more recently introduced technologies can serve as an effective bridge technology between the current environment (nothing) and the higher-performance applications envisioned by most City departments.

Further, industry sources have indicated a plan to begin phase-out of CDPD services in favor of newer alternatives. CDPD service is not expected to be available beyond the end of 2004.

7.9.2.1.2 Palm.Net, Blackberry, Two-Way Pagers & Other Messaging Devices

The City has a small base of users (approximately 100) who are currently utilizing Palm.Net services to provide remote access to E-mail, calendaring, and other such "productivity" applications on Palm Pilot Personal Digital Assistant devices, known as PDAs. This service is carried on the Cingular Wireless Data Network (formerly known as RAM Mobile Data) and operates at a speed of 9.6 Kb/S. This is the same network that provides transmission services to the very popular Research-In-Motion (RIM) Blackberry devices[11], though the two do not directly interoperate.

As the City migrates over time toward standards-based COTS applications, many of the applications the City may elect to implement will have provisions for the use of a variety of commercially-provided networks to provide field access to information, particularly in work order tracking systems.

We have seen systems in the marketplace that can function with Blackberry, Nextel, Palm.Net, two-way Pagers, and a variety of cellular and PCS telephones.

Adoption of these technologies must be carefully considered. The networks upon which they operate are not designed to public safety standards, nor do they offer any prioritization capability for public safety/service traffic. Thus, in a large-scale emergency, when access to these services will be most desired by City users, users are likely to find the service functions poorly, if at all.

Further, security concerns with these devices are considerable; generally their transmissions are not encrypted or secured in any way[12]. Any properly equipped individual can intercept the messages sent and received by these devices. Therefore, their use in potentially sensitive applications must be carefully considered.

The ease of use, economy and value of these types of devices mean they will eventually find a role in the City's networks; considerable discretion should be used in the ultimate development of that role.

7.9.2.1.3 Paging

The primary driver for the existence of the City's Paging System is the need of the Fire & Life Safety Services Department for a secondary dispatch notification system to stations, and for fire crews in the field. Their foremost need is for a paging system that will very quickly notify recipients of messages with a high degree of dependability. This requirement for dependability is the reason commercial paging services cannot meet the needs of F&LSS. Thus, the City will need to continue to provide this service for the foreseeable future. Once the infrastructure has been established, the incremental cost of

[11] RIM Blackberry devices have been announced for other networks, including AT&T Wireless and Nextel.
[12] RIM's Blackberry can be operated in a secure environment, when used in conjunction with a complete Microsoft Exchange enterprise-wide solution, at considerable additional expense than the standard offering.

adding an additional user to the paging system is very low indeed – essentially the cost of the pager and a few minutes of staff time to program it into the paging system. Given these facts, it is likely that the City will reasonably continue to provide the bulk of its own paging services long into the future.

7.9.2.2 High-Speed Data

7.9.2.2.1 Ricochet

Ricochet's technology provides high-speed, wire-free Internet access over a unique data network. Ricochet typically runs at speeds over 175 Kb/S, with bursts to 400 Kb/S. Ricochet operates from an easy-to-use desktop modem or a PC modem card. It does not require a visit by a technician to install hardware or service lines to the user location. These speeds are not future promises -- they are deliverable today with the network in place.

Under the agreement with Ricochet, the City receives a large number of both modems and subscriptions; these will be valuable for roles such as providing Internet access services to parks, and other such roles where their loss due to power failure will not put lives at risk.

7.9.2.2.2 Verizon Wireless

Verizon Wireless is currently the largest wireless carrier in the United States. They have recently began offering 1xRTT high-speed wireless data service under the name of Verizon Wireless "Express Network". This technology is an overlay of an older technology called "Code Division Multiple Access", commonly referred to as CDMA (IS-95), making the phones and other devices backwards compatible for use in non-1xRTT areas or overseas (usually at the maximum data rate of 14.4 kbps).

The Verizon Wireless Express Network is capable of data speeds bursting up to 144 kbps, however currently the network only provides an average speed of 40-60 kbps. Verizon states that once their networks have been optimized the higher data speeds will be possible, which is expected to occur by 1Q 2003. Even though this service is not currently available nationwide, it is available in the greater San Diego area and most of Southern California.

Verizon has partnered with Microsoft for high-speed web access, which is marketed under the name "Mobile Web" offering the usual MSN suite of services and Accenture, which provides access to their Mobile Service Bureau line of enterprise resources. Verizon also partnered with several manufacturers including Qualcomm (several phones), Audiovox Communications (a PocketPC with phone built-in) and Sierra Wireless (PCMCIA card), all of which offer a wide variety of products that work on their Express Network.

While their focus to date has been on providing consumer-focused services, the system can easily transport private network applications as well.

Verizon Wireless offers their Express Network with a variety of calling plans including one unlimited data plan (voice services extra) for $99.99 per month. Prices include using Verizon's slower speed "Quick 2 Net" option when the 1xRTT network is unavailable. The City has not established contract pricing for this service.

It is our opinion that this service provides the best "bridge" technology currently available for public safety data applications until the City can construct a private data network.

7.9.2.3 Police Department

The Police Department currently has approximately 500 CDPD devices in use to support its Automated Field Reporting System and Records Management System, as well as basic dispatch mobile data operations, largely in its Eastern Division.

7.9.2.4 Environmental Services

Environmental Services has successfully utilized approximately 200 devices in refuse collection and recycling vehicles to obtain real-time route performance data, and to permit the dispatch of the closest unit for special pickups.

This project has proven very successful to date, and it is envisioned that as many as 1,000 units may ultimately be required to address a variety of applications throughout the City's Public Works agencies.

7.9.2.5 Water Department

The Water Department has implemented CDPD technology at approximately 65 locations for the collection of corrosion data on pipes, a significant -- and ultimately strategic -- concern. The data transmitted allows the Water Department to regulate and monitor the extent of electrolysis occurring throughout their system. This system will eventually be expanded to cover approximately 120 locations.

7.9.3 Paging

A few departments who have personnel who travel out of the area regularly have equipped these individuals with pagers that are capable of national operation. This specialized requirement is currently addressed on an exception basis. The overwhelming majority of the City's paging needs are addressed by the City-Owned Paging System, described in detail in Section 7.1.4 of this document.

7.9.4 Mobile Satellite Services

The City has made limited use of satellite-delivered mobile communications services to address specialized, small-scale requirements.

MWWD utilizes satellite services on a pilot basis for its "Canyon Overflow Protection System" (COPS) monitoring network. This network is intended to address the problems of monitoring the function of sewage pumping stations located in remote canyons, far off the beaten path. Currently 9 sites are installed.

There are also a handful (5-6) of Globalstar handheld satellite phones for use by staff patrolling remote reservoirs located in distant parts of the County that are not covered by either the City's private network, or any terrestrial public network.

Fire and Life Safety Services have indicated a desire to more effectively communicate with strike team commanders assigned to mutual aid responses in distant places. This could be readily accomplished with Motient mobile satellite services, which can, if desired, be interfaced to the regular vehicle radio, providing access to the satellite radio from a regular hand-held radio when the user is away from their vehicle.

The California Governor's Office of Emergency Services has established a program to coordinate these operations. It is called SKYMARS, and permits local jurisdictions to purchase equipment and services at reduced cost, while permitting units owned by different agencies to communicate directly with each other, and the State.

7.9.5 Palm.Net

The City has a small base of users (approximately 100) who are currently utilizing Palm.Net services to provide remote access to E-mail, calendaring, and other such "productivity" applications on Palm Pilot Personal Digital Assistant devices, known as PDAs. This service is carried on the Cingular Wireless Data Network (formerly known as RAM Mobile Data) and operates at a speed of 9.6 Kb/s. This is the same network that provides transmission services to the very popular Research-In-Motion (RIM) Blackberry devices, though the two do not directly interoperate.

The first strategic experimental application of these devices is in the Fire and Life Safety Services, where the Department's CAD vendor has created an interface between these devices and the CAD system, allowing them access to CAD data.

7.9.6 Ricochet

Metricom, the creator of the Ricochet service, filed for bankruptcy and discontinued network operations in mid-2001, after spending over a billion dollars to construct its network.

Ricochet's technology provides high-speed, wire-free Internet access over a unique data network. Ricochet typically runs at speeds over 175 Kb/s, with bursts to 400 Kb/s. Ricochet operates from an easy-to-use desktop modem or a PC modem card. It does not require a visit by a technician to install hardware or service lines to the user location.

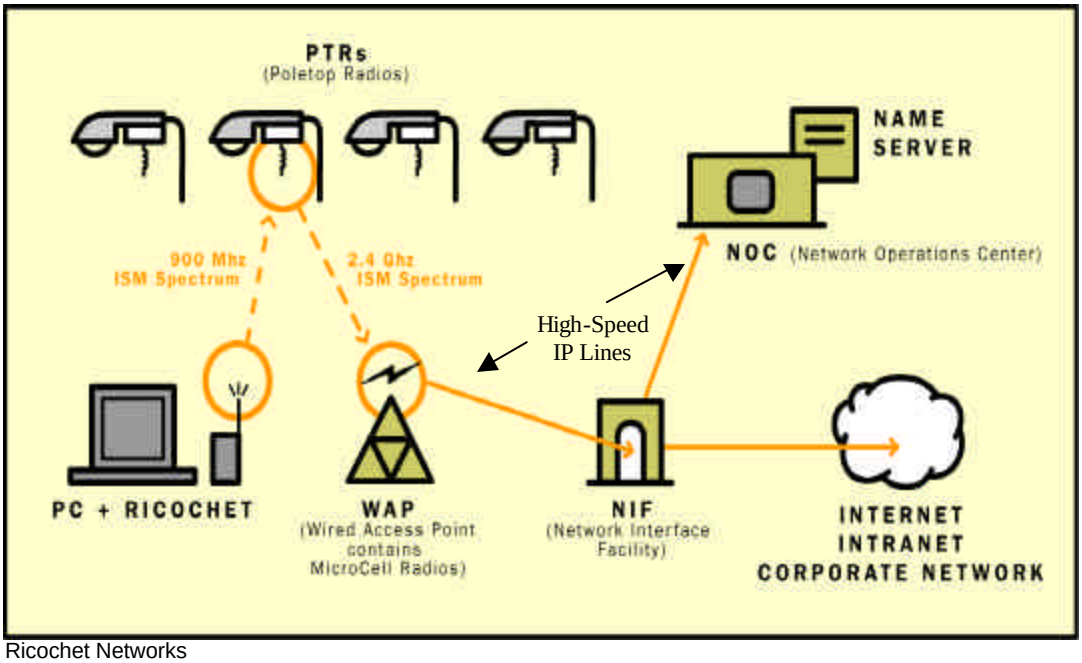
In addition to home and business use, Ricochet is a suitable high-speed Internet access service for municipalities, public safety, universities, hospitality and corporate campuses. Users can access the Internet, their corporate LAN and other resources from anywhere in the Ricochet coverage area.

The Ricochet network was originally deployed in 14 major U.S. cities; San Diego was one of the first. Aerie Networks purchased the assets of Ricochet in November 2001, and is in the process of reactivating the existing network and expanding Ricochet to areas where high-speed broadband access is currently unavailable. The Company is actively seeking network partners to help turn the service back on where it once existed and to expand and install new networks in areas where affordable, broadband access is currently unavailable.

The City has been approached by Aerie Networks, now doing business as Ricochet Networks, Inc. (RNI) to restart the use of the system in the San Diego area. An agreement has been reached with the City, and service has become commercially available in the City.

A review of this technology indicates that it holds significant potential to address many, if not all, of the immediate to mid-term mobile and fixed light route data transmission requirements of the City. While the service is largely intended as a *public* Internet access service, it has been designed to provide *private* IP network transport as well.

The architecture of the network is robust. The basic network architecture is shown in the following illustration:



Ricochet Networks

As can be seen in the diagram, mobile units communicate with Poletop Radios (PTRs) in the 902-928 MHz ISM band. PTRs then communicate to and from Wired Access Points (WAPs) in the 2.4 GHz ISM band. The WAPs then communicate with the Network Interface Facility (NIF) (generally one per market, though more can be configured) -- a fully redundant central networking point -- via whatever means are appropriate: fixed wireless, telephone company circuits, etc. It is at the NIF that connections are made to the Internet or to subscribing private networks.

What is not apparent from the above diagram is that the PTRs can also communicate *with each other* at 2.4 GHz -- not just a WAP. The PTRs can relay transmissions from one to another until they reach a WAP. This means that if a WAP fails, the transmissions that would normally be routed to it are simply relayed via adjacent PTRs (which maintain a routing table for such contingencies) until they reach a working WAP.

This flexible, self-healing mesh architecture is far more robust than any conventional public-safety data network commercially offered to date, and is far less dependent upon the proper function of backhaul circuits to ensure the data reaches its destination.

This network also provides considerable traffic management capabilities that can ensure the transmission priority of public safety traffic.

While RNI has elected to independently operate their network for the time being, it may be feasible in the future for the City to partner with them to provide certain network maintenance operations, which could address the normal concerns about maintenance response in a vendor-owned network environment.

There is a significant potential limiting factor in the adoption of this otherwise interesting technology. It is an often-overlooked fact that in the original Ricochet design, the PTRs were not equipped with any kind of emergency power backup. It would be necessary to reconfigure a substantial number of the PTRs with some level of backup power prior to their use in a safety application. The rest of the network is suitably equipped with auxiliary power arrangements.

If the emergency power situation were to be addressed, this network may hold considerable promise to serve as a solution to address many of the City's mobile data requirements. It would, of course, be necessary to establish a reasonable and appropriate test program prior to significant adoption, and before any strategic public safety use.

For example, Park & Recreation would like to have high-speed Internet access available at each City Recreation Center; this technology could meet that requirement handily. Lifeguards desire E-mail and calendaring from Main Tower locations, and with the use of VPN technology, this too would be an excellent application.

A potential public-safety pilot project might be to provide MDT and AVL service to Lifeguards; their small Department size (only 22 vehicles) makes them an interesting potential test environment.

7.9.7 General Concerns Regarding City Use of Commercial Networks

As the City migrates over time toward standards-based COTS applications, many of the applications the City may elect to implement will have provisions for the use of a variety of commercially-provided networks to provide field access to information, particularly in work order tracking systems.

Systems are available now in the marketplace that can function with Blackberry, Nextel, Palm.Net, two-way Pagers, and a variety of cellular and PCS telephones.

Adoption of these technologies must be carefully considered. The networks upon which they operate are not designed to public safety standards, nor do they offer any prioritization capability for public safety/service traffic. Thus, in a large-scale emergency, when access to these services will be most desired by City users, users are likely to find the service functions poorly, if at all.

The combination of the utility and value of these devices in day-to-day operations and their low cost will probably drive their adoption. Given this, to protect the City's interests, system managers must develop comprehensive plans for departmental operations without access to the devices, and their end-user base must be trained and kept conversant with doing business without their wireless device.

Further, security concerns with these devices are considerable; generally their transmissions are not encrypted or secured in any way[13]. Any properly equipped individual can intercept the messages sent and received by these devices. Therefore, their use in potentially sensitive applications must be carefully considered.

The ease of use, economy and value of these types of devices mean they will eventually find a role in the City's networks; considerable discretion must be used in the ultimate development of that role.

[13] RIM's Blackberry can be operated in a secure environment, when used in conjunction with a complete Microsoft Exchange enterprise-wide solution, at considerable additional expense than the standard offering.

7.10 700 MHz / 4.9 GHz Spectrum

7.10.1 700 MHz Spectrum

In 1998, the Federal Communications Commission adopted service rules for 24 Megahertz of spectrum in the 764-776/794-806 MHz frequency bands (collectively, the 700 MHz band). At the direction of Congress, this spectrum was reallocated from television broadcast services to public safety communications services. It will be available as soon as existing TV stations vacate the spectrum, which is targeted for no later than December 31, 2006. However, this is currently contingent upon Digital Television technology reaching certain market penetration goals. It is questionable if these goals will be reached in the stated time frame.

Because these questions exist, there are measures currently before Congress to move the date up considerably upon which this spectrum must be transferred.

In January 2001, the FCC adopted technical and operational standards for use of the narrow band portion of this spectrum. The standards are based on recommendations of a federal advisory committee, the Public Safety National Coordination Committee (NCC). The NCC is continuing its work with a special focus on wideband interoperability standards.

The City has been active in the local planning process for this spectrum, and has obtained a considerable allocation for the benefit of the City. Currently, the City has been assigned 72 6.25 KHz channels in this spectrum. By number of channels, this allocation essentially more than doubles the spectrum currently available for the City's use; however, no equipment capable of operating at 6.25 KHz channels has yet been seen in the market.

The wideband channels suitable for data transmission have not yet been allocated, as standards have only recently (May 23, 2002) been developed for these frequencies, and so no suitable equipment currently exists. The City intends to continue its active involvement in the spectrum planning process as the wideband spectrum is allocated, and will attempt to procure an appropriate allocation to meet the City's needs.

In addition to the spectrum assigned to the City in the plan, there are a large number of channels available on a shared basis for interoperability/mutual aid purposes. Plans are now being developed by the State as to how these channels will ultimately be managed.

7.10.2 4.9 GHz Spectrum

On February 27, 2002, The Federal Communications Commission reallocated spectrum in the 4940-4990 MHz band for public safety use. In this action, the Commission did not establish the rules under which this spectrum can be utilized, but postulated a number of potential options, and proposed rule-making to establish the necessary rules and standards.

Many of the commenters in the proceeding saw the most appropriate use of the spectrum as close range that is around the immediate scene of an incident. Many saw its principal use in so-called “Personal Area Networks” and “Vehicle Area Networks” that would provide for the

transmission of a wide variety of information, including voice, traditional data, and image, over distances of 500-1000 feet or less.

Others did see the value of longer-range communications and suggested that existing designs for IEEE 802.11b wireless Ethernet equipment and designs for equipment operating in the adjacent U-NII bands could be readily adapted and used for both fixed and mobile high-speed (above 1 Mb/s) links. This equipment would make truly portable networked data operations feasible for the first time.

It is possible that this application may hold significant value to the City. While twice as high in frequency as the band in which IEEE 802.11B equipment operates, preliminary modeling suggests that it would still be quite usable to provide very high speed (over 10 Mb/S), truly mobile data connections.

While a large number of access points would be required, the City certainly owns a far larger number of sites where Network Access Points could be installed. Such an installation would not be a major project: panel antennas for the band are less than 30 inches in height by less than 6 inches in width, and would lend themselves to concealment in a "flagpole" or other such structure.

The site equipment (even with battery backup power) would easily fit into a small outdoor housing that could mount directly to the pole. Extreme height would not be required; 50-60 feet should be sufficient (indeed, preferred) in most cases. Such an access point could be constructed and implemented for under $15,000 each[14]. A quick calculation suggests the City could be well covered by 50 to 60 of these points; thus, the network could probably be built out for $750,000 - $1,000,000 for the access infrastructure. Allowing half that again for the internal transmission elements to tie the access points back into the City's network, and this potential project compares very favorably at a cost of $1.1 to $1.5 Million to other alternative that would provide only low speed services.

One very serious cloud around this silver lining is the likelihood of interference from U.S. Navy operations in immediately adjacent spectrum. The Navy's very-high-power operations radiate noise throughout the allocation at levels ranging from +10 dBm at 4940 MHz to -45 dBm at 4965 - 4990 MHz. The NTIA has stated on behalf of the Navy that all of San Diego County will be subject to these high-level emissions. It remains to be seen whether the equipment envisioned for this band can operate through the noise, or if this otherwise valuable resource will simply be unusable. Of course, it is likely that a certain amount of the interference the Navy has predicted could be mitigated by a local agreement not to operate on the highest frequencies their system utilizes. The question of where the negotiating position ends and real operational issues begin remains to be settled.

[14] This expectation is based on $3,500 antennas, $2,500 access point, $4,000 antenna support/cabinet/power, and $5,000 installation labor.

7.11 Special Purpose Equipment

7.11.1 Transportable Trunking Site

The City of San Diego, as the seventh largest city in the United States, faces many unique challenges. The City is one of America's favorite destinations: with the San Diego Convention Center leading the way, the City is host to many large conventions and events each year. Some of these events are of a spectacular scale, or their visibility and sensitivity on the world stage mandate large public safety responses. Examples of these types of events are the Republican National Convention, the Bio 2001 conference, and the upcoming Super Bowl.

The City also has a huge wildland/urban interface that places the City at great risk from wildfires. These fires often occur in remote canyon areas not well covered by the City trunked infrastructure.

The City's Trunked Radio System is also somewhat vulnerable to disruption through the loss of a radio site. The existing design does not provide a great deal of redundancy of site coverage. Due to the City's challenging terrain, many locations in the City are covered from only a single radio site.

These factors combine to suggest a clear need for a mobile trunking site. This resource would be a self-contained unit, with its own site controller and 5-10 channels of transmission equipment, a generator, and a stowable tower. It would not be intended to simulcast -- that would require too much effort to set up to be practical for quick deployment -- but would be a "zone" of its own in either the RCS, or a possible future City Smartzone system upgrade. It could function as either a standalone system, or be tied into the City's system by microwave relay, and could function completely transparently to system users. It would be in service, and the users would never notice -- except they could now communicate from places where they could not before.

This system could be deployed within hours by Communication Division technical personnel to provide a substantial communications capacity in the event of fires, site loss, or to service the tactical requirements of a planned event.

7.11.2 Mobile Radio Direction Finding Vehicle

IT&C currently operates an elderly former service van equipped with direction finding equipment, which is clearly marked as a City vehicle and has a large Adcock-style antenna array on top of it.

During the interview process with law enforcement, it was noted that on several occasions the Police Department has needed the services of a direction-finding vehicle to support both investigations and a variety of operations. However, the City-owned vehicle,

even though it is well-equipped technically, was inappropriate for the task given its visibility and high profile.

Communications Division also has a continued need for a robust radio direction finding capability to address interference mitigation, and perform other technical studies.

Concern was also expressed by staff about the mechanical soundness of the existing vehicle. Since it is likely such a vehicle may need to travel off of paved roads, reliability is essential.

One option is for a lower-profile vehicle that could be more flexibly equipped with a variety of direction-finding technologies based upon the assignment. For example, an imported pickup truck with a camper shell on the back could be adapted to support both Doppler-based and the Adcock DF technologies. The Doppler could be used where a lower profile is called for on law enforcement support missions; the Adcock could serve at other times.

7.11.3 Quick-Deployment Fixed Wireless Equipment

With the large numbers of special events held throughout the City, the City often has a requirement to implement high-capacity fixed communications links to temporary sites, sometimes on relatively short notice. A significant communications emergency restoration capability is also needed, given the criticality of communications to City operations.

These systems need to be flexible, able to carry a broad range of information, including voice communications, video, and radio control. Such equipment is readily available today on a commercial basis.

The City should purchase several sets (4 or 5) of this non-licensed, fixed wireless transmission equipment, and pre-package it in racked sets, with the necessary multiplexers and data transmission components fully integrated.

This would permit the easy extension of high-capacity links on short notice from well-wired locations to those not equipped, or to reinforce existing services when required.

This equipment could also be used to support the proposed Transportable Trunking Site, previously described in this section.

8. Implementation Plan

8.1 Implementation Strategy

The City has established a vision for how information and communications technology would enable the City "*worthy of our affection*." In order to achieve this vision and the strategic wireless communications goals and objectives, the following critical success factors were identified:

- Strong executive sponsorship and support from City Council and City executives on the City's Wireless Communications Vision and Mission
- Buy-in from City stakeholders including the various City departments
- Commitment of time and resources from the IT Governance Committee
- Funding and staff resource support to execute the Plan
- Ongoing close communications and teamwork throughout the organization
- Phased implementation strategy based on overall City priorities
- Regular progress assessment and communication of the implementation plan objectives
- Annual review process to ensure that the Plan goals and objectives remain consistent with the City's business need
- Resolution of regulatory issues surrounding both the City's current spectrum allocations and proposed expansion at 700 MHz[15]

The next sub-sections describe the current and new initiatives that were identified, as well as a high-level implementation schedule.

8.2 Listing of Initiatives

The following key strategic initiatives are identified and assigned a priority in accordance with the City's IT strategies and objectives. In the listing below, they are ranked by their relative priority. This ranking is based upon several criteria including strategic fit, relative urgency, City readiness, opportunity costs, and others.

8.2.1 Ongoing Initiatives

Rank	Initiative	Estimated Cost
1.	Update City Paging System	$300,000
2.	Upgrade & Expand SCADA Networks	$200,000

[15] This issue is a national-level issue beyond the ability of the City to resolve on its own. The City has in the past, and will continue in the future, to aggressively represent its interests before the Federal Communications Commission, local frequency allocation committees and other such bodies involved in spectrum allocation and regulation.

8.2.2 New Initiatives

Rank	Initiative	Estimated Cost
1.	New Digital Microwave System	$3 Million
2.	New Remote Network Access Methodology	$250,000
3.	New Wide-Area Mobile Data Network	$3-$5 Million (Interim) $6-$8 Million (Permanent)
4.	New City Radio System & Control Equipment	$60-$70 Million
5.	New Primary Public Safety Dispatch Facility	$15-$20 Million
6.	New CAD Systems	$10-$12 Million
7.	Improve Communications Technical Support Capabilities	$700,000
8.	Improve Communications Training Capabilities	$125,000
9.	New Fire Station Alerting Network/Hardware	$1.5 Million
10.	Convert Existing Fire Comm Center to multi-functional Public Service Comm/3-1-1 call center/ Backup Public Safety Comm/Training Facility	$4-$5 Million

A strategic legislative initiative has also been developed:

1.	Enactment of a Signal Booster Ordinance	None

The next sub-sections describe the current and new initiatives that were identified, and their fit in terms of time. Four time scopes have been developed:

1. Ongoing (In Progress)
2. Immediate/Short Term (3 Years or Less)
3. Intermediate Term (4 to 7 Years)
4. Long Term (8 to 10 Years)

The following initiatives are considered ongoing: (In Progress)

1. Update City Paging System

2. Upgrade & Expand SCADA Networks

The following initiatives are considered Immediate/Short Term (3 Years or Less)

1. New Digital Microwave System
2. New Remote Network Access Methodology
3. New Wide-Area Mobile Data Network (Interim Steps)

The following initiatives are considered Intermediate Term (4 to 7 Years):

1. New Wide-Area Mobile Data Network (Permanent Steps)
2. New City Radio System & Control Equipment
3. New CAD Systems
4. New Primary Public Safety Dispatch Facility
5. Improve Communications Technical Support Capabilities
6. Improve Communications Training Capabilities
7. New Fire Station Alerting Network/Hardware

The following initiative is considered Long Term (8 to 10 Years):

1. Convert Existing Fire Comm Center to multi-functional Public Service 3-1-1 call center/Backup Public Safety Comm/Training Facility

8.2.3 Ranking Rationale

The ranking for the new initiatives is based on the following reasoning:

The New Digital Microwave System was chosen first, as it is the backbone upon which all of the key City wireless communications system depend. Serious capacity issues exist currently that limit the City's ability to address immediate needs, and this network will need to be updated prior to the implementation of many of the other key initiatives. The existing microwave network is experiencing loss in reliability due to its age. Spare parts and technical support are becoming more difficult to acquire. This network is no longer supported by the manufacturer. The baseline importance of this initiative to most others drove its top ranking.

The New Remote Access Methodology was chosen second, though this initiative will likely be the first completed. It is a straightforward project that will not require a large capital expenditure, but will provide a platform for several of the initiatives to follow.

The New Wide-Area Mobile Data Network was chosen next due to the criticality of the applications (pivotal to both police and fire dispatch), the severity of the situation of the existing solution, and the impending elimination of the current alternative solution. The current MDT Network is no longer manufactured or supported by the vendor. Parts and devices are no longer available. The capability of the current network does not support the needs of the City. Commercial services are being used as a "bridge technology" until such time as the City can acquire and build a new City-owned and operated mobile data infrastructure. The City will also probably need to utilize the current channels from the MDT Network to provide sufficient channels for the build-out of the new radio network.

The next choice was the New City Radio System & Control Equipment Project, the largest single element of the City's wireless strategy for the next ten years. This ranking was selected due to the time that would be necessary to develop the funding required for this major, multi-year project.

The choice of ranking of the next two initiatives, the New Primary Public Safety Dispatch Facility and New CAD Systems, is driven largely by the timing for the New City Radio System. These projects should, ideally, come on-line toward the end of the Radio System project. The new facility will likely take longer to complete than the CAD System project, so it has been placed before the CAD System project.

The Improve Communications Technical Support initiative is a supporting item to the previous several initiatives, and is ranked accordingly.

The Improve Communications Training Capabilities initiative is a low-cost program that will be of great importance to the success of the New City Radio System project, and should be completed in time to support that project.

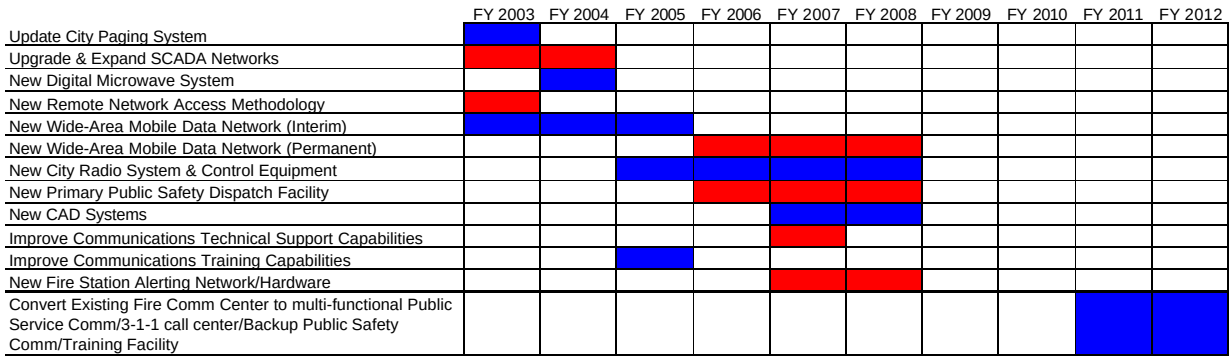
Fire Station Alerting is a longer-term requirement that does not need to be addressed immediately, but should be considered in the CAD System project, and completed in a comparable timeframe with that project.

Conversion of the existing Fire Communications Center to a Public Service Communications Facility must wait until the completion of the new Public Safety Communications Center, and is the longest-term initiative by virtue of this fact.

The Upgrade City Paging System and Upgrade SCADA Networks projects are already underway. The legislative initiative can commence at any time, but should be undertaken sooner than later.

8.3 Projected Implementation Schedule

The following implementation schedule is projected for each of these initiatives:



(continued)

8.4 Key Strategic Initiatives: In Progress

The following key strategic initiatives are currently in progress.

8.4.1 Update City Paging System

ISSUES

- Obsolete encoding technology limits City's ability to obtain replacement pagers
- Current paging transmitters no longer supported by manufacturer
- Current paging terminal no longer supported by manufacturer
- Encoding technology's speed limits ability to add additional users
- Better building penetration and paging reliability desired in many areas
- Improved system coverage in North and East San Diego County outside City limits to reach off-duty emergency personnel

GOALS & OBJECTIVES

- Enhance dependability of City wireless communications systems and related elements
- Ensure adequate system capacity for the timely delivery of information
- Improve the delivery and end-user value of City wireless communications services
- Replace obsolete equipment & technology
- Improve system coverage and penetration
- Provide infrastructure upon which new higher-speed paging technology may be rolled out

RECOMMENDATIONS:

- Add three new transmitter sites at Cowles Mountain, Lake San Marcos and San Ysidro
- Replace transmitters with current technology that will support FLEX encoding
- Replace/upgrade paging terminal with current technology that will support FLEX
- Relocate paging terminal to Chollas hub site
- Begin gradual migration of pagers to FLEX technology on overlay basis once infrastructure established

TIMEFRAME: Six to Eight Months

POTENTIAL SPONSORS: IT&C

BUDGET: $300,000

FUNDING AVAILABILITY: Yes -- Fiscal Year 2003 funds allocated

8.4.2 Upgrade & Expand SCADA Networks

ISSUES:

- Interference issues with MWWD network due to use of unlicensed spectrum in long paths
- Not all Water Department sites where service is desired are presently served
- Use of analog modems in Water Department network is problematic due to periodic failures requiring a manual on-site (at remote location) reset; resets necessitate callouts after-hours, and impacts staff time during business hours

GOALS & OBJECTIVES:

- Enhance dependability of City wireless communications systems and related elements
- Ensure adequate system capacity for the timely delivery of information
- Improve the delivery and end-user value of City wireless communications services
- Replace obsolete equipment and technology
- Reduce interference potential
- Improve network reliability
- Reduce costs of operation and administration

RECOMMENDATIONS:

- Add locations not served by existing networks.
- Migrate MWWD spread-spectrum paths operating in non-licensed bands to licensed bands to enhance dependability and availability of network by reducing interference potential. The City has acquired the requisite frequencies, which were not available at the time of original implementation. Migrate MWWD spread-spectrum radio equipment to shorter and less-critical paths and uses.
- Replace modems in Water Department units with direct digital connection to simplify administration and maintenance, as well as overall availability of network; reduce overtime expense on callouts.

TIMEFRAME: 24 Months

POTENTIAL SPONSORS: MWWD & Water Departments

BUDGET: $200,000

FUNDING AVAILABILITY: Yes - End-user departments.

8.5 Key Strategic Initiatives: Immediate/Short Term

The following key initiatives are anticipated to begin within 3 years or less.

8.5.1 New Digital Microwave System

ISSUES:

- Many existing segments at capacity
- Significant new additional capacity needed for:
  - New radio system
  - New mobile data capacity
  - New dispatch consoles
  - New Water Department strategic operational requirements
- In-place equipment no longer manufactured; parts support will become problematic
- Existing network designed as voice-only network; adding data applications problematic

GOALS & OBJECTIVES:

- Enhance dependability of City wireless communications systems and related elements
- Ensure adequate system capacity for the timely delivery of information
- Improve the delivery and end-user value of City wireless communications services
- Replace obsolete equipment & technology
- Increase reliable high-speed data capacity
- Maintain network reliability (99.999% available)
- Address strategic operational requirements of user departments

RECOMMENDATIONS:

- Replace existing digital microwave network with updated radios that will provide transmission capacity ranging from 45 Mb/S to 155 Mb/S.
- Engineer network for data transmission, as Project 25 radio systems are IP-based, and to address the Water Department's requirements, significant data transmission capacity will be required.

TIMEFRAME: 18 Months

POTENTIAL SPONSORS: IT&C, Water Department & all Public Safety Departments

BUDGET: $3,000,000 (Replacement of existing sites); Does not include potential new sites

FUNDING AVAILABILITY: Currently undefined

8.5.2 New Remote Network Access Methodology

ISSUES:

- The network is now the core IT resource, not the application *per se*
- Remote network access consistently identified as most important issue by City departments
- Remote access requirements exist not just for wireless access, but for external fixed points as well
- Security issues very significant; even "average" user accesses sensitive data
- Public Safety security issues particularly demanding
- Without consistent method, administration of access and system support will become quite difficult

GOALS & OBJECTIVES:

- Provide City field forces access to appropriate City information resources regardless of location
- Provide improved interoperability both between City departments and between City departments and outside agencies
- Improve the delivery and end-user value of City wireless communications services
- Provide appropriate levels of privacy of transmissions
- Provide appropriate authentication of authorized users
- Provide consistent user interface
- Provide affordable cost of administration

RECOMMENDATIONS:

- A consistent, cross-technology City-wide method for such access is required to permit secure access from a variety of wireless sources, and from external fixed points as well.
- The method selected must provide the highest reasonable level of security available; one potential solution would consist of a virtual private network utilizing Triple-DES encryption, and two-factor authentication.
- A single, consistent access method is recommended for all users, since the City's security needs, even for the "average" user, are high; and a single method will simplify administration and operation of the network, as well as simplify user training and support.

TIMEFRAME: 4 to 6 Months

POTENTIAL SPONSORS: City CIO, IT&C, SDDPC

BUDGET: $250,000

FUNDING AVAILABILITY: Currently undefined

8.5.3 New Wide-Area Mobile Data Network

ISSUES:

- A Large number of strategic mobile data requirements exist throughout City operations, notably in Public Safety and Enterprise Departments
- Public Safety requirements are essential to smooth daily operations
- Fire operations built on "dynamic dispatch" concept that requires high-performing data network to carry unit location information
- Police implementing new Records Management and Automated Field Reporting systems, which will dramatically escalate bandwidth requirements
- Existing network too slow (4800 bits/sec) to support modern applications, slow even with current applications
- Technology in use by City sold by original supplier to another manufacturer who discontinued manufacture and support a few years after implementation
- Existing network not capable of supporting the City's general technological direction (IP-based applications and networks)
- Existing network cannot provide sufficient capacity to address even current needs of entire City
- Insufficient equipment on hand to meet current demands -- no equipment in BLS ambulances or Fire staff vehicles to ensure availability for line Fire apparatus and ALS ambulances
- Due to strategic & life-safety-sensitive nature of many applications, mobile data network should ideally be owned or controlled by the City
- Technology needed to meet City's requirements on horizon, but commercial availability unlikely before 2005
- Required spectrum for City-owned solution (700 MHz) not likely to be available in San Diego before 2006/7 - may not be available even then due to regulatory/border issues
- Carrier-provided services have been implemented on a limited basis to provide a bridge to higher-speed services
- Original interim solution (CDPD) will not be available for use after 2004
- New carrier-provided solution (2.5G and 3G services) provides 5 - 7 times the performance of CDPD, but at double the (current) monthly recurring cost - cost may be able to be reduced through negotiation
- Ricochet can provide significantly better data performance at far lower cost, but cannot currently meet City's reliability requirements due to lack of back-up power at poletop radios and some geographic holes in coverage.

GOALS & OBJECTIVES:

- Enhance dependability of City wireless communications systems and related elements
- Ensure adequate system capacity for the timely delivery of information
- Provide City field forces access to appropriate City information resources regardless of location
- Provide improved interoperability both between City departments and between City departments and outside agencies

- Improve the delivery and end-user value of City wireless communications services
- Replace obsolete equipment & technology
- Provide reliable higher-speed data capacity to support IP-based applications
- Maintain network availability (99.9% available)
- Address strategic requirements of user departments

RECOMMENDATIONS:

- Because implementing optimal long-term solution must wait for availability of equipment and spectrum, interim steps are needed:
- **Interim Steps:**
    - Begin migration of City users from existing private data network and CDPD to other carrier-provided services, such as the "2.5G" and “3G” data services now available from various carriers
    - Migrate applications to open, IP base to minimize or eliminate problems incurred by changing transmission media
    - Work with Ricochet and local partner to address deficiencies limiting City's ability to use Ricochet service for critical Public Safety applications
    - Re-purpose existing private network frequencies to voice radio system as users leave
- **Intermediate to Long-Term Steps:**
    - Design, acquire and implement City-owned private network on public safety frequencies at 700 MHz
    - Migrate public-safety-sensitive applications to private network once established
    - Migrate other applications if cost-effective and network performance adequate

TIMEFRAME: Interim Steps, immediate to 36 months; Intermediate to Long-Term Steps, 4 to 7 years

POTENTIAL SPONSORS: Citywide

BUDGET: Interim Steps, $3 - 5 Million; Intermediate to Long-Term Steps, $6 - 8 Million

FUNDING AVAILABILITY: Currently undefined

8.6 Key Strategic Initiatives: Intermediate Term

The following initiatives are considered Intermediate Term, and are planned for the next four to seven years:

8.6.1 New City Radio System & Control Equipment

ISSUES:

- Current system uses proprietary analog technology now at the end of the product life cycle
- System central controller running at or beyond capacity
- Current number of channels adequate for current user base, but cannot adequately handle additional users from other City departments
- Limited interoperability with RCS due to analog City system and digital RCS system
- Limited interoperability between City departments as not all departments on trunked system
- Very limited secure communications capability - requires use of "special" radios that require specific issue
- Strong need for improved in-building coverage City-wide
- System provides poor coastal area coverage
- Other areas also have less than optimal coverage
- Consoles/dispatch equipment approaching end of service life
- Recording equipment in use not fully compatible with trunked technology

GOALS & OBJECTIVES:

- Enhance dependability of City wireless communications systems and related elements
- Ensure adequate system capacity for the timely delivery of information
- Provide City field forces access to appropriate City information resources regardless of location
- Provide improved interoperability both between City departments and between City departments and outside agencies
- Improve the delivery and end-user value of City wireless communications services
- Replace obsolete equipment & technology
- Provide improved in-building coverage
- Provide enhanced security of communication

RECOMMENDATIONS:

- Design, acquire and implement new APCO Project 25-based trunked radio system, including new consoles/control equipment
- Continue to maintain and strengthen cooperative and interoperational ties with RCS, including potential participation in wide-area "zone" system

- Develop policy on system accessibility and secure communications - needed because the City will probably not be able to financially justify secure radios for all users
- Replace existing recording equipment with equipment fully compatible with the new system
- Design and build a new, independent City Trunked Radio System that interoperates closely with the County of San Diego's Regional Communications System (RCS) -- Independent system recommended due to:
  - **Technology**
    - The RCS currently uses proprietary technology not compatible with technology currently used by the City, nor does it utilize state-of-the-art technology
    - The County has indicated a desire to begin migration to an APCO 25-based network and the degree of change required to accomplish this is the same as if the City built an independent network
    - RCS in-City coverage is not as good as the City's current system (which is less than optimal, and would provide users with more coverage problems than exist today)
    - Extensive site construction would be required to permit comparable coverage to today's system
  - **Redundancy**
    - Redundant networks provide capability for RCS units to use City system where coverage is available in the event of major RCS system failure, and vice versa, if City system is independent (important feature for public safety responders)
  - **Responsiveness**
    - RCS system technical management and maintenance resources are limited and significantly below the level required for the City's needs - adequate for routine operations but potentially problematic in emergencies
  - **Cost**
    - The City would not be able to contract service to other agencies and provide cost recovery for use of the RCS as is currently done for the City network
    - The City would have to invest significant resources to join the RCS and would have less benefit for the money spent – decreased in-City radio coverage, lack of network management and resource control, unable to recoup investment, etc.

TIMEFRAME: 2 to 6 Years

POTENTIAL SPONSORS: Citywide

BUDGET: $60 -70 Million

FUNDING AVAILABILITY: Currently undefined

8.6.2 New Primary Public Safety Dispatch Facility

ISSUES:

- Existing Police Communications Center "landlocked"; no available expansion space
- Existing City Trunked Radio System "Prime Site" components at Police Communications Center; no space available for addition of proposed new system components
- Existing Fire Communications Center also "landlocked" with little room for growth
- Backup City EOC space needed to address contingent loss-of-use of existing EOC facility in large-scale emergency impacting Downtown area
- Physically diverse PD/FD communications facilities complicates interoperability and real-time information sharing

GOALS & OBJECTIVES:

- Provide improved interoperability both between City departments and between City departments and outside agencies
- Improve the delivery and end-user value of City wireless communications services
- Replace space-restricted Police Communications Center
- Replace space-restricted Fire Communications Center
- Simplify Police-Fire/EMS interoperation
- Reduce response times
- Provide backup City EOC away from downtown in event of large-scale emergency

RECOMMENDATIONS:

- Construct a new, multi-function facility to support the following functions:
  - 9-1-1 Primary Public Safety Answering Point
  - Primary Police Communications Center
  - Primary Fire/EMS Communications Center
  - Secondary Lifeguard Communications Center
  - Backup City Emergency Operations Center

TIMEFRAME: 3-6 Years

POTENTIAL SPONSORS: Citywide

BUDGET: $15-20 Million; $13-17 Million for building, $2-3 Million for radio consoles

FUNDING AVAILABILITY: Currently undefined

8.6.3 Design, Acquire and Implement New CAD Systems

ISSUES:

- Police CAD (Computer Assisted Dispatch) system is at the end of its technology lifecycle
- Very limited upgrade path for PD CAD; cannot support dynamic dispatch
- Fire/EMS CAD system has a more modern architecture that can be extended through upgrades in the interim
- Neither CAD system supports mobile 9-1-1 Phase II location information
- No interoperation between Police and Fire/EMS CAD systems
- No ability to share information with adjoining jurisdictions

GOALS & OBJECTIVES:

- Provide improved interoperability both between City departments and between City departments and outside agencies
- Improve the delivery and end-user value of City wireless communications services
- Replace obsolete equipment & technology
- Support Dynamic Dispatching for PD
- Provide interoperability between Police and Fire/EMS CAD systems
- Support Mobile 9-1-1 Phase II location information

RECOMMENDATIONS:

- Acquire new CAD system (or systems) capable of serving Police and Fire/EMS requirements
- Need not be a single system -- may be difficult to find single vendor capable of optimally addressing both Police and Fire/EMS requirements -- but systems need to be able to share information and interoperate with each other
- Must fully support dynamic dispatch
- Must fully support Mobile 9-1-1 Phase II position data interface

TIMEFRAME: 3-6 Years

POTENTIAL SPONSORS: Public Safety

BUDGET: $10-12 Million

FUNDING AVAILABILITY: Currently undefined

8.6.4 Improve Communications Technical Support Capabilities

ISSUES:

The planning process has identified issues with several technological support capabilities for IT&C Communications Division. These are:

Radio Direction Finding:

- Existing City Radio Direction-Finding Vehicle in poor mechanical condition
- Vehicle is too high-profile to assist in law enforcement missions
- Effective Radio Direction-Finding capability needed to address routine technical issues

Backup/Temporary Mobile Communications:

- No backup equipment available in the event of a trunking site being destroyed
- City has no ability to provide temporary high-capacity communications service integrated with existing City operations for special events and emergency operations
- City has no ability to provide service in areas not regularly covered by City Trunked Radio System, such as remote canyons

Backup/Temporary Fixed Communications:

- City has no ability to provide high-capacity, fixed-location communications services for special event or emergency operations
- City has no ability to provide high-capacity communications restoration services to key sites

GOALS & OBJECTIVES:

- Enhance dependability of City wireless communications systems and related elements
- Ensure adequate system capacity for the timely delivery of information
- Provide City field forces access to appropriate City information resources regardless of location
- Provide improved interoperability both between City departments and between City departments and outside agencies
- Improve the delivery and end-user value of City wireless communications services
- Replace obsolete equipment & technology
- Provide improved in-building coverage
- Provide enhanced security of communication
- Provide interference tracking capacity
- Address law enforcement radio tracking needs
- Provide high-speed data and video transmission capacity
- Provide high-capacity on-site voice, data and video communications capacity for events
- Permit rapid restoration of failed sites
- Improve City's ability to respond to large-scale emergencies

RECOMMENDATIONS:

- Design, acquire and implement the following:
  - New Radio Direction-Finding Vehicle to address both technical interference tracking needs and law enforcement missions.
  - Mobile Trunking Site, to permit reinforcement of radio communications capacity in the event of fixed site failure, or for special events.
  - 3 Sets of Rapid-Deployment Microwave Radios and Multiplexers, both for emergency service restoration and for special event transmission requirements.

TIMEFRAME: Five years

POTENTIAL SPONSORS: Citywide

BUDGET: $700,000 total; $50,000 for Vehicle, $150,000 for Rapid-Deployment Microwave, $500,000 for Mobile Trunking Site

FUNDING AVAILABILITY: Currently undefined

8.6.5 Improve Communications Training Capabilities

ISSUES:

- Many concerns identified by end-users in planning process are not actual system deficiencies, but are actually areas of inadequate training
- Many City departments provide no formal training for use of radios
- Public Safety communications training, while formal, requires additional elements regarding available system resources and their use
- No staff in Communications Division currently tasked with development and operation of training programs

GOALS & OBJECTIVES:

- Improve the delivery and end-user value of City wireless communications services
- Improve quality of end-user communications training in all departments, thereby increasing the effectiveness and productivity of the City's investment in communications infrastructure.

RECOMMENDATIONS:

- Establish a full-time communications training position in Communications Division, both to improve hands-on end-user training and to work with other departments on the preparation and administration of communications training courses.

TIMEFRAME: 3 Years

POTENTIAL SPONSORS: IT&C

BUDGET: $125,000 first year; $85,000 annual personnel costs, $20,000 program costs

FUNDING AVAILABILITY: Currently undefined.

8.6.6 New Fire Station Alerting Network/Hardware

ISSUES:

- The in-use fire station alerting system was custom-manufactured for the City
- Replacement devices no longer available
- The City plans to construct additional fire stations within the next 10 years
- Existing system provides little information to first responders
- Existing alerting system stressful to responders, particularly on overnight responses

GOALS & OBJECTIVES:

- Improve the delivery and end-user value of City wireless communications services
- Replace obsolete equipment & technology
- Provide more information at time of initial dispatch
- Decrease stress on first responders, particularly on overnight responses

RECOMMENDATIONS:

- Design, acquire and implement a new Fire Station Alerting Network from a proven commercial source that utilizes modern alerting and notification technology

TIMEFRAME: Concurrent with new CAD or after (Approximately 5 -6 Years)

POTENTIAL SPONSORS: Fire & Life Safety Services

BUDGET: $1.5 Million

FUNDING AVAILABILITY: Currently undefined

8.7 Key Strategic Initiative: Long Term

The following key strategic initiative is viewed as long term, and is targeted for 8 to 10 years:

8.7.1 Convert Existing Fire Comm Center to multi-functional Public Service Comm/3-1-1 Call Center/Backup Public Safety Comm/Training Facility

ISSUES:

- City currently has no location suited for housing 3-1-1 call-taking operation
- Station 38 Public Service communications center is "landlocked"
- Public Safety communications require an effective backup facility, even with new center
- Existing Fire Communications Center will be available after relocation to new facility

GOALS & OBJECTIVES:

- Enhance dependability of City wireless communications systems and related elements
- Provide improved interoperability both between City departments and between City departments and outside agencies
- Improve the delivery and end-user value of City wireless communications services
- Replace space-restricted Station 38 facility
- Provide 3-1-1 call-taking center
- Provide backup public safety communications facilities
- Improve communicator training
- Provide backup City EOC away from downtown in event of large-scale emergency
- Provide inter-department electronic workflow

RECOMMENDATIONS:

- Once Fire communications has relocated to the new facility, adapt the existing Fire Communications Center to support the following functions:
  - Primary 3-1-1 Call-Answering Point
  - Primary Public Works Dispatch Point
  - Backup 9-1-1 Primary Public Safety Answering Point
  - Backup Police Communications Center
  - Backup Fire/EMS/Lifeguard Communications Center
  - Police Communications Training Facility
  - Fire Communications Training Facility
- With backup Public Safety communications facilities in place, center can serve as a training site for City communicators.

TIMEFRAME: 9 -10 Years

POTENTIAL SPONSORS: Citywide

BUDGET: $4-5 Million, including equipment and software

FUNDING AVAILABILITY: Currently undefined

8.8 Legislative Initiative

The following key strategic legislative initiative is targeted for immediate effort:

8.8.1 Enactment of a Signal Booster Ordinance

ISSUES:

- The City cannot cost-effectively design a radio system to provide effective coverage inside every structure
- Despite this, Public Safety needs dictate that effective communications be possible from inside structures

GOALS & OBJECTIVES:

- Enhance dependability of City wireless communications systems and related elements
- Ensure critical public safety communications capability inside of structures
- Provide objective criteria for that capability
- Provide clear methodology for compliance
- Provide testing for initial compliance
- Provide re-testing to ensure function
- Be flexible in implementation methodology while ensuring proper level of reliability

RECOMMENDATIONS:

- An approach that a number of jurisdictions around the country have adopted is that of placing the burden on the owner of a new building to ensure that public safety communications can function within that project
- To achieve the communications goal, these ordinances typically specify:
  - A particular signal level that must be maintained over a certain percentage of the floor area,
  - Testing procedures for City Staff to verify those levels
  - Technology solutions to achieve those levels
  - Ongoing monitoring and periodic testing requirements to ensure the function of the solution installed
- These ordinances typically exempt:
  - Buildings permitted in R-1 and R-2 zones
  - Wood frame buildings
  - Buildings 30 feet in height or less as long as the buildings do not make use of metal construction or have underground storage or parking areas

TIMEFRAME: Twelve Months

POTENTIAL SPONSORS: Public Safety Departments, Development Services Department & IT&C

BUDGET: Not Applicable

FUNDING AVAILABILITY: Not Applicable

9. High-Level Economic Analysis

9.1 Projected Funding Requirements

As part of the strategic planning process, a high-level economic analysis was conducted to determine the City's overall funding needs to help achieve its wireless communications strategic goals and objectives.

Of the initiatives identified, the most significant from a funding perspective is related to public safety needs. It is envisioned that these initiatives would be funded through issuance of bonds and federal grants.

Analysis of funding options will be undertaken using the City's new IT governance framework.

The estimated funding needs by fiscal year are as follows. The next page provides a high-level estimate, by fiscal year, of one-time costs for each initiative.

- FY 2003: $1.1 - $1.8 Million
- FY 2004: $3.4 - $6.8 Million
- FY 2005: $25 - $29 Million
- FY 2006: $30 - $35 Million
- FY 2007: $30 - $39 Million
- FY 2008: $8.8 - $11 Million
- FY 2009: None Projected
- FY 2010 None Projected
- FY 2011 $2.5 - $3.3 Million
- FY 2012: $1.5 - $2.75 Million
- **Total** **$102.3 - $128.65 Million**

Initiatives	Initiative Total		FY 2003		FY 2004		FY 2005		FY 2006		FY 2007	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ongoing Initiatives												
1. Update City Paging System	300,000	300,000	300,000	300,000								
2. Upgrade & Expand SCADA Networks	200,000	200,000	200,000	200,000								
Immediate/Short Term Initiatives												
3. New Digital Microwave System	2,550,000	3,000,000			1750,000	2,275,000	800,000	725,000				
4. New Remote Access Methodology	200,000	300,000	200,000	300,000								
5. New Wide-Area Mobile Data Network (INTERIM STEPS)	3,000,000	5,000,000	800,000	1,500,000	1,800,000	2,800,000	400,000	700,000				
Intermediate Term Initiatives												
6. New Wide-Area Mobile Data Network (PERMANENT)	6,000,000	8,000,000							4,000,000	5,000,000	1,000,000	2,000,000
7. New City Radio System	60,000,000	70,000,000					24,000,000	28,000,000	24,000,000	28,000,000	9,000,000	10,500,000
8. New Police & Fire/EMS CAD Systems	10,000,000	12,000,000									8,000,000	9,600,000
9. Build New Public Safety Dispatch Facility	15,000,000	20,000,000					1,000,000	2,000,000	3,500,000	5,800,000	8,500,000	9,800,000
10. Improve Communications Technical Support Capabilities	650,000	750,000					50,000	55,000	140,000	161,000	460,000	534,000
11. Improve Communications Training Capabilities	35,000	45,000					35,000	45,000				
12. New Fire Station Alerting Network/Hardware	1,250,000	1,750,000									500,000	700,000
Long Term Initiative												
13. Convert Existing Fire Comm Center to Multi-Function Communications/3-1-1/ Training/Backup Facility	4,000,000	5,000,000										
Total Fiscal Year Budget	**102,300,000**	**128,650,000**	**1,500,000**	**2,300,000**	**3,550,000**	**5,075,000**	**26,285,000**	**31,525,000**	**31,640,000**	**38,861,000**	**27,460,000**	**33,134,000**

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FYs 2008 - 2012

Initiatives	Initiative Total		FY 2008		FY 2009		FY 2010		FY 2011		FY 2012	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ongoing Initiatives												
1. Update City Paging System	300,000	300,000										
2. Upgrade & Expand SCADA Networks	200,000	200,000										
Immediate/Short Term Initiatives												
3. New Digital Microwave System	2,550,000	3,000,000										
4. New Remote Access Methodology	200,000	300,000										
5. New Wide-Area Mobile Data Network (INTERIM STEPS)	3,000,000	5,000,000										
Intermediate Term Initiatives												
6. New Wide-Area Mobile Data Network (PERMANENT)	6,000,000	8,000,000	1,000,000	1,000,000								
7. New City Radio System	60,000,000	70,000,000	3,000,000	3,500,000								
8. New Police & Fire/EMS CAD Systems	10,000,000	12,000,000	2,000,000	2,400,000								
9. Build New Public Safety Dispatch Facility	15,000,000	20,000,000	2,000,000	2,400,000								
10. Improve Communications Technical Support Capabilities	650,000	750,000										
11. Improve Communications Training Capabilities	35,000	45,000										
12. New Fire Station Alerting Network/Hardware	1,250,000	1,750,000	750,000	1,050,000								
Long Term Initiative												
13. Convert Existing Fire Comm Center to Multi-Function Communications/3-1-1/ Training/Backup Facility	4,000,000	5,000,000							3,500,000	4,250,000	500,000	750,000
Total Fiscal Year Budget	**102,300,000**	**128,650,000**	**8,750,000**	**10,350,000**					**3,500,000**	**4,250,000**	**500,000**	**750,000**

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10. Performance Measures

10.1 Performance Measures

The City will use the following high-level measures to track its performance as a result of the implementation of the Wireless Communications Long-Range Plan and its initiatives. These measures are designed to provide the City with an objective, reliable means of gauging the costs, performance and efficiencies of systems and processes. Where necessary and appropriate, the measures will be further defined between the City and its service providers. They are also designed to measure the effectiveness of wireless communications on the City's internal and external processes and alignment of the wireless communications organization with the business objectives of the City.

- End-User Customer Satisfaction
  - Improved functionality
  - Improved service delivery
  - Improved public safety response times
  - Improved field operations
  - Increased ease of use
- Project Implementation Success (overall from both technology and business perspectives)
  - Within budget
  - Within scope
  - Meets business requirements
  - Customer satisfaction
- Employee Satisfaction
  - Training
  - Skills alignment
  - Salary and benefits
- Achievement of Business Objectives
  - Increased efficiency of communication within and among departments (e.g., through improved interoperation, both between City departments, and with other levels of Government)
  - Improved City wireless communications reliability and service
  - Improved trunked radio system coverage
  - Improved interoperability within departments and with outside agencies
  - Implemented Virtual Private Network strategy to provide secure computer network access from remote locations
  - Improved public safety's mobile data network and AVL system

- Deployed mobile data and AVL technology into additional public safety units
- Increased capacity of microwave back-bone system to address both mobile and strategic fixed transmission capacity needs
- Improved City-owned paging system coverage and penetration
- Increased capacity of trunked radio system
- Enhance the public service departments' field response and customer service through the use of mobile data
- Established wireless communication user training program
- Improved dispatch facility radio and telephone control systems
- Improved emergency operations center radio and telephone control systems
- Develop and implement a 3-1-1 plan for the City
- Enhance disaster recovery by developing and maintaining emergency back-up systems
- Develop City radio system interference reduction plans

11. Appendix A. Glossary

Glossary

Note: Terms used in one definition which are defined in another are listed in **bold.**

ACD:	Automatic Call Distribution, a method of fairly and equitably tracking incoming phone calls until they are answered, and evening the inbound call flow among call takers.
Access	A database program produced by the Microsoft Corporation.
AD:	Active Directory, a component of Microsoft Windows 2000 server. A more advanced version of AD will be included in .NET server, the successor to Windows 2000 Server.
ADA:	Americans with Disabilities Act.
ALI:	Automatic Location Identification. In Dispatch operations, a display of the address or other identifying location information for a calling party. Under Enhanced 9-1-1 Phase 2, being extended to location information for mobile (cellular) telephones, in conjunction with **GPS**.
ALS	Advanced Life Support. Refers to medical procedures legally restricted to performance by an individual licensed as a paramedic or higher. Generally considered invasive procedures, such as establishment of intravenous line. Also refers to a medical vehicle staffed and equipped for such procedures.
AMR:	(1) American Medical Response, a major private **EMS** transport provider. (2) Automated Meter Reading, as employed by the Water Department.
ANI:	Automatic Number Identification. Refers to both (1) display of a calling party's phone number in a Dispatch operation and (2) display of a calling party's radio number, unit identifier, or other identifying information. See also **ALI**.
APCO 25	Association Of Public Safety Communications Officials, Inc. Project 25; a standards development effort for public safety digital radio systems.
API:	Application Program Interface. A set of interfaces between one application and another, such as between Microsoft Windows and an application which runs on Windows.
APLS:	Automatic Personnel Location Systems. A method of automatically transmitting the position of (e.g.) a firefighter to an incident commander.
ArcView:	a **GIS** program written by ESRI. A tool used by **SanGIS**.
ARJIS:	Automated Regional Justice Information System.

ATV:	Amateur Television. Television transmission utilizing radio frequencies allocated for the Amateur Radio Service and operating under 47 CFR 97. Use requires a properly licensed operator.
AutoCAD:	A program from AutoDesk Corporation that is used by architects and others for design and drafting. (Note that **CAD** in this sense is Computer-Aided Design or Drafting, not Dispatch.)
AVL:	Automatic Vehicle Location.
BA:	Breathing apparatus (Fire equipment).
BC:	Battalion Chief.
BDA:	Bi-Directional Amplifier, commonly used in buildings to provide two-way boost of radio communications, including portable radio and cellular communications.
BLS	Basic Life Support. Refers to an ambulance, typically staffed by personnel certified as Basic Emergency Medical Technicians, that is not equipped to perform **ALS** procedures.
CA:	(1) Certificate Authority, part of a **PKI**. (2) Computer Associates, a major enterprise-class software manufacturer.
CAD:	(1) Computer-aided Dispatch. Currently, the City of San Diego uses **PRC CAD** for Police Dispatch and **Tri-Tech CAD** for **F&LSS**. (2) Computer-aided Design or Drafting.
CalGang:	A network provided by the State of California for tracking gang members.
CalID:	The California ID system, used to track fingerprints and related identity indicia.
CalPhoto:	The California state photo ("mugshot") tracking system.
Cap Code:	The individual system address of a pager to which a page is directed.
CBT:	Computer-Based Training.
CCTV:	Closed-Circuit Television. The San Diego City School District is testing CCTV transmission to their headquarters site via their existing data network.
CDPD:	Cellular Digital Packet Data. A commercially available cellular technology which provides two-way data transport, usually to mobile units in the field. In extensive use, within the City of San Diego, in various departments.
CDR:	Call Detail Recording.
CD-R:	Compact Disc-Recordable. This is currently the most popular and inexpensive method for storing and exchanging large (up to 650 MB) volumes of data. Requires a more expensive drive mechanism than

	CD-ROM but the discs produced are readable by the vast majority of CD-ROM and CD audio equipment in existence.
CD-RW:	Compact Disc-ReWritable. Similar to **CD-R** but discs can be completely rewritten many times much like a floppy. Most **CD-R** drives will also write to this format. CD-RW media is more expensive than **CD-R** and has significantly greater compatibility issues.
CHP:	California Highway Patrol.
CIP:	Capital Improvement Program.
CLEMARS:	California Law Enforcement Mutual Aid Radio System. A statewide radio system to provide interoperability among law enforcement agencies.
CLETS:	California Law Enforcement Telecommunications System. A statewide network operated by the California Department of Justice to provide access to centralized databases, including **NCIC**, **DMV** and criminal history information, as well as distributing bulletins to law enforcement agencies. Accessed through **SUN** or **ARJIS**.
COB:	The City Operations Building.
Code 3	Refers to operation of an emergency vehicle with lights and siren activated.
COPS:	Canyon Overflow Prevention System. A pilot project of **MWWD** to prevent flooding in canyons and easements around the City.
COTS:	Commercial-Off-The-Shelf. Refers to products and applications that are available from vendors on an ordinary commercial basis that can be implemented without extensive customization prior to use.
CPU:	Central Processing Unit, the "brain" of a computer, such as an Intel Pentium III or IBM/Motorola PowerPC G4.
CRM:	Customer Relationship Management, usually in the sense of a software application used for the purpose of tracking customers.
CRT	Cathode-Ray Tube. A display device typically used with a computer or test instrument.
Crystal Reports:	A third-party report generation tool which extracts data from many different database formats.
CSR:	Customer Service Representative.
DACS:	Digital Access Cross-Connect System.
dB	Decibel. A relative measure of electrical strength.
dBm	**Decibel** in relation to a Milliwatt, or thousandths of a Watt.

DBA:	Database Administrator, usually a staff position or consultant.
DDoS:	Distributed Denial of Service. Method of attacking an otherwise secure system by infiltrating and taking control of less secure systems as 'zombies' to launch an overwhelming number of simultaneous requests.
DMV:	(1) The State of California Department of Motor Vehicles. (2) Photos or other information stored by the DMV and accessed by City staff.
DoD	United States Department of Defense.
DOS:	(1) Disk Operating System, the predecessor to Windows. (2) Denial of Service attack, a network-based attack on an Internet-connected enterprise's ability to use their own Internet connection.
DS-0:	Digital Signal Level 0. A circuit capable of carrying 64 Kilobits/Second. There are 24 DS-0s in a **DS-1** or **T-1**.
DS-1:	Digital Signal Level 1. A circuit capable of carrying 1.544 Megabits/Second. Commonly used as a synonym for **T-1**.
DS-3:	Digital Signal Level 3. A circuit capable of carrying 45 Megabits/Second. Commonly used as a synonym for **T-3**.
DTV:	Digital Television, commonly a synonym for HDTV or High-Definition Television.
E-commerce:	Generally, any commercial system for conducting cash- or cash-equivalent business over the Internet. In many ways, the successor to **EDI**.
EDI:	Electronic Data Interchange, an early "paperless" business transaction system which predates the Internet.
EDM:	Electronic Document Management.
E-Government	Generically used to mean any government initiative that involves or extends existing governmental customer service onto the Internet.
802.11:	See **IEEE 802.11**.
802.1x	See **IEEE 802.1x**. Compare to **IEEE 802.11**.
802.11x:	Often used to mean "either **802.11a** or **802.11b** wireless networking." Compare to **IEEE 802.1x**.
E-911	Enhanced 9-1-1 service. Provides calling number **(ANI)** and location information **(ALI)** to **PSAP**.
EMA:	A consultancy employed by the Water Department to evaluate its **WAN**, **SCADA**, and other networking requirements.
EMD:	Emergency Medical Dispatch, a quick-look up system for providing pre-arrival medical instructions to callers.

EMS:	Emergency Medical Services (or System).
EMSA:	The Emergency Medical Services Authority of the State of California.
EOC:	Emergency Operations Center.
ERP:	Enterprise Resource Planning or ERP tool. The Street Division has partnered with **SAP** America, Cybertech Systems and **ESRI** to develop an ERP tool known as the **SAP** Synergy System.
ESRI	Environmental Systems Research Institute, a leading vendor of **GIS** systems and software used by the City.
FAQ:	Frequently Asked Questions, usually in the sense of a list collated and regularly updated on a website.
FCC:	(1) The City of San Diego's Fire Communications Center. (2) The Federal Communications Commission.
FEMA:	The Federal Emergency Management Agency. Complemented at the State level by **OES**.
FireRMS:	Fire-related Record Management Systems.
FIRESCOPE:	FIrefighting RESources of California Organized for Potential Emergencies. A partnership of state fire service agencies to more effectively manage and coordinate mutual aid response resources.
FLEX:	A newer paging encoding format, used by many paging equipment manufacturers and service providers. A one-way paging protocol. See also **ReFLEX** and **InFLEXion**.
F&LSS:	Fire and Life Safety Services.
FTEs:	Full-time Employees.
FTP:	File Transfer Protocol.
GASB 34:	Government Accounting Standards Board Regulation 34.
GFOA:	Government Finance Officer's Association.
GIS:	Geographic Information System.
GPRS:	General Packet Radio System, a **3G** service intended to replace **CDPD** and other cellular data transmission systems.
GPS	Global Positioning System. A satellite network operated by the Unites States Government to provide high-accuracy, high-availability position information throughout the world.
GSC:	Golay Sequential Code. A paging encoding format, used by the City of San Diego's Paging System.
GUI:	Graphical User Interface.

HazMat:	Short for Hazardous Materials. (1) The materials themselves. (2) An incident, as in, a "HazMat incident". (3) The response team for a HazMat incident.
HE58 database:	A City-Proprietary **mainframe**-hosted **HazMat** database.
HTML:	HyperText Markup Language, a program language used for webpages.
HUD:	Head-Up Display. A way to display information safely to a driver or pilot, without requiring him or her to look away from driving. Implemented in the newest Cadillacs.
HVAC:	(1) Heating, Ventilation and Air-Conditioning. (2) The control of such systems.
ICS	Incident Command System. A standardized set of practices, definitions and terminology used to manage emergency situations.
ID	Identification. Refers to automatic unit identification transmitted by City trunked radios.
IBM 3270	A legacy terminal system produced by IBM, generally used for access to **mainframe** computer systems.
IEEE 802.11:	A collection of protocols for wireless communications. See **IEEE 802.11a, IEEE 802.11b**, **IEEE 802.1x**.
IEEE 802.1x:	A security (encryption and authentication) standard, which works independent of the transport medium (e.g., on both wired and wireless networks). Implemented natively in **Windows XP**; due to be supported in Windows 2000 by 3Q02; not supported on previous versions of Windows. See also **IEEE 802.11a** and **IEEE 802.11b**. Distinct from **802.11x**, which is often used as a synonym for "either **IEEE 802.11a** or **IEEE 802.11b**".
IEEE 802.11a:	A 54 Megabit/Second wireless protocol operating on the 5.6 GHz **U-NII** band. See also **Wi-Fi5**.
IEEE 802.11b	An 11 Megabit/Second wireless protocol operating on the 2.4 GHz **ISM** (Industrial, Scientific, Medical) band. It has become extremely popular for wireless computer communications. See also **Wi-Fi**.
IEEE 802.11g	A proposed standard for supporting isochronous communications over **IEEE 802.11a** or **IEEE 802.11b**.
InFLEXion:	A Motorola-created paging protocol for voice paging. See also **FLEX** and **ReFLEX**.
IOS:	(1) Installation Order System, as used by the Water Department to place work orders. (2) Internetworking Operating System, such as employed within Cisco routers.

IP	Internet Protocol, commonly used as a synonym for **TCP/IP**.
ISDN	Integrated Services Digital Network, a digital phone line capable of on-demand service up to 128 Kbits/Second.
ISM:	Industrial, Scientific, and Medical radio frequency allocations, or bands. These bands are used by (among other devices) cordless telephones, the Metricom **Ricochet** network (for data backhaul), **IEEE 802.11b** devices, and microwave ovens.
ISP	Internet Service Provider.
IT	Information Technology.
IT&C:	The Information Technology & Communications Department of the City of San Diego.
ITGC:	The City of San Diego's Information Technology Governance Committee.
IVR:	Interactive Voice Response.
Kb/S	Kilobits Per Second.
KHz	Kilohertz. A measurement of frequency. 1,000 Cycles per second.
LAN:	Local Area Network, a collection of computers connected together, usually at the departmental or building-wide level . Most LANs run on Ethernet, which can run at speeds from 10 Mbits/second to 1 Gbits/Second. Compare to **WAN** and **MAN**.
LawAir:	A county-wide **talkgroup** for aircraft usage.
LED	Light-emitting diode. A solid-state illumination device typically used in place of an incandescent lamp.
LDAP:	Lightweight Directory Access Protocol.
MAC:	The serial-number-like addresses of Ethernet cards. Unique to each network card. Also used by wireless networking cards.
MAN	Metropolitan Area Network, such as one which covers an entire municipality or downtown area. Compare to **LAN**.
MBC:	The **MWWD**'s Metro Biosolids Center.
MDCs:	Mobile Data Computers, as commonly used in public-safety and public-service vehicles. Often used interchangeably with **MDT**.
MDTs:	Mobile Data Terminals. Often used interchangeably with **MDC**.
MESA:	A joint venture between the Telecommunications Industry Association of the US and the European Telecommunications Standards Institute, for the purpose of developing a joint specification of mobile broadband technology to be deployed in public safety

	applications.
MetaFrame:	An application from Citrix Corporation that allows remote access to customer applications, either over a network, a dialup or a **VPN** connection.
Mobile radio:	A vehicle-mounted radio. Compare to **Portable radio.**
ms:	Millisecond, or thousandth of a second.
MSDS:	Material Safety Data Sheet.
MWD:	The Metropolitan Water District of Southern California. Supplier of water to client public agencies including the City of San Diego.
MWWD:	The Metropolitan Wastewater Department of the City of San Diego.
NCIC:	National Crime Information Center. Both a communications protocol for requesting, and an organization which processes requests for, information on criminal suspects on a nationwide basis. Operated by the FBI.
NCC:	The Public Safety National Coordination Committee, charged with (among other tasks) creating standards for the narrow band portion of the 700 MHz spectrum.
NIF:	Network Interface Facility. A communications and network access facility within the Metricom **Ricochet** network. The NIF communicates with **WAP**s (sense 2).
NOC:	Network Operations Center.
NT:	Short for Microsoft's Windows NT or "New Technology". Replaced by Windows 2000, Windows XP and (later) .NET server.
NTIA:	National Telecommunications and Information Agency. An agency of the United States Department of Commerce charged with spectrum management activities for the United States Government.
OCI:	Overall Condition Index. Used by SAP Synergy to represent a road's condition.
OCR:	Optical Character Recognition. The process of converting human-readable documents into machine-readable ones.
OC-3:	Optical Communications level 3. A circuit carrying 155 Megabits/Second, or the equivalent of three T-3 circuits.
OES:	The State of California's Governor's Office of Emergency Services. Complemented at the Federal level by **FEMA**.
Oracle:	A popular, large-scale database management and lookup program produced by Oracle Corporation.
PSAP	Public Safety Answering Point in 9-1-1 systems.

PBX:	Public Branch eXchange, a telephone switch.
PCR:	Patient Care Records.
PD:	(1) The City of San Diego Police Department. (2) The Police Dispatch facility.
PDA	Personal Digital Assistant. A highly portable computer, typically pocket-sized, generally used for personal data management, such as schedules, lists, etc. Many can be programmed for more sophisticated applications.
PDF:	Portable Document Format. An Adobe standard for electronic documents which can be read on nearly any computer system. Used extensively in the publishing industry for proofing.
PI or **PIO**:	Public Information or Public Information Officer. A media liaison.
PKI:	Public Key Infrastructure, part of the setup necessary for an encrypted and trustable network for data interchange.
PM:	Preventive Maintenance.
Portable Radio:	A handheld radio. Compare to **Mobile radio**.
POCSAG:	Post Office Code Standards Advisory Group. (UK) Refers to a radio paging format standard.
POST:	Commission on Peace Officer Standards and Training of the State of California.
PRC CAD:	A CAD application sold by Litton, now part of Northrup Grumman. PRC CAD is used by the City of San Diego's Police Department.
PSAP:	Public Safety Answering Point. A location where 9-1-1 calls are answered, and usually also dispatched.
PTR:	Pole-Top Radio. A communications relay employed by the Metricom (now **Ricochet**) network. PTRs communicate with subscriber equipment (**Ricochet** interface cards/modems) and **WAP**s, which in turn talk to the **NIF** and, ultimately, the Internet or a private data network.
RAM Mobile Data:	An early, lower-speed wireless communications system.
RCS:	The Regional Communications System, operated by the County of San Diego for itself and many member governmental organizations.
ReFLEX:	A two-way paging protocol, developed by Motorola. See also **FLEX** and **InFLEXion**.
RF	Radio Frequency. Applies to any radio emission.

RFPs:	Request for Proposals.
RIM:	Research in Motion, the manufacturer of the Blackberry devices.
RMS:	Records Management System. Used in the Police Department to track criminal records and related information. Integrated with **CAD**.
ROV:	Remotely Operated Vehicle. **MWWD** uses an ROV to inspect pipelines and outfall at ocean discharge outlets.
SANNET:	The City of San Diego's data network, as operated by **SDDPC**.
SanGIS:	The San Diego area **GIS** system, operated as a Joint Powers Authority. The City of San Diego is a major participant in this system.
SAP	SAP America, Inc., a provider of ERP software used in the Street Division Synergy System.
SCADA:	Supervisory Control And Data Acquisition. Both a generic term for data and control systems, and a specific implementation used by City Departments for water and wastewater information gathering.
SDDPC:	San Diego Data Processing Corporation.
SDMA:	San Diego Mutual Aid. A talkgroup to provide cross-departmental communications capability when needed.
Simplex:	Communications on a single radio frequency, not employing a repeater. Compare to **Duplex.**
SKYMARS:	A mutual aid radio network operated by OES that operates through Mobile Satellite Service.
SMS:	Short Messaging Service. Popular for sending short (typically less than 200 character) text messages to cellular telephones and other handheld radios.
SPLASH:	A legacy computing application used by the Water Department.
SQL:	Structured Query Language, a messaging standard for querying databases (and receiving answer sets) in Client/Server systems.
SUN	San Diego User Network. A network providing law enforcement database access.
Sunpro:	The Fire **RMS** system in use by the City of San Diego.
SWIM:	Sewer/Water Information Management. A legacy computing application used by the Water Department and **MWWD**.
T-1:	A digital telephone circuit capable of carrying 1,544,000 bits per second (1.544 Megabits/Second), or the equivalent of 24 simultaneous voice conversations. Also used to transmit data including computer communications. Often used interchangeably

	with **DS-1**.
T-3:	A digital telephone circuit capable of carrying 45 Megabits/Second. Often used interchangeably with **DS-3**.
Talkgroup:	An assignment within a trunked radio system. Essentially equivalent to channels within a conventional radio system.
TCP/IP:	Transport Control Protocol/Internet Protocol. The basic transport medium used for the Internet.
TDD:	Telecommunications Device for the Deaf.
TDM	Time-Division Multiplexing.
3G:	Third-generation Cellular networks. The developing infrastructure for next-generation cellular networks, which supports higher-speed data connections and other advanced services. One such service is **GPRS**.
TNPP:	Telocator Network Paging Protocol.
USB:	Universal Serial Bus. First made available in Windows 98, not well implemented in Windows **NT.** Its implementation was further improved with Windows 2000.
UHF:	Ultra-High Frequency. In the context of this report, refers to the band between 450 and 512 MHz.
U-NII:	Unlicensed-National Information Infrastructure band. A radio band in the 5.2-5.8 GHz range. Used by (among other devices) **802.11a**/**Wi-Fi5** devices.
uV	Microvolt. Electrical unit. One-Millionth of a Volt.
VLAN:	A Virtual **LAN**, or Virtual Local Area Network. A networking method involving the bridging or tunneling between two physically separate locations, over an insecure network. Often used to carry secure or confidential traffic over an insecure network, such as a corporate **LAN** or the Internet itself.
VHF:	Very High Frequency. In the context of this report, refers to the VHF High-Band, between 150 and 174 MHz. Originally used by the City of San Diego for its primary public-safety dispatch channels. Still in general use within the City by many Departments. Dispatch operations have moved to an 800 MHz **trunked radio system**.
Visio:	A visual layout application, often used for basic architectural and block diagram layouts. Now owned by Microsoft.
VPN:	Virtual Private Network. A technology for providing secure access to private data networks from remote locations (or via insecure communications such as **802.11**) using the Internet for transport.
WAN:	Wide area network.

WAP:	(1) Wireless Application Protocol. See **WML**. (2) Wired Access Points within the Metricom **Ricochet** network. WAPs communicate with other WAPs, with **PTR**s, and, ultimately, with the **NIF**.
WEP:	Wired Equivalent Privacy. An encryption method which is part of the **802.11** standard. Compare to **802.1x**.
Wi-Fi:	Short for Wireless Fidelity. (1) A synonym for **802.11b**. (2) An industry standards organization which tests for and approves interoperability of **802.11b** equipment in the **ISM** band.
Wi-Fi5:	Short for Wireless Fidelity at 5 GHz. (1) A synonym for **802.11a**. (2) The **Wi-Fi** industry standards organization which tests for and approves interoperability of **802.11a** equipment in the **U-NII** band.
Windows XP:	The successor to Windows **NT** and 2000. The server version of Windows XP is .NET Server.
WML:	Wireless Markup Language. An offshoot of **HTML**, used for representation of pages for wireless devices, particularly mobile/portable wireless phones.
Workflow:	A generic term for managing the flow of work, particularly within a multi-departmental organization where approvals may be required by multiple individuals or divisions for a single piece of work, such as a permit.

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