

Santa Monica City Net

An Incremental Approach to
Building a
Fiber Optic Network



Santa Monica

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Executive Summary

Santa Monica, an affluent community along the western edge of Los Angeles County has adopted a strategy for building a municipal fiber network that virtually any city should find instructive.

In 1998 Santa Monica unveiled a concrete yet visionary Telecommunications Master Plan that led it to adopt an incremental approach to fiber optic network construction. The result has been one of the most successful “dig once” policies in the United States, reducing the cost of laying fiber by up to 90 percent by coordinating fiber and conduit installation with other capital projects or in joint trenching with other entities.

The costs of building out the network were paid largely by the savings generated by discontinuing expensive leased lines and a combination of grants for intelligent traffic systems. City Net began with an investment of \$530,000 to connect municipal facilities, the School District, and Santa Monica College with city owned fiber offering much higher capacity connections than previously available. The City’s network saved some \$400,000 in the first year and ultimately resulted in \$700,000 per year in ongoing savings. The City continued to reinvest those savings to expand the network to reach across the city. This approach allowed Santa Monica to build a vast fiber optic network without issuing debt.

The network was built in an incremental but not ad hoc fashion. The distinction is important - the City Information Systems Department mapped key locations where fiber would ultimately be needed. In coordination with other capital projects, such as connecting traffic signals or replacing water mains, the City found opportunities to build conduit and fiber to those locations over time.

The Plan encouraged laying plenty of extra fiber, so when high tech firms like Google asked the City for access to its fiber, Santa Monica could oblige.

As more businesses requested access, City Net developed various ways of meeting their needs. It will lease dark fiber to businesses that want it, including to other carriers that want to connect their customers. Santa Monica also aggregates the demand of multiple subscribers with needs of between 100 Mbps and 10 Gbps in order to get discounted rates. Finally, the City will soon provide access directly to a number of low-income housing units in a pilot project.

Leasing fiber to other service providers and providing services to local businesses has resulted in over \$5 million in revenues - and growing - for the City General Fund. Businesses have been able to lower their costs by over 2/3 for high capacity connections, retaining and generating jobs in the community and keeping the office vacancy rate far below nearby communities.

The accumulated savings has funded many public amenities, including free Wi-Fi in 32 hot zones and along nine major commercial corridors. Some 80 percent of the traffic signals are synchronized, 550 video cameras assist public safety, and drivers have several ways of getting realtime parking information.

Nationally, the vast majority of the over 400 local governments that make telecommunications services available to local residents and/or businesses have done so via a municipal electric department. Santa Monica’s approach could be duplicated by any community interested with the basic tools any local government already has.



Introduction

Santa Monica is an affluent community in southern California sandwiched between the Pacific Ocean and the city of Los Angeles. Nearly 90,000 people call Santa Monica home, but it swells to 300,000 on weekdays and can peak at over 500,000 on weekends.

Santa Monica's City Net was built incrementally at a low cost without incurring any debt. The network primarily connects public facilities, institutions, and businesses, with plans for a pilot to also connect some apartment buildings with low-income housing.

Jory Wolf, Santa Monica's Chief Information Officer and head of the Information Systems Department (ISD), has been the principal inspiration and the head of City Net from its earliest days.

Starting with a cable franchise network connecting dozens of municipal buildings, Wolf developed a plan to connect a larger swath of the city. As streets were opened for other projects over the years, the City was able to install conduit and fiber underground at a dramatically reduced cost – lowering the cost of building the City's network at the expense of building the network over a longer duration.

In the end, what may be most surprising about Santa Monica's approach is how few other communities have duplicated it. Wolf has made every effort to

share the approach with other communities, some of whom have moved forward with their own projects. This case study outlines the key features of Santa Monica's approach and lessons learned.

The Santa Monica story is one of perseverance and foresight. Those behind the network refused to settle when they encountered roadblocks, instead building political will and finding new paths that would allow them to construct a network that would meet local needs. Unlike the vast majority of communities in the U.S. that have built their own networks, Santa Monica does not have a municipal electric company. The Information Services Department took responsibility for the community network.

Santa Monica's story began with the same first chapter as nearly every other community network: a gap in available broadband services. In this case, the municipality was concerned about the rising cost of meeting its internal communication needs.

Demographics

Population: 90,000	City Budget:
Households: 48,000	\$521 Million
Rental Occupied: 70%	Information Systems
Owner Occupied: 30%	Department Staff: 43

In 1998, GTE (later Pacific Bell and today Verizon) provided phone service. Century Cable, later purchased by Adelphia, provided cable television. Mismanaged into bankruptcy, Adelphia was purchased by Time Warner Cable. Neither incumbent showed much inclination to work with the community in meeting the growing needs for fast, reliable, and affordable services.

We should recall that in the mid 1990s networking consisted of turtle-slow dial-up services and what seemed blazing fast T1 lines (offering 1.544 Mbps). The public Internet was two years old. E-mail attachments barely worked. Web pages with simple graphics were haltingly slow but mysteriously exciting.

The 1996 Telecommunications Act upended the regulatory environment with the stated goal of unleashing competition. Telecommunications was suddenly something a city could do itself. Speaking about the Telecommunications Act changes, then Senator Trent Lott (R-Miss.) said, "I think the rural electric associations, the municipalities, and the investor-owned utilities are all positioned to make a real contribution in this telecommunications area."¹

Santa Monica's residents were ahead of the technological pack. In 1996, 34 percent already had dial-up connections to the burgeoning Internet, a time when only 35 million people in the entire world had used the Internet.²

The City had made early investments in geographic information systems (GIS) and other technological innovations, including early Internet connections. Santa Monica had actually created the first municipally owned and operated Public Electronic Network (PEN) on February 21, 1989,³ with hopes that this would open

15 Largest Employers in Santa Monica

- Santa Monica College
- The City of Santa Monica
- Santa Monica-UCLA Hospital
- Santa Monica-Malibu Unified School District
- Saint John's Health Center
- MTV Networks
- RAND Corporation
- Activision Blizzard Inc.
- ET Whitehall (Shutters on the Beach and Casa del Mar)
- Universal Music Group
- Yahoo!
- Rubin Postaer & Associates
- Ascent Media Group and Loews
- Lionsgate Entertainment
- Edmunds.com

access to and for government services. The key strategy was: "to provide the bandwidth necessary to support enhanced service delivery and *to give the City control* over operating costs for its internal telecommunications needs"⁴ (emphasis added).

The PEN was wildly successful, going from over 500 residents in two weeks to approach 4,000 in just over two years. The PEN featured e-mail, schedules of city events, and a discussion board. Some 19 public terminals in locations like city libraries ensured anyone could join in.⁵ Among other things, the PEN demonstrated that the City itself could be an important catalyst in expanding access to telecommunications.

However, the new technology introduced complications as well. Like most IT departments of the day, growth was addressed only when needed, leaving a patchwork of servers and data center locations with only a few interconnecting networks. Maintenance headaches ensued, and a combined cost for leased voice and data lines that grew beyond \$1.3 million per year by 2002 with near certainty to rise higher.



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Creating The Master Plan

The 1996 Telecommunications Act ended the telephone monopoly just as the 1992 Cable Act had earlier prevented local governments from awarding a cable monopoly (though cable companies continued to refuse to compete with each other). Policy changes led to more requests for permits to build new networks in the public rights-of-way in communities all over the country, often to compete for business customers rather than residential. Telecommunications construction threatened to shorten the life of streets and increasingly disrupted traffic and access to local businesses. (See “Right-of-Way Concerns” below.)

Santa Monica was prepared. One of the most important lessons to draw from Santa Monica is their engagement of various stakeholders, and the examination of their market. A belief in the importance of local government ensuring essential infrastructure led Santa Monica to develop multiple policy options and a variety of recommendations for city processes. They began a process to create a Telecommunications Master Plan.

Creating the Plan took two years and involved various forms of public engagement, including workshops;

surveys to businesses residents, and existing telecommunications providers; as well as interviews with City departments and key businesses and people.

The City tasked a Telecommunications Working Group of 9 prominent local citizens to work with a consulting firm and 15 City employees to develop the Plan. Many of the materials they used in generating the Plan, including surveys and workshop notes were included in the appendices to the final document.⁶

The Plan anticipated the way that changes in telecommunications law would likely bring more choices to businesses, but that competition for residential services was extremely unlikely.

“The lack of immediate competition in the residential phone market is logical, however. Unlike large, commercial customers, who often pay substantial fees for data, voice and video services, individual households pay a relatively modest amount for all these services. The relatively small revenue per customer and the relatively large capital costs involved in reaching each customer make the home market a difficult one to serve without the revenue support of many large business customers using the same network.”⁷

In addition to studying the market, the Working Group examined City needs and assets. Importantly, it did

Right-of-Way Concerns (ROW)

Prior to the 1996 Telecommunications Act, access to the ROW was more predictable because few firms were building networks. Transitioning from a regulated monopoly approach toward encouraging competition meant more firms in the ROW and a greater reluctance for firms to engage in joint trenching as it would mean revealing their investment plans to competitors. Santa Monica’s Telecommunications Master Plan explains:

“All of the applicants seeking to install conduit and fiber cable are companies that have been certificated as competitive local exchange carriers [CLECs] by the California Public Utility Commission. Thus, these companies may, as a matter of law, utilize the dedicated rights-of-way in the City to deliver their services. The City may, however, regulate the time, manner and place of entry by the CLECs, as with any other carrier.”

Each new network could tear up the street, reducing its quality and lifespan while also disrupting traffic and access to local businesses. Santa Monica’s Telecommunications Master Plan recommended the City install a network with excess capacity that would allow the City to serve those businesses and lease fibers to other ISPs that would also compete for subscribers.

“A fundamental objective of the City with respect to telecommunications is the development of extensive infrastructure that can enable service through a network of conduit. The provider of the service is of lesser significance than the presence of the network infrastructure because any number of providers could make use of the network of conduit once it is in place. The infrastructure cost, the difficulty in getting conduit installed, the deleterious effect on the City’s street system and the inconvenience to the public as the ROW is repeatedly entered all support the value of logical, economical and well-planned infrastructure as a City priority.”

not merely ask departments what they needed, but rather adopted a broader approach:

“The interview team attempted to avoid discussions about technologies, systems and equipment; rather, it attempted to direct the conversation toward an identification of each department’s mission followed by a critical analysis of the functional ways the department worked well and ways it could work better.”⁸

In analyzing City needs, the group searched for ways that all departments could benefit from similar investments, seeking to remove organizational silos rather than reinforce them.

These interviews led to the inescapable conclusion that the City’s leased lines were a limitation. The GTE line for monitoring the water treatment plant was frequently interrupted by GTE technicians confused about its purpose. A more robust network would allow a single telephone system to connect all city offices. In short, the group recognized that the City’s telecommunication needs were escalating and outpacing what the market was making available. Building the City’s own network would provide a variety of benefits.

As many local governments have found, extensive GIS maps can dramatically improve productivity. Virtual layers allow the same map to display everything from sewer pipes deep under the roads to the traffic lights over them. Unfortunately, the City’s limited telecommunications capacity did not allow all departments to access the maps in the late 90’s. Many buildings were connected with partial T1s, with less than a megabit of connectivity when remote users needed at least 10 Mbps to “provide useful access” to the GIS database.⁹



Working with conduit in a trench.

The final Plan, issued in 1998 had over 70 pages of analysis and recommendations not counting the voluminous exhibits.

It recommended the City build a network to, at the very least, connect itself and community anchor institutions with fiber networks.

The Plan included recommendations for managing Public Right-of-Way, using advanced networks to deliver government services, leveraging public works projects to “support the cost-effective installation of telecommunications infrastructure,” facilitating competition to encourage universal access, and establishing “rational plans for the growth and evolution of telecommunications services in Santa Monica.”¹⁰

Master Plan Recommendations

In examining what specific action the City should take, the Working Group examined three options:

1. Do nothing - also known as “continued reliance on existing providers.”¹¹
2. Municipal Fiber Network (MFN) – a ring connecting City sites and conduit for lease to others where possible.
3. Full Service Network – a hybrid fiber-coaxial (cable) network connecting residents and businesses – offering video, Internet, and telephone or some combination thereof.

In considering the “do nothing” option, the Plan noted that it would require no capital investment, maintenance, or operations expenses. The City could depend on the state and federal agencies to regulate the providers, noting that the services from GTE and Century Cable had been rated as “adequate to good.”¹² However, the Plan noted that prices from the private sector were likely to increase and the City would be “bound to the technology cycles of GTE and Century Cable.”¹³ In ultimately discarding this option, the Plan assumed that existing providers would continue providing their services in the community regardless.

The Working Group also discouraged the Full Service Network option, in part because the models predicted it would cost \$35 million and was not expected to break even for over 10 years, if ever. Additionally, the challenge of competing with existing providers would

be significant. This approach assumed a mere residential take rate of 21% for cable television service, 20% for Internet access, and 15% for telephone service. It should not be surprising that a network will not pay for itself if the expectation is that only 1 out of 5 potential subscribers would take the service.

Such pessimistic assumptions were not unreasonable at the time. The cable network would have duplicated the incumbent provider's technology. Today, however, full fiber optic service is a substantial upgrade over existing cable and DSL services.

Santa Monica ultimately chose the middle path, one that would involve little risk and modest investment while lowering the future cost of building a more substantial network if that was later decided. As initially conceived, the fiber network connecting anchor facilities was expected to cost approximately \$2 million to build and expected to achieve payback over 10 years when compared to the present costs of leasing services. However, the network was built in stages that differed from those first anticipated, changing the costs.

Aside from immediately saving money the Plan would give Santa Monica greater control over future costs: "The MFN enables the City to better control its critical telecommunications functions and plan for their development with a greater degree of certainty."¹⁴

Santa Monica already had some experience with fiber, having previously invested in a fiber run from City Hall to the Civic Auditorium. That investment provided a nice contrast with a leased fiber circuit from GTE that ran between the City Hall and Main Library, which was simply described as "expensive."¹⁵ This experience fits with that of many other communities. In Florida, for example, Martin County found it could save millions of dollars by building its own network rather than leasing from the cable company.¹⁶

The Santa Monica Plan recommended building the MFN over three fiscal years, coupling the network expansions with already planned capital projects to reduce the costs of placing fiber in the public rights of way. Specific capital projects were identified for laying fiber and conduit, including planned street widening construction, street light wiring upgrades, and replacement of irrigation mains. The Plan even estimated the expected cost savings from coupling the fiber expansion with capital projects that involved trenching. Expected savings varied from 30% to 55% of standalone project costs, but turned out to be even greater.

Municipal Fiber Network Benefits

Some of the anticipated benefits of the MFN, as identified by the 1998 Plan:

- City phone systems become more reliable, secure, and have new features while reducing cost \$79,000 per year
- Access to Santa Monica's three campuses and Santa Monica-Malibu Unified School District buildings, allowing centralized and more efficient IT services
- Distance learning between the high school and Santa Monica College; more collaboration between library and various schools
- Link Santa Monica College interns to entertainment partners
- Increase municipal facility data access from 256 kbps to 100 Mbps
- Reducing annual data charges to 13 municipal facilities by \$46,000/year compared to current price for far slower connections
- Greater efficiencies in services, including expanded use of video conferences and video surveillance
- Greater flexibility in shelter and disaster management
- Improved transit systems
- Connection with nearby communities in regional network
- Encouraging competition by leasing conduit and fiber

The Plan ended with detailed suggestions, but not a final network design. The Working Group had created maps identifying important city locations such as large businesses, high tech and entertainment firms, new media companies, and large nonprofits like Santa Monica College. It sought input from officials with expertise in planning and community development, public safety, public works, re-development, economic development, finance, and from the City Manager's office.

With the map, they examined every major planned public works project for the coming five years, from traffic management to street reconstruction to transit projects. The map proved to be quite valuable, as Jory Wolf could reference it in future years when capital projects were planned to facilitate more network expansion.

More than 15 years later, the Plan continues to offer useful lessons. The applications that have emerged since the original visioning were not obvious in those early days, but those creating the Plan wisely built in flexibility that allows for them. The network has become essential for advanced educational applications, smart traffic routing algorithms, parking meters that accept credit cards, and a variety of other applications that contribute to a higher quality-of-life and a better environment for businesses.

The Plan viewed the fiber network as foundational, allowing for future growth as technology inevitably evolved. Santa Monica's record refutes critics who said that technology advances too quickly for local governments to keep up. The City did not have to anticipate every advancement to know that it would need to remain flexible and scalable while moving information across its city at affordable rates. To achieve that flexibility it chose the gold standard, fiber optics, as the foundation for the network.

The essential goal of the Plan was to give the city control over its information future, and it has achieved that goal. As City Council member Michael Feinstein enthusiastically said at the time, "The fact that the city will be controlling the information loop gives us the best leverage to accomplish our social and financial goals."¹⁷

Early Execution

The Master Telecommunication Plan was completed and accepted but local leaders elected not to fund the routes encouraged by the Plan. Elected leaders always have multiple priorities and forward-looking plans like this are often delayed, sometimes permanently.

The one early concrete result of the plan occurred when Pacific Bell, applied for an excavation permit in 2000 to place conduits underneath several area streets. The City requested Pacific Bell place two 4-inch conduits along 17,000 feet of the road and pull boxes that would allow it to later be populated with fiber. Pacific Bell did the work prior to agreeing on how to share the cost. Later in 2002, the City agreed

Can A City Run a Fiber Network?

Committing to building a fiber network rather than continuing to lease from existing carriers can seem daunting, especially when those carriers frequently argue that the knowledge required to operate a network is too specialized for a local government. The Working Group disagreed with such claims, noting:

"The fiber ring itself, will require virtually no maintenance. Emergency restoration is important, of course, even when the redundancy and safety of a ring is achieved in Phase III. Cities that do not own their own electric utility, like Santa Monica, should consider retaining an engineering firm to perform that function. There are firms that contract to provide similar services to CLEC's, institutional network operators and others.

The electronics should be covered by an on-going service contract with the manufacturer that specifies a response time. Four hour service is usually acceptable, particularly when the fiber ring is in place. The cost of this maintenance, based on current pricing, has been included in MCG's cost estimates. However, the City will need a trained individual to handle routine network administration and simple moves, adds and changes.

In addition, if the City decides to lease conduit and/or dark fiber to third parties, the manager should be responsible for administering the program. This would hold true, even if the City hires an outside firm to provide network management services. The City needs a knowledgeable network manager who is employed directly by the City and responsible only to it.

The financial models used to cost the network assume that a manager is hired at a total annual salary of \$75,000 (including benefits)."

Wolf reflected on his results, "Cities that have electric utilities already have the assets, equipment and skill sets necessary to build, manage, and maintain low voltage fiber-optic networks. **Santa Monica has demonstrated that even cities without electric utilities can do the same by using a mix of internal and contracted resources**" (emphasis added).

Plan Overview

A summary from the May 5, 1998 City Council Meeting:

Locate the MFN route in consideration of (1) the location of City facilities needing connection to a high speed network; (2) the location of other public institutions that could use the MFN; (3) the location of businesses and other telecommunications providers that might be interested in lease of capacity or being a partner in providing competitive services to the public and businesses of Santa Monica; and (4) the location of street repair and other City capital improvement projects which would facilitate the installation of conduit to reach Santa Monica's eastern border for the purpose of regional connection.

to pay no more than \$220,000 for that work as their portion of joint trenching.

Following the dot-com crash of 2000 and its negative impact on municipal budgets, the prospects for Santa Monica's MFN became more bleak despite the Pacific Bell conduit. Jory Wolf, then Manager of the Information Service Department, had already assembled all of the "right" ingredients into the City's Plan to save for funding. He had identified the need, assembled focus groups, talked to potential providers, conducted surveys of the public and businesses, and educated governmental units and his council. He had estimated the cost to build the MFN and sought to include those costs in the capital improvement budgets, without success.

An opportunity to move forward arose in 2002 when Adelphia's cable franchise was up for renewal. Rather than having Adelphia manage an institutional network (I-Net) connecting public facilities, Santa Monica negotiated for Adelphia to connect 43 buildings with six strands of fiber and provide physical maintenance on those routes. Of the 43 buildings, 13 were School District facilities, six College buildings and 24 City locations. This marked the first fruition of the personal and agency relationships Wolf built during the initial process of developing the Plan. With this network, Santa Monica would be able to cut its telecom expenditures by ceasing to lease circuits from other providers.

Institutional Networks

Institutional networks (I-Nets) connect community anchor institutions—most often schools, libraries, and municipal facilities. Many of these networks were built by cable companies as part of their franchise obligations, offering free or subsidized connections to public institutions in return for access to the public rights-of-way. However this approach can perversely discourage building a network that is accountable to the community and undermine long term savings.

Franchise agreements commonly contain restrictions on the use of the network, such as not allowing commercial traffic. Restrictions on who can use the I-Net eliminate opportunities for economic development and collaborations with the non-profit sector.

Because the I-Net generates no revenue, some cable companies have been very slow to fix failures or other problems. Many local governments have found themselves at the mercy of a national cable company that refuses to upgrade capacity as local government needs grow. Local governments that had grown dependent on free services awoke to a rude shock when the franchise ran out, and renegotiations involved steep price increases, or when franchises were effectively revoked by changes in state law.

When local governments do not pay for the network they depend upon, they have no source of funds to use in the same way that Santa Monica did. And securing new funds, even for this essential need, can be challenging.

Santa Monica used the franchise-provided network as a means to build a network that it could control, so when the state revoked local authority over franchise negotiations in 2006 (the Digital Infrastructure and Video Competition Act, or DIVCA), Santa Monica was not left in the lurch. Other cities in California and elsewhere have not been so fortunate, having to pay very high fees to continue leasing lines when their franchise-provided I-Net was taken from them.

The City paid a \$530,000 one-time fee to Adelphia for building the network. The cost would have been substantially higher without striking a deal with Adelphia as it already had such a substantial presence in the City. The ongoing annual cost of \$37,200 for maintenance was split among the City, School District, and Santa Monica College, based on the number of facilities connected. The network was completed by May, 2002.

The ISD invested in the equipment and expertise to operate the network providing connections between the various facilities owned by each of the three entities; each contracts its own Internet access independently from ISPs.

Santa Monica's agreement with Adelphia allowed the City to stop leasing expensive lines (mostly from the phone company Verizon), generating savings that started at \$400,000 a year and grew.¹⁸ Importantly, one of the key visionary objectives was achieved – gaining control over the City communications network and costs. Cities that own their own equipment can budget for future upgrades and take advantage of technological advances that lower the cost of moving bits. Cities that lease lines are often at the mercy of the few carriers decisions about how much to increase prices and how long the carrier can delay investment in higher capacity connections.

It is important to stress that the financial foundation of Santa Monica's City Net came from cost savings by connecting community anchor institutions. If the schools, libraries, and other municipal facilities had already been connected by a statewide education network or other large regional solution, those cost savings would not have been available to Santa Monica's business case. This is the danger of building networks dedicated to singular purposes (often called silos) — the community "anchor" institutions cease to be available as an anchor tenant in a business model that allows the community to connect everyone. Thus a well intended investment by a state could have important long term detrimental impacts on community control over future network costs.

The annual telecom costs for Santa Monica dropped from \$1.3 million to \$700,000,¹⁹ enabling its \$530,000 investment to be paid back in the first year, even without putting a value on the dramatically improved services.

At this point the City adopted a policy crucial to the long term success of the network. The city council agreed to reinvest the savings from the network to

Don't Strand Your Fiber!

Designing the physical layout of a network, or outside plant engineering, is a whole discipline in and of itself. Planning and forethought are essential to maximizing the benefits of assets deployed as part of other capital projects. Just putting "conduit" or "fiber" in the roads is not sufficient. Communities should have a plan and sense of what they need to avoid stranding their fiber.

Decisions about what (or how much) conduit and fiber is available will impact what kind of network can be built. Fiber networks come in different varieties, most commonly passive optical network (PON) or active ethernet in fiber-to-the-home deployments. An active ethernet approach will likely take each strand of fiber all the way back to the Central Office (or headend). Connecting 3,000 homes on the west side of Anytown, USA, means running 3,000 strands of fiber across town. This would require a great deal more conduit in some areas than a PON, where optical splitters allow multiple subscribers to share the same fiber strand.

The size of a fiber bundle varies by number of strands and type (loose fiber, ribbon fiber, etc.), requiring decisions to be made.

- 1) What is the physical size of the conduit (1", 1.5", 2", 4") and should it have innerduct for future needs (again 1", 2", 4" etc).
- 2) Where should the conduit be placed? Will the network have aggregation points in the field or will all fibers terminate in the central office?

A likely scenario for an existing network: a different department wants to connect traffic lights to it. The following questions will arise. Where can new connections be made? Where are the splice boxes? Or the economic development people want to connect a business park which requires redundancy. Does the conduit allow for physically diverse paths to the location to ensure that if one is accidentally cut the other will continue to provide connectivity?

finance network expansion. Wolf credits the history of public engagement around the Plan with generating the political will to reinvest these funds.

The City continued to fund the Information Systems Department at the same level, allowing the network to continue investing in telecommunications infrastructure and systems. Later, the ISD would have the capacity to re-engineer the City's voice system to once again improve functionality and reduce costs.

Many cities have built networks for internal use rather than leasing higher cost connections from big telephone or cable companies. But the savings are often used for other public projects or services. Few

have taken the next smart step: reinvest those savings to expand the network and realize compounded community benefits. Santa Monica's reinvested savings have since funded the extensions of City Net that continue to reap benefits.

The agreement with Adelphia did not permit Santa Monica to run commercial traffic over the network, such as that from local businesses. Santa Monica could only use the network for connecting anchor institutions. However, the cost savings would be used to build a network that the City fully controlled, moving it closer to the vision established in 1998.

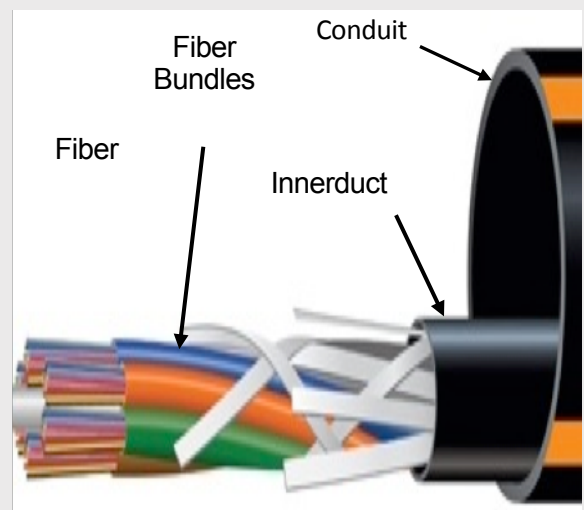
Dig Once Policies

"Dig Once" policies have become popular among a variety of local and national decision makers and, when done correctly, can be quite helpful. Dig Once means that when an entity opens the streets or other public rights of way for work, they should either place conduit or fiber for others to use as well in the trenches created by the construction. Common projects involve road renovations, water and sewer main installations, etc. These policies may be more important at the local level, than state or federal, given the need to expand fiber along corridors not already well served.

Compared to the cost of opening and then reconstructing a road, the fiber itself is cheap, costing from 50 cents to a couple of dollars per foot depending on how many strands are needed. Placing fiber and conduit along with other capital projects can save \$30,000 to \$100,000 per mile. Fiber can be "pulled" or "blown in" to conduit long after the conduit was installed.

The key to success in these dig-once fiber policies is having a map or plan for where and what fiber will be eventually deployed. Without a plan, conduit or vault placement can be convoluted and less than useful (see the "Don't Strand Your Fiber" box). The best plans are constructed on city geographic information systems (GIS), which are detailed with various layers of information. The most useful layers describe the physical attributes of the area and how the connections are to be made, such as the number of homes and business eventually needing to be connected; the number of fiber strands necessary to connect them; points where fiber aggregates. It is like building a freeway. You may know that you will eventually need four lanes, but start with two. If you don't have a plan you may only allow space for two and put the exits in the wrong place – and that mistake can be expensive later on. There are many companies that can help a city with such plans. That said, it may make sense to place conduit in a few areas as opportunities arise even without a map – this includes bridges, overpasses, intersections, railroad right-of-way, and other places that can be complicated to cross.

A recent report, [*Gigabit Communities: Technical Strategies for Facilitating Public or Private Broadband Construction in your Community*](#), from CTC Technology & Energy offers many insights to what local governments can do in this regard.



The Birth of City Net

The City created a Telecommunications Master Fund, seeded with the savings from discontinuing leased lines, which provided the capital necessary to expand beyond the Adelphia-provided I-Net. Santa Monica would effectively have two distinct networks: one where Adelphia limited how it could be used and one that the City could use without any restriction. The networks were interconnected, but the City had to ensure no commercial traffic used the fiber originally provided by the Adelphia franchise.

The goal of using communications to facilitate economic development remained elusive. Other goals such as linking the internal systems of city departments to improve efficiency were yet to be realized. But important building blocks were in place.

As the I-Net demonstrated the savings and other benefits from public ownership, Wolf pushed for more. In 2004, telecommunication budgets of all city departments were merged, reflecting a total annual expenditure then nearing \$1.3 million.

The director of public works, director of economic development, and the City's planning director each began to offer collaborative support for City Net. With the budget consolidated and savings in the Master Fund accumulating, Santa Monica expanded its own independent fiber network.

Building a network on an incremental basis can be a challenge, one that Santa Monica deals with, in part, by ensuring it puts as much fiber in the ground as practical whenever there are opportunities to do so.

Fiber-strand counts in City Net vary from 96 strands to 418 strands, though the vast majority of the network has over 300 strands available. Putting 288 strands in the ground rather than 144 increases the project costs minimally because the most significant cost is digging up the ground, a cost that is independent of how much fiber will be placed. Planning is essential. Without a good plan, a conduit may not have enough space for the amount of fiber required or might even be on the wrong side of the street. (See "Don't Strand Your Fiber" box.)

Originally, Santa Monica had wanted to place four conduits in the ground, each four inches in diameter, but that proved to be too expensive and they settled on one conduit of three inches in diameter. Fortunately, advances in technology allowed much greater fiber counts within conduit. Additionally, beginning to offer "lit" services reduced the amount of fiber needed. Many businesses receiving lit services can share a single fiber whereas dark fiber typically requires a dedicated pair of fibers for each connection.

The first fiber bundle the City used had 92 strands but the following bundles each had 318 or more to ensure plenty of fiber for future use. It can be hard to forecast fiber demand; having extra fibers is a good practice.

City Net has four miles of conduit within abandoned water mains, something that has been controversial in other cities and required discussion in Santa Monica. Water departments often prefer to fill old mains with cement to prevent cave-ins that could shift the ground. To use the mains and maintain safety, City Net inserted conduit before sealing the pipes with cement, a compromise that has worked well for all parties.

City Net was growing on an incremental, but not ad hoc basis. Jory Wolf had a larger plan, informed by the original vision of meeting municipal needs in the short term, but being prepared to connect others as needed to spur economic development and ensure a high quality of life with ubiquitous connectivity in public spaces. The City has used a GIS map to plot where fiber paths are needed and in what volume. This approach is fundamentally different from throwing conduit or fiber cables in the ground haphazardly whenever a street has been opened for construction.

City Net's GIS map contains many layers, from municipal locations and infrastructure to new development to major commercial locations. Wolf established agreements with public works allowing City Net to get in the ground whenever they worked on a new project. If public works was tearing up a street along a corridor that had been identified as a high priority for the network, City Net included its conduit at much more affordable cost than would be the case if City Net had to pay the full cost of construction. The planning department agreed to

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Four Key Steps to Success

Establish a concrete and viable vision. A vision needs to identify the *potential benefit(s)*, both quantitative and qualitative, and a reasonably concise *assessment of the problem(s)*. A common problem is a lack of local control over essential infrastructure. Gaining control over the infrastructure is one piece, but what will that allow the community to do?

Hope is a valuable part of vision. The community has to have faith that it can do better and find ways of bringing the community together to create (or maintain) a good place to live and work.

Find a Champion. Santa Monica was lucky. From the beginning it had a champion in Jory Wolf. He understood the problem, the technology, and the possibilities. What is more, he had the commitment to stay the course. A champion has the respect of others and will singularly focus on getting the network built. A champion should be ready to rapidly respond to the claims of opponents.

Time and again cities go through the exercise of feasibility studies and market surveys; they charge departments with studies for the betterment of economic development or they hire outside consultants to tell them how to approach these issues. Without a champion, they often fail to proceed further. Without commitment, studies gather dust and citizen task forces temporarily get excited just to see their expectations dashed. It seems simple, but it is critical.

Build Commitment. Champions need support and elected officials need a movement to give them courage and resolve. Santa Monica gathered together key groups: utility companies, existing users of the burgeoning city network, the School District, an intercultural advisory council, and the local chamber of commerce (some chambers are “captured” by powerful cable and telephone companies and will be hostile). Discussion flowed. These discussions created the inclusivity needed for the vision. This demonstration of support was important in gaining approval by the City Council.

Market surveys are often performed to evaluate public support. That can be valuable, but it is not the primary aim of commitment building. After all, it was six years before Santa Monica actually began City Net with fiber in the ground. Two key ingredients were obvious in Santa Monica as it built commitment. The first is building an inclusive vision while understanding the political environment – creating a realistic dream. The second, and most important, is patience and persistence. In the beginning, this process is called education and building a vision; it is later called marketing and promotion. They are the same. This is a long-term process.

Allow Sufficient Flexibility to Take Advantage of Opportunities. The vision must be adaptable to opportunities when they arise. Do not let the perfect be the enemy of the good. In 2002 Adelphia’s franchise agreement with Santa Monica was up for renewal. Four years had passed since the vision was first articulated and Santa Monica had not yet taken concrete steps to build a network. The technology landscape had changed, but the intent of the original vision had not. Cable franchise agreements creating institutional networks were becoming common, but the standard I-Net zero cost approach would not have fulfilled the goals identified by Santa Monica. Adelphia, the City, the School District, and the College agreed to a somewhat unconventional approach – Adelphia built a network for the City to operate and own. Franchise negotiations provided the urgency. And this I-Net approach offered an opportunity to reduce telecommunications expenses. Though the vision was not entirely fulfilled, it was a beginning. It provided a foundation for the network that was really desired.

include City Net vaults in new developments. Vaults (or hand holes) are underground boxes that allow fibers to be spliced together as new connections are made. This approach provided the infrastructure to connect new buildings to the network in the future at a lower cost.

Conduit itself ranges in cost from just over \$2,000 per mile to as much as \$9,000 per mile. Yet when installed along with other projects, early placement can save upward of \$30,000 to \$100,000 per mile compared to the the costs of coming back later to tear up the streets again. A 2014 report from CTC Technology and Energy says, “On average, the cost for a provider or locality of pulling fiber in existing conduit is 10 percent of the cost of underground construction without the conduit.”²⁰

Placing fiber ranges in cost from \$15,000 per mile in very rural areas with few strands and a plow to as much as \$100,000 per mile or more to bore under city streets and sidewalks that are already crowded with other utilities.²¹ The cost for fiber itself, which varies by type and the number of strands, may only cost \$1,850 per mile for 12 strands up to \$13,200 per mile for over 400 strands. Importantly, fiber can be “blown in” through conduit later when the actual network construction begins.

By establishing proactive policies, City Net dramatically reduced the cost of future installations while building its network. Rather than borrowing millions or even tens of millions of dollars, Santa Monica has built its network without having to borrow anything. It has dramatically reduced its telecommunications expenses while radically increasing the availability of high speed services for the City and area businesses.

Connecting Businesses

The excitement over City Net’s potential persuaded the director of economic development to begin promoting City Net’s capabilities and to include Jory Wolf in conversations with new businesses.

By 2006, City Net’s progress in deploying fiber was beginning to attract the attention of businesses seeking very high capacity connections at affordable rates, including Google. The search giant needed to locate its facilities in areas with plentiful, low cost bandwidth. Like other businesses that operate their own private networks, it wanted access to “dark fiber” rather than “lit services.” As is still true today, much of the demand for dark fiber is to connect campus

The Importance of Aggregation

Santa Monica’s connections to the carrier hotel at One Wilshire created another community benefit for businesses. In the Internet world, ISPs pay, and in-turn charge customers, for what are known as Transit Fees. These fees are a complex series of relationships and calculations, which effectively are expressed “for this much use we charge ‘x’ per megabit of traffic.” Transit fees, or peering costs as they are sometimes called, decrease in cost as the amount of guaranteed traffic, or revenue, increases. This principle is the same as in a purchasing cooperative – bulk discounts.

City Net aggregates the traffic from multiple businesses and passes the savings in Transit Fees along. For dedicated (unshared) connections in Santa Monica, businesses pay approximately \$16.20 per Mbps for 100 Mbps, but this would drop to \$8 per Mbps for 1 Gbps commitments and \$5.46 per Mbps for 10 Gbps.

Prior to City Net, the local competitive market rate for a business requesting 100 Mbps was \$50 per Mbps and higher (or \$5,000 a month in total). The cost for 1 Gbps was \$35 per Mbps, a staggering \$35,000 per month, and that was only if a business could convince a provider to build the network lateral to their building. 10 Gbps wasn’t even offered.

City Net helped businesses realize a 67.6% reduction in costs on 100 Mbps service. The savings on a 1 Gbps rate is 77.14% attesting to the purchasing power obtained with the City Net model. Jory Wolf is now looking at 100 Gbps technology.

facilities or remote offices so employees can connect to resources across town as if they were down the hall. They want very fast, low latency connections that have no need to run across the Internet.

Fiber is “dark” if no equipment terminates the strand, which is to say it is an all-but useless glass tube between point A and B. Only when that tube is connected with lasers, or terminated, it has nearly boundless capacity for transmitting bits. By leasing

dark fiber, businesses can transfer as many bits as they choose, at whatever capacity they choose; purchasing “lit” services often means having to pay much more over the duration of use, particularly for very high capacity connections.

From 2006-2008, the interest in connectivity came from very large entities – businesses and nonprofits – with specific needs, in particular connecting multiple offices within Santa Monica with extremely high capacity links. The City was not yet making Internet access available to subscribers.

Additionally, the City was not planning to serve residents. Verizon had built its fiber-to-the-home (FTTH) network called FiOS out to approximately 60 percent of Santa Monica residents. The rest have access to DSL, though all residents have access to Time Warner Cable services.

City Net focused on serving large businesses by leasing dark fiber. Such connections appealed most to large businesses, and a dozen or so signed up with City Net. One oft related story involved a very large employer that was considering leaving and was looking for less expensive places to build new facilities. They approached the City asking for lower taxes, the elimination of permit fees, or other offsets to their facility expense. The City instead offered affordable broadband with capacity up to 10 Gbps. They stayed.

However, most businesses had neither the need nor inclination for dark fiber. They wanted better connections, but not the responsibility for lighting leased fiber. In both Palo Alto and Burbank, fewer than 100 firms each have gone to the trouble of leasing dark fiber from the municipal utility.

In 2008, the City surveyed 3,000 businesses within 200 feet of the City Net backbone to understand their



Installing Fiber and Conduit

needs and options presently available to them. The responses showed that a majority believed the bandwidth they needed was unaffordable and one in four suggested the level of service they needed was not even available at their location. The results suggested to Santa Monica that many businesses had a need of between 100 Mbps and 1 Gbps but did not want to light their own fiber.²²

To meet those needs, City Net would need a robust connection to the world, which in southern California meant One Wilshire in Los Angeles. One Wilshire is a carrier hotel located 15 miles outside Santa Monica, where hundreds of ISPs interconnect and offer connections at rates approximately 70 percent lower than the prices providers charged in Santa Monica. With a direct link to One Wilshire, City Net could offer more service options to local businesses. Many carriers refused to lease the connection to the City out of fear of losing customers in Santa Monica to City Net, but the City ultimately found a provider that would work with them. In 2011, the Los Angeles Department of Water and Power was selected in an RFP to build a redundant route along a different path to One Wilshire.

With the first connection to One Wilshire, City Net developed an innovative model for connecting subscribers. Businesses could connect by paying the installation costs of expanding the network to their building and repaying that investment with lower rates. Those fiber connections became the property of City Net – expanding its reach.

Though they had not yet identified any customers that would need more than 1 Gbps services, City Net invested in equipment that would allow it to offer a 10 Gbps link. Not only were business needs escalating, they hoped to attract businesses to the area that would need the greater capacity.

As City Net grew, it began offering lit services by bundling subscribers for ISPs rather than becoming a provider itself. Lit services are what most of us use when we connect to some carrier or ISP. The carrier constructs the architecture or equipment that transfers traffic along the network and businesses purchase a service. Seventy percent of City Net’s customers today purchase these services because that solution requires less technical expertise than operating over a dark fiber network.

City Net provides management of the network on a 24-hour, seven-day basis from a commercial network operations center (NOC). Not only do they ensure that



everything is working the way it should, they also provide a customer portal so business can see the quality of the network and how much capacity they are using. In addition to the NOC, City Net services include "remote hands," an on-site service for local businesses that have a small or no tech presence.

In the early years, they had suggested that customers who absolutely needed 24x7 reliability should maintain a backup connection, but by expanding redundancy over the years, City Net is sufficiently reliable that additional connections are unnecessary.

When leasing dark fiber, City Net had first relied on word-of-mouth advertising. With lit services, it began actively advertising on city buses and getting the word out through the chamber of commerce. It also began directly contacting real estate brokerage companies and property management firms.

It kept the offering simple, with three plans: 100 Mbps, 1 Gbps, and 10 Gbps as well as continuing to make fiber available to competitors. While incumbents have refused to use the network, other ISPs have preferred to contract fiber builds to City Net, which can do them faster and at lower cost due to its extensive presence in the city.

When a business wants to connect, City Net expands the network using funds from the Telecommunications Master Fund, which consistently runs a positive balance. When the business is connected, it pays a one-time construction fee and then a monthly fee based on the service it chooses. Through the lower monthly fees for service, businesses often break even on the construction fee within 1-3 years.²³

In 2009, the leasing of dark fiber and additional services was generating \$140,744 in additional revenues beyond the savings already accumulating in the Telecommunications Master Fund.²⁴

By summer 2010, City Net had connected 15 commercial subscribers and was generating \$270,000 per year in revenue.²⁵ For context, the municipal utility in Burbank, a city of comparable size had been leasing dark fiber to local businesses for years, generating enough net income to put a significant amount into Burbank's general fund, escalating to over \$1 million by 2010.²⁶

In 2011, City Net had 35 customers and was offering a 100 Mbps connection for \$1,620 per month and \$8,000 for dedicated 10 Gbps capacity.²⁷ It now has over 110 customers, and generates \$1.6 million annually in revenue. City Net requires approximately

\$1 million each year to operate, not including an additional \$500,000 revolving fund used to expand to commercial customers that then reimburse the cost. This includes salaries and wages for four employees.²⁸

Over the years, Wolf has remained adamant that the goal of City Net was to encourage economic development and improve quality of life rather than maximizing revenue. The following stories provide evidence that the network has had a significant impact on local jobs.

The Santa Monica Daily Press interviewed John Kacperski, from Medical Information Technology Services at the Santa Monica-UCLA Medical Center after they had been on City Net for one year. He highlighted City Net's customer service in particular as superior to other carriers: "We needed to change the way the fiber came into the hospital and they were there to do it within hours."²⁹ Since connecting to the network, the medical center implemented a telemedicine initiative and hired 180 software developers.³⁰

Santa Monica's thriving entertainment industry had been in the habit of using private planes to ferry hard drives from location to location due to the extremely high cost of the highest capacity Internet connections. Now Sohonet, a private company, uses City Net's high capacity connections to enable entertainment companies to move bits with considerably less expense.

Overlooking the Pacific Ocean, the Fairmont Hotel Santa Monica, offers 300 Mbps to guests because of its high capacity connection from City Net. With a history of hosting U.S. presidents, it is now a "tech-friendly hotel." *Travel+Leisure Magazine* has ranked it the best hotel in Los Angeles County for business travelers, and it has attracted major conventions, including the 2013 LA Technology Summit.



Wireless Hot Spots

In 2006, Santa Monica created a free Wi-Fi pilot project at some parks, the libraries, the Civic Auditorium, City Hall, and some other areas with heavy pedestrian traffic. In the first year, the Wi-Fi saw about 750 users per day.³¹

Wireless is sometimes seen as a competitor to wired technologies, but Santa Monica's approach reveals the more complicated truth – wired and wireless are complementary. The Wi-Fi hotspots are enabled by the robust fiber-optic City Net. A person using the Wi-Fi knows only that they have an easy and robust connection. Their device connects to a Wi-Fi radio probably within a few hundred feet. The signal is then put on the fiber-optic network and sent anywhere in the world, likely over wires for the rest of its journey.

The Wi-Fi network has expanded significantly over the years, funded by revenues from City Net connections. The city had 23 hot spots by summer 2010, increasing to 27 in May 2011 with over 2,000 users connecting each day.³² They added another two locations in 2012 before significantly expanding access along nine major streets in 2013 at a cost of \$213,500.³³ By then they were seeing 3,800 daily users. Current operating costs for 32 hot zones and nine commercial corridors are \$60,000 per year. This includes leasing of bandwidth and minimal staff administration.

Users have to sign into the network once an hour in order to continue accessing it. Those who live close to a hotspot may attempt to use the Wi-Fi in their homes as a replacement for DSL or a cable connection but City Net discourages such behavior because the network was not designed for this kind of intense use. It is designed as an amenity, benefiting visitors and making public areas more helpful for everyone.

The Wi-Fi has contributed to a range of city services that include public safety video cameras, pay-on-foot parking stations, real-time parking information on signs and smartphones, traffic cameras, synchronized traffic signals, a transportation management center, and a soon-to-go-live transit priority for mass transit vehicles.

Technical Challenges

Building a municipal network has many challenges, both political and technical. Political challenges can

involve strained relationships between various public agencies, such as a school district that does not want to work with a municipality or a county that has bad relations with other local governments.

In Santa Monica, the College, School District, and City were willing to work together but wanted to keep their own data physically separate from other agencies.

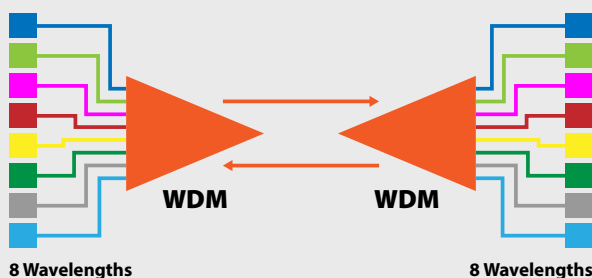
With only six strands of fiber in the original Adelphia network, it was not possible to allocate a unique pair of strands to each entity. To get beyond this impasse, Santa Monica embraced a technology called wave division multiplexing (WDM). WDM accommodated local agency demands for security through physical separation by allowing agencies to share a single fiber but still have unique wavelengths that would prevent the commingling of data from different departments.

WDM allows as many as 40 different wavelengths to be sent and received on a single fiber strand. It is just like a highway with multiple lanes; only in this case all the cars stay in the lane in which they first got on.

People often have fairly fixed ideas on how technology should be implemented even when they might not know why they hold those ideas. The idea that the sole and exclusive use of a given fiber strand implies network ownership or creates security is not

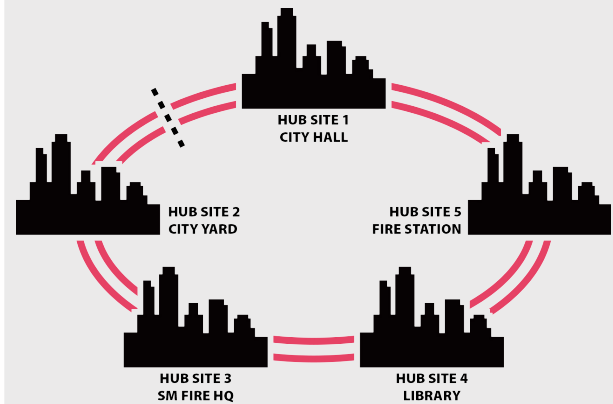
Wave Division Multiplexing

Wavelength division multiplexing (WDM) is a method of transmitting data from different sources over the same fiber optic link at the same time whereby each data channel is carried on its own unique wavelength. The result is a link with an aggregate bandwidth that increases with the number of wavelengths employed. In this way, WDM maximizes the use of fiber-optic infrastructure; what would normally require two or more fiber links instead requires only one.



Put It On a Ring

Santa Monica wanted to build its network as a ring, so a failure would not isolate any sites. In the case of a failure, Hub Site 1 and Hub Site 2 can still communicate by traversing the rest of the ring.



fully grounded in today's technical reality; still, those ideas persist and can be important for some people (and regulations). Good technology people need to be adaptable, even to these not-so-technically-correct issues and solve problems creatively.

Wolf wanted to build a ring topology for redundancy and here again the WDM technology is important. A ring sends data around the circle in one direction to each of the nodes (or Data Centers in Santa Monica's case). Any failure between two nodes will cause the network to turn that signal around – sending it in the opposite direction on a different wavelength – until it reaches the sought-after node.

Even though the initial opportunity via Adelphia's I-Net was resource constrained, there were technical abilities to accommodate the growth of the network in terms of users and applications. As dense wave division multiplexing (DWDM) was being introduced to the network in 2005, the City was able to seek new partners and begin planning for new applications.

With the exception of temporary aerial arrangements during construction, City Net's fiber is underground. Many of the community fiber networks built by municipal electric utilities use poles, which are owned by the utility. However, the process of getting on poles owned by another entity can be cumbersome and lengthy. While Aerial builds can seem attractive due to lower initial capital costs, they have operational and maintenance costs that usually exceed these initial savings. When coupled with pole rental fees, Santa Monica's approach of installing

conduit at low costs may be significantly easier and more cost effective in the long term.

Recent Developments

The network now supports 550 video cameras for public safety, 55 video cameras for traffic management and synchronizes 80% of the traffic signals. Seventy percent of the cameras are hard wired into the network. The rest are connected wirelessly. Some of these investments were made possible by grants that Santa Monica could take full advantage of because of the substantial infrastructure already in place.

Real estate companies have begun to recognize the value of broadband in marketing and pricing their properties. Fifteen different property management firms have placed 105 different large commercial parks and multi-tenant buildings on City Net.³⁴

These real estate firms directly attribute 14.5 percent of leases for retail business to City Net's availability and ease of connection.³⁵ To encourage more buildings to join the network, the City Net web site lists "On-Net Commercial buildings" for companies that may be seeking space with an affordable ultra fast connection already in place.

A 2011 *Wall Street Journal* article took note of Santa Monica's quick recovery from the recession due to high-tech postproduction firms relocating there: "Santa Monica's office-vacancy rate fell to 11.5% in the fourth quarter, from 14.3% in the same period a year earlier, while vacancies for overall Los Angeles County remained at a recessionary peak of 17%."³⁶ Santa Monica's occupancy rate was a stunning 94 percent in 2012.

City Net currently supports over 100 businesses with another 22 companies waiting to be connected. The network is averaging five new customers a month. Expansions for additional services continue. As the network grows, the costs to connect new businesses declines, which will likely result in more businesses connecting, leading to a virtuous cycle of declining cost for connecting still more businesses.

Disaster backup is critical to the importance business places on their information, so City Net has located its disaster recovery site in Las Vegas with multiple physical routes to ensure reliability and safety for their business customers.

As new buildings are constructed in Santa Monica, the City requires developers to include vaults or some

Additional Networks

Mount Vernon, Washington, is another one of the few communities to build an extensive fiber network available to local businesses in a community without a municipal electric department. The Information Systems office operates the open access network and multiple companies have located in town due to its impressive connections. See <http://bit.ly/mt-vernon>

Martin County, Florida, transitioned from a franchise-provided dark fiber network to their own fiber network. The impetus for its investment was Comcast's attempt to increase the cost of the dark fiber network by over 800% over five years after the franchise expired. Martin County instead built a new network, considerably superior to what Comcast offered, and has forecast a savings of \$30 million over 20 years. See <http://www.ilsr.org/florida-fiber-gigabit>

Chanute, Kansas, also built a municipal broadband network incrementally without borrowing by first connecting key anchor institutions and later local businesses. The utility has plans to expand to serve every business and resident in the community. See <http://www.ilsr.org/chanute-rural-gigabit>

Chattanooga, Tennessee; Lafayette, Louisiana; and Bristol, Virginia, are three of the most impressive citywide fiber networks in the country. Each has resulted in tremendous economic development, lower prices for telecommunications services, and various other benefits to the community.

See <http://www.ilsr.org/broadband-speed-light/>

form of access to allow Internet providers, especially City Net, to easily gain access to the building.

Seven independent private fiber providers use City Net to support their customers. As has long been the tradition amongst carriers, using and acquiring fiber that is already in the ground is preferable because of the high cost of building new networks.

Finishing City Net

After 16 years of hard work, City Net has built out 90 percent of its original plan. It has fully connected all the public entities in the community. The focus is now on one final commercial corridor, wiring it so local businesses can connect, upgrading traffic signaling, and adding Wi-Fi. The final piece is being funded by a Los Angeles smart transportation grant minus the Wi-Fi costs, which are funded by accumulated savings from the Telecommunications Master Fund.

The initial vision has been continually enhanced. Back in 1996, few were thinking of Wi-Fi or carrier hotels with physically redundant, reliable, and re-routable connections. And 10 Gig circuits? Well that might have seemed a lot in 1996, but today it is hardly sufficient for City Net and its customers. City Net is looking at a greater use of DWDM and 100Gbps backbones to support the ever-increasing demand. Because of smart planning and a shared vision among key stakeholders and elected officials, City Net has a fund that allows continued new investments.

City Net is exploring new ways to benefit the community. For instance, having learned that many businesses do not have the inside expertise to manage high-speed networks, it may begin providing

consulting, help desk functions, or more. Jory Wolf says, “business either needs to have network knowledge or we need to provide this. We need to make it simple to use these services.”³⁷ As the Institute for Local Self-Reliant’s case study, *Broadband at the Speed of Light*, notes BVU Authority in Virginia has long excelled at providing services to the local businesses as well.³⁸

Though Santa Monica has done everything it can to encourage Verizon to expand FiOS to everyone in town, many still lack access. However, City Net is examining what it can do directly to ensure everyone has the access needed to thrive in the modern digital economy. The network is in the midst of selecting a number of multiple-dwelling unit buildings with affordable housing that will connect to City Net. Unlike Santa Monica’s business community, which received bundled services through an independent ISP, City Net will be the service provider for these units.

Santa Monica is recognizing that the big cable and telephone companies are apt to leave many without adequate access to the Internet. Having an asset like City Net allows Santa Monica to try different approaches in building a 21st century utility. In this case, the funds that City Net saved the city of Santa Monica are being used to expand the network to those who are least connected to the Internet.

Final Thoughts

“The legitimate object of government, is to do for a community of people, whatever they need to have done, but can not do, at all, or can not, so well do, for themselves in their separate, and individual capacities.”

—Abraham Lincoln

The early visions born in 1996 established a purpose and identified as much of the future as could be seen at that time. There were failures and setbacks along the way, as well as a few joyous wins. Cities beginning today might think it is a different time. It's not.

Technology changes, but many of the challenges remain unchanged. Some people will say we don't need the latest telecommunications technology; some will think it too hard to make change happen. Or, maybe they will say it's someone else's job. One thing is certain: Local governments who believe they can continue to ignore telecommunications because it is “someone else's job” will fall behind.

Today, Santa Monica's high school graduates can enroll in a youth technology program that engages students with hands-on projects and expose them to career opportunities in IT and private tech startup ventures.³⁹ Santa Monica was designated a “Top-Ten Digital City,” by the Center for Digital Government. The City was honored as a “Citizen-Engaged Community” by the Public Technology Institute. Harvard University selected Santa Monica as one of the Top 25 Innovations in Government - the only one in broadband. The awards continue to stream in; Santa Monica's dream of being the “silicon beach” are coming true.

Wolf estimates the total cost of building the network exceeds \$5 million. The overwhelming majority of it came from joint trenching, revenues from the network, and grants. It all started with a community-led plan and the smart decision to reinvest savings, taking control of connections to three public entities – the School District, City, and College. Santa Monica's businesses have benefited both from City Net directly and because competing providers have lowered their prices in response – by approximately 20 percent.⁴⁰ Over the years, City Net has also returned \$5 million to the General Fund.⁴¹

Take control of your community's destiny. Be careful of providers that tell you that you do not need very high speed telecommunications or that you cannot do it without their company. Work with existing providers where possible, but don't let their needs limit the community's aspirations. As Wolf notes:

“When I talk to prospective post-production and tech businesses seeking to relocate to Santa Monica, they tell me it is no longer the cost of real estate, but the cost of IP driving the decision. Municipalities that fail to offer an infrastructure where businesses have all components essential for operations – space, power, water, broadband, etc. risk losing the most stable industries in the current economy. Furthermore, if the United States is to compete globally, a fiber optic network is the backbone and requirement of all educational, business, and civic operations in the future.”⁴²

More than 400 communities have built world-class fiber networks that offer services to local businesses and/or residents. Most have relied upon their municipal electric utility. Santa Monica shows that a city without a municipal electric utility can, with patience, perseverance, and excellent leadership, build a successful self-financed network. It is a strategy virtually any city would do well to investigate.

List of City Net Awards

The following are a list of awards City Net has won for both its infrastructure approach and applications.

- 2004 Public Technology Institute, Institutional Fiber Network
- 2005 Los Angeles Consortium of Governments Award, Best Practices in Technology
- 2006 Public Technology Institute, Real-Time Parking Availability Online
- 2007 Center for Digital Government – Digital Cities Winner, 1st Place
- 2007 Public Technology Institute, Parking Meter Debit Card: Santamonicard
- 2007 Public Technology Institute, Real-Time Video System
- 2008 Public Technology Institute, Security Video Camera System
- 2009 Center for Digital Government – Digital Cities Winner, 1st Place
- 2009 Public Technology Institute, Institutional Network GIS Application
- 2010 Public Technology Institute, Beach Parking Automated Payment System
- 2011 Information Week Magazine, Best Government Innovator: Broadband Networks
- 2011 Public Technology Institute, Advanced Broadband Initiative
- 2011 Center for Digital Government – Digital Cities Winner
- 2012 Public Technology Institute, Mobile Parking Website
- 2012 Information Week Magazine, Best Government Innovator: Mobility Solutions
- 2012 Broadband Communities Magazine, Top 100 Fiber To The Home
- 2013 Broadband Communities Magazine, Top 100 Fiber Leaders

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- 6 Santa Monica Telecommunications Master Plan, see <http://muninetworks.org/content/santa-monica-telecommunications-master-plan>
- 7 Telecommunications Master Plan, page 35
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- 9 Telecommunications Master Plan page 25
- 10 Telecommunications Master Plan page 54
- 11 Telecommunications Master Plan page 40
- 12 Telecommunications Master Plan page 40
- 13 Telecommunications Master Plan page 40
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- 15 Telecommunications Master Plan page 25
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