Final Report

City of Atlanta
Telecommunications Policy
Advisory Committee

Subcommittee on New Technologies

June 28, 2005

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EXECUTIVE SUMMARY

The Telecommunications Policy Advisory Committee (TelePAC) was established by the City Council to advise the Mayor and the Council on telecommunications technology policy matters. One important element identified by TelePAC is the need to provide policy advice on the most beneficial applications of newer technologies and investment options that might best serve the interest of both the citizens and government of Atlanta, Georgia. A subcommittee of TelePAC on New Technologies was formed to investigate these matters. This Report summarizes its conclusions as to what policies and investments by the City may offer the best returns.

The nature of telecommunications has changed in drastic and important ways in the last decade. Cities like Atlanta are seriously challenged to manage their own communications technology and policies effectively and efficiently. Operation of basic City functions and growth of the tax and economic base of the City now require Atlanta to adapt to a climate where high-speed networks are essential.

Eight policy alternatives were examined.[1] These cover a range of options and represent broad strategies rather than narrow project comparisons. Each of these policy alternatives was evaluated using a scorecard analysis that rates compliance with evaluation criteria. For this analysis, the criteria included (a) innovativeness and adaptability to future conditions, (b) affordability, (c) potential to generate revenues for the City, (d) feasibility of implementation, (e) potential impact on economic development, (f) overall impact on City population, (g) relevance to core City functions, and (h) the likelihood of success.

After weighting these criteria two superior policy alternatives emerged:

(1) Investment in e-government through web-based processing of transactions and services; and

(2) Investment in a wireless local area network.

[1] The policies analyzed are set forth in TABLES 2-6 at the end of this Report:

- investing in web-based transaction capabilities for enhanced delivery of City service;
- electronically archiving City records and webcasts of open meetings to enhance citizen participation and decrease back-end compliance costs with open records requests;
- investing in the creation of a wireless local area network (WLAN) on the Wi-Fi standard that would connect seamlessly with existing hot spots and greatly expand wireless Internet coverage in Atlanta;
- investing in the creation of a wireless municipal area network (WMAN) on the WiMAX standard that would provide a blanket of wireless coverage throughout the City to provide service to underserved areas and enable mobile access;
- upgrading the City telecommunications infrastructure by acquiring capacity where it is currently leased and increasing the security and stability of municipal architecture;
- investing in global positioning system (GPS) equipment for navigation and tracking for public safety vehicles and other important City assets;
- investing in a fiber network connecting the Atlanta Public Schools (APS) that will allow for better long-term information management and create opportunities for collaboration with other educational institutions using advanced instructional technology; and
- subsidizing broadband access to underserved areas in the City of Atlanta.

Based on an evaluation of all the alternatives, this Report recommends that the City of Atlanta prioritize its new technological investment in these two areas. Other projects worthy of investment include upgrading the City's network infrastructure, creating a fiber network for APS, and creating an accessible electronic record archive.

1. INTRODUCTION

1.1. BACKGROUND

The focus of this report is on potential investments in new telecommunications technologies by the City of Atlanta, Georgia. In March 2004, the Atlanta City Council passed a resolution creating a Telecommunications Policy Advisory Committee (TelePAC) with the purpose of "reviewing City policy so as to advise the Mayor and City Council on maximizing the use of telecommunication technology and programs so as to benefit the public's health, safety, and welfare."[1] Part of TelePAC's mission is to advise City policy "regarding the deployment of new technologies within the city that would maximize the availability of telecommunications services." This report broadly examines potential investments in new technologies that the City of Atlanta could make, compares alternative policy options, and makes recommendations for changes in the City's telecommunications policies.

Telecommunications technologies have historically provided the infrastructure essential for the growth and vitality of our economy and society. As such, investments in new technologies are an important part of the City of Atlanta's future. In a report adopted in December 2004, Mayor Shirley Franklin outlined her vision of Atlanta as a "thriving core of the metropolitan area" that is a "competitive city, nationally and internationally."[2] The *New Century Economic Development Plan for the City of Atlanta* focuses on three broad issues of importance to the City: (1) economic opportunity, (2) healthy neighborhoods and quality of life, and (3) physical infrastructure. Economic opportunity includes improving and maintaining a good business climate, developing the workforce to enable all citizens to take active roles in the economy, and creating jobs that will sustain economic growth. Healthy neighborhoods and quality of life issues include ensuring the availability of quality, affordable housing for the workforce, investing in public schools, protecting public safety, revitalizing underserved areas, and fostering cultural and recreational opportunities for all residents. Physical infrastructure issues faced by the City include upgrading the water and sewer system, managing solid waste, and improving transportation within the City.

1.2. REPORT OBJECTIVES

Advanced telecommunications technology can help the City of Atlanta in all three of the strategic areas of improvement set forth in the *New Century Economic Development Plan*. First, better communications networks can improve economic opportunity by expanding the resources available to businesses and by enabling Atlantans to become integrated into the information economy. Second, new telecommunications technologies can help improve quality of life in the City by distributing the benefits of technology throughout neighborhoods and schools, improving delivery of City services, enhancing public safety efforts, and lowering barriers to information. Finally, new technologies can improve Atlanta's telecommunications infrastructure as well as serve City officials who manage other crucial parts of the City's physical foundation. This report

examines on a broad scale what new technological advances and applications can help the City of Atlanta meet the goals outlined by Mayor Franklin.

2. PROBLEM DEFINITION & POLICY FRAMEWORK

Any evaluation of Atlanta's telecommunications policy regarding investment in new technologies requires clarification of the goals in order to properly assess the present policy situation and future options. If the goal is to "maximize the availability of telecommunications services," we must understand the different possible definitions or interpretations of just what is included in the term "telecommunication services". This definition and the line between "telecommunication services" and "information services" has been and continues to be the subject of a continuing regulatory and policy debate. For our purpose standard policy analysis requires a redefinition of the problem that will ensure all possible alternatives are investigated and presented for evaluation. For reasons set forth below, in this Report we adopt a working definition of telecommunications services as "broadband Internet access."

In this context we will examine: (1) What are the problems; (2) what are the options available to the city; and (3) which of these options appear to have the most promise. The ultimate choices must be made by the City leadership and policy makers.

2.1. POTENTIAL PROBLEM FORMULATIONS

In this case, there are at least four possible interpretations of the problem facing Atlanta, each of which incorporates a set of priorities that must be established by policymakers:

2.1.1. PROBLEM A: INVESTING IN CUTTING EDGE TECHNOLOGIES

One of the motivations for expanding telecommunications services is the desire to be on the cutting edge of modern technology, which affects the perception of cities as they market themselves. Many communities in California's Silicon Valley have used this motive as justification for municipal involvement in telecommunications. Lompoc, California, for instance, cites improved quality of life in the community as one of the driving factors for its investment in wireless Internet and fiber networks and uses phrases like "cool concept!" in its marketing.[3]

2.1.2. PROBLEM B: CREATING ECONOMIC DEVELOPMENT

Communities often justify investment in telecommunications and information networks based on the impact they will have on small businesses in the region, linking provision of telecommunications services to economic development. Advanced telecommunications services are important for economic development because they enhance flows of information in the market and enable more competitiveness based on innovations from new technologies. Many rural or declining regions have focused on this strategy, not wanting to be left behind by the "new economy." For example, Scottsburg, Indiana reportedly moved ahead with a wireless Internet plan after a 2002 survey indicated three companies were considering leaving the small town because they did not have broadband access.[4]

2.1.3. Problem C: Reaching Underserved Areas

Although the rural communities seeking economic development opportunities from advanced telecommunications services certainly qualify as underserved by the markets, the justification of investment based on potential economic growth is distinct from the justification of investment based on concerns for equity or universal service. For example, the City of Philadelphia has promoted its wireless initiative as beneficial for all of the city's citizens, 60% of which do not have access to broadband Internet.[5] Additionally, broadband Internet access, especially wireless access, can increase the independence of people with disabilities, an often underserved population. The lack of broadband proliferation and use by all segments of society has created competitive problems for the United States, which has fallen in world rankings of broadband use. The inability to reach a broad audience via broadband is an impediment to the delivery of broadband-enabled civic and municipal services.

2.1.4. Problem D: Increasing Revenue for the City

Another problem facing the City is the loss of tax revenues from phone bills as customers increasingly rely on cellular phones or Internet telephony for their communications needs. Loss of revenue from technologically driven change has occasionally been a sticking point for telecommunications policy, most recently at the federal level where concerns for state tax revenue blocked a permanent extension of the Internet access tax moratorium.[6]

None of these four problem formulations are mutually exclusive. In fact, they each present considerations that are of interest to the client. As a result, they will be factored into the criteria established for evaluating policy alternatives later in this report.

2.2. Defining "Telecommunications Services"

Determining the array of services and technologies encompassed by the phrase "telecommunications services" can be somewhat problematic, and government regulators have grappled with this task over the last decade. The Telecommunications Act of 1996 created separate regulatory categories for the Internet (which it described as an "information service") and for telephone service (which it described as a "telecommunications service"). However, these definitions have been challenged and redefined by converging digital technologies. In particular, Voice over Internet Protocol (VoIP) has perplexed regulators and courts alike, with some declaring it to be a telecommunications service, some declaring it to be an information service, and others declaring it to be a hybrid.

In general, telecommunications technology is moving in the direction of unification—towards a single protocol that can result in voice, data, and video transmission. Currently, the best candidate for this unification of services is via high-speed broadband Internet access. Broadband Internet access has become the focus of national telecommunications policy, with initiatives at the federal level initiated by both the Federal Communications Commission (FCC) and the Department of Commerce to make broadband access universal by 2007.[7]

Consequently, broadband Internet access will serve as the definition of telecommunications service for this analysis, with exceptions noted along the way. There is no established definition

of what constitutes "broadband Internet access." The FCC has adopted a two-pronged classification system for reporting purposes, in which connections that allow transmission speeds of more than 200 kilobits per second (kbps) in at least one direction (upstream or downstream) are classified as "high-speed" broadband lines, while networks with at least 200 kbps in both directions are classified as "advanced services" broadband lines.[8] The Computer Science and Telecommunications Board of the National Research Council has adopted a more complex definition that says broadband services should perform at a level high enough to encourage the development of new applications and should not limit consumer's ability to access content.[9]

The importance of broadband Internet access differs among constituencies. Individuals demand broadband access at home because of the enhanced services that it enables, many of which are focused on entertainment. VoIP is an important application that also makes broadband more attractive to consumers, and streaming video capabilities offer new opportunities as well. Businesses, on the other hand, rely on high-speed connections for their economic success. Broadband Internet access enables more comprehensive data transactions and the enhanced communications that help spur economic development.

Historically, telecommunications services have been divided by the nature of the content provided, such as video, data, or voice. However, convergence has weakened this distinction and focused the telecommunications sector on the differences between the transmission protocols. There are currently at least seven technological methods available for providing telecommunications services:

2.2.1. DIGITAL SUBSCRIBER LINES (PHONE LINES)

Digital subscriber lines (DSL) are traditional telephone lines that enable high-speed Internet access via special modems that are installed on the premises. Most DSL subscribers in the U.S. have a connection referred to as asymmetric DSL (ADSL), which maximizes download speeds by limiting the upload speeds of subscribers. Download speeds for ADSL range from 256kbps to 3Mbps, but the speed varies based on the distance of the subscriber from the provider's office. At long distances (approximately 18,000 feet), signal quality deteriorates in copper wiring, which means that some phone customers may be too far from the central office to have access to the service. Additionally, DSL signals cannot travel through fiber-optic cables or across bridging or amplifying devices used by phone companies to extend copper wiring, so customers whose phone lines are connected to these devices are not eligible for DSL service.

The FCC reports that in June 2004, 35.8% of "high-speed" broadband lines in the United States were provided by ADSL.[10] This is a sizeable increase from December 1999, when ADSL constituted only 13.4% of high-speed lines. However, because of the asymmetry of the technology, ADSL composes a smaller percentage of "advanced services lines" as reported by the FCC, only 16.1% in June 2004. The majority of users with high upstreaming capabilities have cable modem connections to the Internet (see below).

Because DSL uses traditional phone lines to provide broadband Internet access, nearly all (95%) ADSL lines in the U.S. are operated by incumbent local exchange carriers (ILECs).[11] In the City of Atlanta, BellSouth is the incumbent local carrier. It is not known, however, what percentage

of City residents can be served by BellSouth's DSL service, which is known as "FastAccess," due to the technical limitations noted above.

2.2.2. CABLE

Coaxial cable lines currently offer access to the Internet at speeds usually ranging from 2-4 Mbps to 30 Mbps, although coaxial cable lines transmit data by converting signals into 6 MHz "channel," a task that is undertaken by cable modems on the customer's premises. The signals may be converted onto a fiber optic line at a later stage of the cable network (creating a hybrid fiber-coax network, or HFC), but the signals are transmitted to the customer's home via coaxial cable. Unlike ADSL, which requires an asymmetric upstream/downstream data flow, cable broadband allows more upstream data capacity.

One of the benefits of the cable systems is that they are nearly ubiquitous, reaching almost all (approx. 97%) of households in the United States, especially in metropolitan areas.[12] Additionally, it has become the dominant technology for provision of broadband. According to the FCC, 74% of "advanced services lines" were provided via coaxial cable in June 2004.[13] Growth in cable broadband has been slower than DSL in recent years[14], possibly due to the earlier dominance of cable over DSL in the broadband market. One additional benefit of cable is that because the majority of cable systems have been upgraded to a hybrid fiber-coax network, an eventual upgrade to an all-fiber network might be easier to complete.

2.2.3. WIRELESS NETWORKS (WI-FI, WIMAX)

There are a number of wireless networking protocols in existence or in development that offer high-speed Internet access. The most common is known as Wi-Fi, a short-range wireless signal that operates under the IEEE 802.11 standard. Wi-Fi signals generally only travel a few hundred feet from their transmission point, which means that Wi-Fi coverage only occurs in "hot spots" unless an extensive network of antennas is constructed. This service, which may be provided free or for a fee, is often offered by restaurants, coffee shops, airports, and other locations that might attract customers with laptops. Wi-Fi signals must be broadcast from a fixed Internet access point, which means that it is not usually an access option for home desktop computer users. Therefore, Wi-Fi has become the dominant Internet access standard for mobile devices, such as laptops and PDAs. Wi-Fi technology is used to create wireless local area networks (WLANs). These are distinct from wireless personal area networks (WPANs), which are typically used at very short range to connect personal devices wirelessly.

According to the FCC, satellite and wireless connections composed only 1.3% of high-speed connections in June 2004.[15] This is primarily because wireless networks require a secondary connection to the Internet backbone. However, the FCC has recognized wireless as a unique broadband solution because of its ability to connect mobile devices and integrate information systems.[16] Furthermore, one of the growth areas in wireless broadband is in the creation of wireless municipal area networks (WMANs), which could deliver broadband access to end users without a secondary Internet connection.

WMANs can span distances of up to 30 miles, which is important for backhaul applications as well as providing last-mile connectivity in metropolitan areas.[17] Most WMAN networks operate under the IEEE 802.16 family of standards. One of the more popular standards is commonly referred to as WiMAX. WiMAX offers speeds of up to 75 Mbps. Unfortunately, WiMAX deployment has been slowed by a debate in the industry over what standards should be used for the technology. Another consideration is whether the radio frequencies used for WMANs involve licensed or unlicensed spectrum. According the FCC's Wireless Broadband Access Task Force, the frequencies most ripe for WMAN deployment are located in the 2.5 GHz band, designated by the FCC as the Broadband Radio Service (BRS) and Educational Broadband Service (EBS) band. These frequencies require licenses from the FCC, which will be held by wireless Internet service providers (WISPs) such as Clearwire.[18] Additionally, the FCC recently released spectrum in the 3650-3600 MHz band for non-exclusive licensing for WISPs that should enable WiMAX deployment.[19]

2.2.4. CELLULAR NETWORKS

Wireless broadband can also be offered through a cellular architecture, upgrading to a third generation (beyond analog and digital) packet service, abbreviated as 3G. These networks, unlike the fixed networks above, are completely mobile because they do not require a customer to be confined to a particular location. The service is targeted primarily at cell phones, personal digital assistants (PDAs), and wireless modem cards attached to laptop computers. Currently, wireless networks in the U.S. use two main digital voice technologies, CDMA and GSM. Each of these has been extended by overlay networks called (1xRTT and GPRS) that enable data transmission services. The maximum speeds of these networks are approximately 110 kpbs and 144 kbps, respectively. These networks are often described as "2.5G" because they are a bridge between the digital voice networks and the high-speed packet service of 3G, which offers speeds at least three times as fast.

Major U.S. wireless companies have begun to roll out advanced 3G services in metropolitan areas. Verizon Wireless, for example, has offered Atlanta business customers access to its 3G EV-DO network, with 300-500 kbps data speeds, since September 2004, and the company also launched a multimedia service (VCAST) targeted at consumers beginning in February 2005.[20] Atlanta-based Cingular Wireless has announced plans to build a 3G UMTS (Universal Mobile Telecommunications System) network that covers most major markets by the end of 2006.[21] The Cingular network is expected to have data speeds of 400-700 kbps.

In addition to the traditional cellular architecture, the evolving IEEE 802.20 standard, described as Mobile Broadband Wireless Access (MBWA), enables peak data rates of over 1 Mbps and combines features of fixed and mobile wireless networks. Customers in the Raleigh-Durham, NC area have been able to access one of these networks since February 2004, based on the Flash-OFDM technology developed by Flarion and provided by Nextel.[22]

2.2.5. FIBER

Fiber optic cables are strands of glass that carry digital information over long distances, much like copper wire or coaxial cable does. However, fiber networks have much more capacity, so they can carry more traffic and handle much larger bandwidth, crucial for high-speed

connections. Fiber networks also face less signal degradation, require less power, and are more flexible than copper networks. For all of these reasons, and due to the fact that fiber material is often cheaper than the current materials deployed, fiber has widely been installed for telecommunications backhaul networks. The data speeds for fiber networks are very large compared to current broadband networks (as much as thousands of times as fast, over 1 Gbps).

When fiber is extended to customer premises (known as Fiber to the Home, or FTTH), the services available to consumers dramatically increase. However, this deployment comes at a high cost, especially in existing neighborhoods with sidewalks, sprinklers, and other local infrastructure. According to AT&T CEO David Dorman, putting fiber into the home can cost as much as $1000-$1500 per unit, which he says makes wireless networks more affordable to deploy.[23] BellSouth CEO Duane Ackerman has acknowledged his company's intention to deploy fiber in new neighborhoods but to provide DSL service in neighborhoods that require retrofitting.[24]

Municipalities have played a role in FTTH deployment. Although less than ten percent of fiber deployments are undertaken by cities, nearly a third of the homes in the U.S. that are passed by fiber are reported to be served by municipal fiber networks.[25] However, only communities with municipal electric utilities (MEUs) that have some previous investment in communications are very likely to deploy FTTH. Since Atlanta is not served by a MEU, municipal fiber deployment would probably be difficult for the City to implement. Furthermore, the City is already served by fiber rings that provide service to the universities and business districts within the City. Therefore, the need for Atlanta to deploy a municipal fiber network is much lower than for truly underserved regions.

Fiber-to-the-home does deliver a tremendous potential for an increase in services, so much so that networking experts have called it "future proof"—unable to be obsolesced by future technologies. However, the evidence suggests that there is not currently enough demand for high-bandwidth services to justify broad deployment to residential areas. Some industry observers expect alternative pathways such as wireless networks to drive long-term demand for FTTH.[26] Nonetheless, some major municipal governments view FTTH as an opportunity for their cities to gain a competitive advantage in the information economy. The City of Seattle, Washington, for example, just released a Task Force report endorsing fiber as the best long-term solution for broadband access.[27] Seattle hopes to distinguish itself as a leading business incubator for advanced communication technologies and applications; Atlanta could also use this strategy.

2.2.6. SATELLITE

Personal satellite systems have been used to provide video content to consumers for years, directly competing with cable companies. In the same vein, satellite transmissions can provide broadband Internet access at speeds of up to 2 Mbps (in the current market). However, these services are usually fairly expensive for consumers. Rates for services comparable to DSL can be as much as three to four times as expensive, although some lower-price packages are usually available.

An additional limitation with satellite broadband, as with all satellite services, is that customers' satellite dishes must have an open look towards the sky. Trees, buildings, or other obstructions can cause unevenness in service eligibility. As such, satellite systems are ideal for rural areas where DSL and cable are not feasibly provided due to physical limitations. Satellite broadband, therefore, is not an attractive candidate for investment by the City of Atlanta.

2.2.7. Broadband over Power Lines

One emerging potential conduit for high-speed Internet access is electric power lines. Broadband over power lines (BPL) would enable consumers to connect to the Internet through the electric outlets already installed in their homes. The advantages of BPL are that no new wiring is required; users can plug a special modem into electrical outlets to receive their data access. Data speeds for BPL are comparable to those for cable modems, with first-generation BPL technology achieving bit rates of 300-500kbps and later advances nearly double those speeds. However, the speed can increase depending on the quality of the transmission lines and technological advancement. BPL signals will only propagate a few thousand feet along power lines, so connections to the Internet backbone must not be far from customers who are served by it. Therefore, it is currently distance-sensitive, similar to DSL. However, this should not pose a significant problem for urbanized areas. And as with any utility, scale economies apply. Consequently, there is debate over the viability of BPL. According to telecom officials, 25% market penetration is required to keep a technology economical; this may be a problem for BPL.[28]

Another challenge posed by BPL is radio interference that occurs as a result of electromagnetic radiation emitted from power line equipment at BPL frequencies. Certain radio systems, especially those of low-power licensees such as amateur radio or ham radio operators, may be affected. The FCC has required BPL operators to mitigate their interference with licensed operators. However, there are also economic regulatory issues that must be addressed with respect to BPL. Since electric utilities are heavily regulated, what consideration must be given to BPL? Should a "hands off" regulatory approach dominate the landscape, or should BPL be subject to open access requirements similar to the current telephone regulatory regime? The answers to these questions are unsettled and will play a significant role in the development of BPL as an alternative to other broadband technologies.

Currently, BPL deployments in the United States are occurring on a trial basis. A survey of BPL trials was conducted by the National Association of Regulatory Utility Commissioners' (NARUC) BPL Task Force, finding no active trials in the state of Georgia.[29] However, more and more utilities are experimenting with BPL technology, and it is likely that some form of BPL access will come to the Atlanta area in the next few years. Nonetheless, there is little that the City of Atlanta can do with respect to Broadband over Power Lines, given that Atlanta has no control over the electric power grid, which is under state regulatory authority. Also, investments by power companies in BPL necessitate certain economies of scale, which means that selective deployment of the technology (even when/if perfected for commercial use) is improbable.

Should the City of Atlanta determine that BPL is a strategically important investment, City leadership might begin discussions with Georgia Power (and parent Southern Company), both of which are headquartered within city limits. If the Georgia utility industry intends to begin

investing in BPL, the City might be able to persuade them to start their pilot programs in Atlanta. This is an unlikely outcome, however, and there is little certainty that such a project would even be beneficial to the City in the long run.

2.2.8. SUMMARY

It should be noted that all of the above offer, at least in theory, the opportunity to access traditional telecommunications services and access to entertainment programming (historically provided by cable). However, a history of universal service principles for plain old telephone service (POTS) has brought basic phone connectivity to the overwhelming majority of dwellings in America, and the problem of access to a basic telephone service is virtually non-existent, especially in urban areas. Additionally, entertainment services have only been effectively distributed via cable or satellite, due primarily to the franchising agreements necessary for content provision. This situation is changing, however, as cellular phone companies and Internet service providers focus increasingly on providing video programming.[30]

2.3. POLICY FRAMEWORK

Given the wide scope of competing telecommunications technologies today, there are a large number of stakeholders and policy actors involved in this process (see Table 1). Potential policy actions must be analyzed in the context of the framework created by these actors, who have varying influences on the successful implementation of policies selected. Below are descriptions of the various stakeholders, their perspectives, and their role in the telecommunications policy process.

2.3.1. CITY OF ATLANTA

The City of Atlanta, through the City Council and the Mayor's office, is the primary decision-making actor in this policy framework. The City's finances will be affected by any investments it makes in new telecommunications technologies, and therefore decisions regarding telecommunications policy may affect other policy arenas as well. The City could also choose to let the market dictate the emergence of new technologies, but this would not eliminate the City's role as a provider of services and as a regulator of the public right-of-way. Through the Department of Information Technology, the City will be the primary implementer of new telecommunications technologies. The City stands to benefit from new technological investments through efficiency gains, the ability to expand or add new services, and possible revenues raised. At the same time, the City faces potential costs in deploying the services, both in terms of financial losses and administrative support.

2.3.2. ILECS, CLECS, AND TRADITIONAL WIRELINE COMPANIES

The City of Atlanta is served almost exclusively by BellSouth, the incumbent local exchange carrier (ILEC). BellSouth owns most, if not all, of the telephone lines in Atlanta, although it has arrangements to lease those lines to other carriers. In addition to providing phone service, BellSouth offers many residents broadband Internet connections through DSL, although this service is not available everywhere. Phone companies generally oppose municipal provision of telecommunications services because they perceive cities as competitors, although they would

not object to policies that increase private demand for their services. The U.S. Telecom Association, a trade association for telecommunications providers of which BellSouth is a member, argued in 2003 that local governments competing with private service providers have at least four unfair advantages: exclusionary control of public rights-of-way, exemptions from taxes, fees, and regulatory requirements levied on private firms, the ability to interfere with state-controlled regulatory regimes, and fundraising powers without the restraints of debt and capital markets.[31] In addition to these concerns, phone companies also service the City, so they have an interest in protecting their contracts.

2.3.3. CABLE COMPANIES

Cable companies, which also provide broadband Internet service, have an interest in the City's telecommunications policy. Cable television service in Atlanta is provided by Comcast Cable, a division of Comcast Corp., which includes metro Atlanta in its franchise area. Comcast has an interest in increasing demand for its bundled telecommunications packages, which generally include TV content, voice services, and Internet access. Although VoIP services have often been provided by third party companies such as Vonage, Comcast unveiled its own IP-based phone service in January 2005 in three markets with plans to offer the service to all of its markets (including Atlanta) by mid-2005.[32] Early prices for Comcast's voice service are higher than competitors, but Comcast has the advantage over third-party providers of controlling their own networks. Comcast also has an interest in renewing its franchise agreement with favorable terms.

2.3.4. INTERNET SERVICE PROVIDERS

Internet service providers (ISPs) are companies that provide access to the Internet to customers. Phone companies and cable companies are a part of this group when they offer Internet access, but there are two other kinds of ISPs that are relevant. One type of ISP provides access to the Internet for customers who dial into the network through their telephones via modems. Atlanta-based Earthlink is one such ISP. There are also wireless ISPs, or WISPs, who provide access to the Internet via wireless networks. Generally, ISPs as a group are in favor of increasing demand for Internet services because they will have a greater customer base. ISPs want Internet service penetration rates to be as high as possible, so they generally are supportive of applications that might increase the utility of the Internet. WISPs are in favor of expanded wireless Internet coverage, since they generally benefit from additional subscribers. They may rely on the City of Atlanta in two ways, either by leasing City space for wireless network equipment or by contracting with the City directly to provide services.

2.3.5. ELECTRIC UTILITIES

Georgia Power, which serves the City of Atlanta with electricity, is a stakeholder because of its role as a potential Internet service provider (previously discussed under "Broadband over Power Lines"). While currently there are no investments in BPL by the utility company, Georgia Power has an interest in seeing a widespread demand for broadband Internet service because their network reaches all of the potential customers, unlike the phone or cable companies. However, the energy company's interests in telecommunications policy are relatively small compared to other stakeholders such as the cable or phone companies. In addition to Georgia Power, the

Municipal Electric Authority of Georgia (MEAG) is an electric power authority that is publicly owned and operated by its 49 member cities and is headquartered in Atlanta. MEAG is the third largest power supplier in Georgia, although it does not serve the City of Atlanta. MEAG also indirectly operates a 1,500 mile statewide fiber optic network through Georgia Public Web, playing a role in the state's telecommunications systems. MEAG is prohibited by law from directly providing IT services, though it is allowed to resell them. MEAG, therefore, has an interest in continuing to provide low-cost services for its members, although it is a non-profit provider.

2.3.6. Telecommunications Network Providers

Atlanta is served by a number of telecommunications network providers, including AGL Networks, Level3, Southern Telecom, Looking Glass Network, and XO Communications. These firms provide high-speed fiber optic cable network capacity to businesses, universities, and other institutions with high demand for these services. These backhaul networks are concentrated in the business districts are used by large firms. Connections to these networks, which are underground, require permission from the City to dig up streets and disrupt traffic. These network providers are interested primarily in growing their customer base, which is heavily tied to the City's economic development. Additionally, their cost of doing business is directly affected by City permit fees.

2.3.7. Businesses

The business community generally has a strong demand for advanced telecommunications services. Businesses are mostly served by private telecommunications firms, but they would also benefit from improvements in city services that occur as a result of telecommunications technology investments. Additionally, many businesses are relying on wireless networks for communication via their laptops, PDAs, and smart phones. These businesses would benefit from the expansion wireless networks.

2.3.8. Consumers of telecommunications services

Consumers of telecommunications services are people who subscribe to telephone, cable, or Internet services, as well as those who take advantage of other telecommunications networks (such as wireless hot spots). Consumers are generally looking for a wide range of choices, quality service, and low costs. They would applaud investments in new technologies if they can take advantage of them and they do not cost too much money.

2.3.9. Citizens

Citizens of the City of Atlanta have a direct interest in the actions of their local government. They have a myriad of concerns, most of which revolve around concerns that their tax dollars are spent wisely. They may or may not favor municipally-backed or –provided telecommunications services, but they are likely to be skeptical of plans that do not serve the needs of the community as a whole. Additionally, citizens have a demand for more efficient city services and processes, things that increase "customer service" quality. Finally, citizens appreciate an open government, where meetings and records of City activities are easily accessible. These are all goals that might be served by investments in new telecommunications technologies.

2.3.10. EDUCATIONAL INSTITUTIONS

A number of educational institutions in Atlanta stand to benefit from new telecommunications technologies. In particular, the Atlanta Public Schools (APS) would benefit tremendously from an increase in broadband Internet use at the homes of its students. Incorporation of the Internet into learning both inside and outside the classroom could help boost achievement of APS students. Additionally, APS could use advanced telecommunications networks of its own to increase its effectiveness.

The many institutions of higher learning located in the City of Atlanta also have an interest in becoming more connected with the community through advanced telecommunications technologies. Extensive fiber networks currently connect many of the colleges and universities in the City, and they are better served when more businesses and City institutions are also served by these networks. The potential for collaboration also creates a potential for economic development, in addition to the added educational opportunities.

2.3.11. SUMMARY

The table below summarizes the stakeholder interests for Atlanta's telecommunications policy.

Table 1

Stakeholder	**Interests**	**Importance/Impact**
City of Atlanta	Promoting economic growth; balancing its budget; improving internal efficiency; lessening administrative burden.	Major; Decision-maker and primary implementer
Phone companies	Providing voice, broadband, and video services to paying customers.	Major; new policies could directly impact profitability, service relationships.
Cable companies	Providing video, voice, and broadband Internet services to paying customers.	Major; must contract with City for service provision.
Internet Service Providers (ISPs)	Selling access to the Internet; increasing overall demand for Internet services.	Minor; effects are indirect.
Electric utilities	Providing a broadband alternative for underserved areas.	Minor; effects are indirect and in the future.
Telecommunications Network Providers	Attracting businesses with high demand for network services.	Minor; effects are indirect.
Businesses	Increasing productivity; expanding competitive alternatives for telecommunications services.	Major; may enhance business climate, provide funding.
Consumers	Expanding competitive alternatives for broadband, telecommunications services.	Minor; effects are generally indirect.
Citizens	Better City service delivery; enhanced protection of welfare, public safety; proper fiscal management.	Major; may effect all directly; voters play important role.
Educational Institutions	Connecting to peer institutions and creating new collaborations; increasing opportunities for students.	Major; may serve as partners in development, effects for education could be direct.

All of these stakeholders have voices, but two have real and sustained influence on the policy process. The telephone and cable companies play major roles because they are major market forces in the City and rely on government franchises and state regulations to operate; the evolving regulatory structure surrounding Internet-enabled services affects both them and the City's relationship to them. Both of these entities have a substantial capacity to influence policymaking at the Federal and State levels, which may affect the City of Atlanta's ability to deploy new telecommunications technologies. Therefore, the interests of these providers must be carefully considered when crafting policy. Internet service providers (ISPs) who are not phone or cable companies have less of a direct interest because they rely on the networks of others to provide their services, although they stand to benefit or lose depending on their access to the underlying telecommunications technologies. The ISPs are also less of a political force simply because they are relatively new players in the telecommunications industry and there are more competitive firms in the market. Similarly, fiber network providers are only indirectly affected by City policies that attempt to promote economic development.

The business community has historically been a powerful force in the City of Atlanta.[33] This fact alone merits special consideration, but the business community also has a special role as the center of economic development in the region. In addition to its own need for telecommunications services, the business community has an interest in maintaining Atlanta's reputation as a business-friendly city. Therefore, advances that help business productivity in general or that increase the quality of life are seen as positive. Consumers of telecommunications services play a much more minor role, since the effects of increasing competition or expanding alternatives may not be tangible to them. Additionally, the benefits might not be universal. Finally, citizens play a major role because they are affected in a myriad of ways and they wield power at the ballot box.

2.4. CURRENT TECHNOLOGICAL INVESTMENT

Understanding Atlanta's telecommunications policy framework requires that we examine the current state of investment in telecommunications infrastructure present in the City. Given our definition of telecommunications services, we can examine three general areas of investment: broadband Internet, wireless networks, and educational technology.

2.4.1. BROADBAND DEPLOYMENT

There is no readily available method for determining the level of subscription to broadband services in the City of Atlanta. This is unfortunate, since it leaves the City without exact information as to the magnitude and quality of unmet need within its borders. Neither of the City's primary residential Internet service providers, BellSouth and Comcast, make their subscribership data publicly available.

There is also limited information collected on Internet and computer use collected at the Federal level. The U.S. decennial census has not added a question relating to Internet or computer use, so no detailed geographic information is available regarding this. However, the Census Bureau does ask questions related to Internet access in the Current Population Survey, most recently conducted in September 2001. Using the most recently available statistics for the City of

Atlanta, we can estimate that approximately 43.4% of Atlanta households had some form of Internet access in 2003.[34] The statewide figure for Georgia in 2001 was more precisely estimated to be 46.7%.[35] However, Internet adoption has grown dramatically in recent years, so the actual numbers are likely to be closer to the more recently reported national average of 60%. According to a survey conducted by the Pew Internet & Public Life Project, Internet use in the Southeast (GA, FL, SC, NC) has bridged an historical divide to come close to the national average in Internet adoption.[36]

Generally, Internet adoption (and broadband adoption in particular) is highly correlated with income and education levels. According to a study by the Leichtman Research Group in September 2002, both access to and demand for broadband services increases with income.[37] Therefore, we would expect to find higher rates of Internet adoption in more wealthy areas of the City. According to the most recent Census figures (1999), 21.3% of Atlanta families are below the poverty level, and 38.1% of households have incomes below $25,000.[38] These households tend to be concentrated in the southeastern, northwestern, and central parts of the City. These areas are most likely the areas which are underserved by broadband access. They are also the parts of the City where adoption rates of broadband, when available, are lower.

Therefore, the City of Atlanta's current broadband infrastructure has room for improvement. Like many cities, Atlanta's wealthier residents are better served by cable and phone lines offering broadband connections, and poorer residents have fewer options (especially affordable options) to have broadband Internet access in their homes. Currently, through most of America, broadband is treated as a market good rather than a utility. The result is that access is to broadband in Atlanta is non-uniform and not universal.

2.4.2. Wireless Networks

Many parts of the City of Atlanta are populated by private wireless networks that enable free or for-free access to broadband Internet. These Wi-Fi "hotspots" tend to cluster around business frequented by business professionals carrying Wi-Fi enabled phones, laptops, and PDAs. According to Jiwire.com, a free online directory of wireless networks, there are 246 locations in Atlanta for wireless Internet access, 61 of which are free of charge.[39] However, given the limited range of these hot spots, wide distribution does not equal widespread availability.

The City of Atlanta's Department of Information Technology (DIT) has entered into negotiations with Biltmore Communications for the development of a wireless network covering parts of the City. Biltmore will develop a business plan for a seamless, integrated wireless network that enables connectivity with city facilities and with private networks. The plan calls for use of Motorola mesh networks technology to create both a 2.4GHz system for public use and a 4.9GHz system for public safety. Currently, the Biltmore Communications networks serves the Georgia World Congress Center, Technology Square at Georgia Tech, Colony Square, and several residential communities.[40] The proposed network will first be expanded to cover City Hall and the Atlanta airport, then other areas of the City.

2.4.3. EDUCATIONAL TECHNOLOGY

Atlanta Public Schools currently invests heavily in technology through participation in the Federal Communications Commission's E-rate program, which is funded with universal service fees paid by all telephone users in the United States. The E-rate program was created as part of the 1996 Telecommunications Act, and it provides funding for Internet connectivity for schools and libraries in economically disadvantaged areas. Atlanta Public Schools has spent more than $60 million since 1998 on computers and Internet connections, although the spending of E-rate funds has been under investigation.[41]

Atlanta is currently served by a series of fiber networks that enable high-speed connectivity and data transmission among various campuses. The National LambdaRail (NLR) fiber optic network links research universities across the country, including Georgia Tech. Within Atlanta, fiber rings are provided by various entities, including AGL Networks, Southern Telecom, Xspedius Fiber Group, Level3, Looking Glass Network, and XO communications. Recently, the DeKalb County School System contracted with AGL Networks to build an all-underground fiber network connecting 141 buildings in the system; the network will achieve Gigabit Ethernet speeds that will be used for network data operations; the network will offer special educational opportunities as well such as high-speed video communications systems. The DeKalb County project has costs of over $18 million; a similar project for APS would likely cost less because APS is a smaller school system than DeKalb, although many other factors influence the cost.

Additionally, the Georgia Department of Adult and Technical Education operates distance-learning programs through its system of technical colleges in the state. One of these, Atlanta Technical College, is located in the City limits. Atlanta Technical College participates in the Georgia Virtual Technical College, which enables residents to take classes online. This opportunity could be greatly enhanced by better broadband Internet access for Atlantans.

2.4.4. CONCLUSION

Currently, investments in advanced telecommunications infrastructure in Atlanta could be improved by strategic policy approaches to help meet the needs of all Atlantans. Expansion of broadband Internet, wireless, and fiber networks can benefit Atlanta in a variety of ways—giving more opportunities to consumers, businesses, and educational institutions in a way that can promote economic development. Private market forces have created a framework that offers enormous potential if expanded to cover the needs of the City as a whole. The City of Atlanta can build upon the strength of existing infrastructure by utilizing applications that increase the quality of services to residents and businesses and create new opportunities for civic participation. In the next section, policy alternatives that can expand Atlanta's telecommunications opportunities will be explored.

3. BEST PRACTICES

In this section we examine best practices from other cities that have invested in new technological infrastructure, hoping to glean insight from their mistakes and successes. Specifically, we focus on municipal wireless networks.

3.1. MUNICIPAL WIRELESS NETWORKS

This section of the report is intended to glean information about what has and has not worked for public wireless networks already in place or currently being implemented. Wireless networks are being deployed by local government authorities across the United States for a variety of uses, including public safety, education, and economic development. As larger cities such as New York and Philadelphia begin to implement plans for wireless networks, information from existing networks in smaller communities and larger-scale deployments in regional networks is important. Most developments to date have been in rural areas, but lessons can be learned from these initiatives.

3.1.1. PHILADELPHIA, PA

The City of Philadelphia has proposed the most ambitious plan for a municipal wireless network in the country, and it has received the most amount of publicity (both positive and negative) as a result. The Wireless Philadelphia initiative has put out a request for proposals (RFP) that seeks high-speed (1 Mbps average) network that can cover 95% of the entire City of Philadelphia (135 square miles).[42] The network will include free access for certain city locations (such as public parks) and pay access for the rest of the network, although some residents will be subsidized.

On February 9, 2005, the Wireless Philadelphia Executive Committee released the business plan for the initiative.[43] The plan calls for a nonprofit organization to oversee the implementation of the wireless network, which will be outsourced to a private company. The startup funding for the nonprofit would not use city sources. The business plan would have the nonprofit sell wholesale access to the network to retail ISPs, telecommunications companies, institutions, and other nonprofit corporations. Service providers would handle the billing, marketing, support, and additional services. The city will act as an "anchor tenant" for the network. The city projects wholesale rates of $9.00/month for fixed residential service and $100/month for a premium business connection. There are seven planned pricing tiers. Whether or not Philadelphia can make this project work is unknown, but the volume of business and government professionals working on the Philadelphia wireless network suggests that the business plan is solid.

3.1.2. CORPUS CHRISTI, TX

Corpus Christi, Texas deployed a municipal Wi-Fi network for the purpose of serving agencies including utilities and public safety departments. Their network, in its first phase, will cover approximately 18.5 square miles. The city will use 300 Tropos Wi-Fi cells to create a mesh network, which will cost the city approximately $600,000 in its first year.[44] The city plans to use the network to facilitate automated gas and water meter reading, which will eliminate the need for manually recorded consumption. Corpus Christi worked with a non-profit technology research company called Public Technology, Inc. The city will use existing city fiber for the backhaul connections. Police and fire departments will be connecting to the network using Virtual Private Network (VPN) authentication. This has eliminated the need for a trunked data network for secure police uses.[45]

In addition to the public uses, the public has access to the Corpus Christi network, and several ISPs have partnered with the City to offer full Internet service. After the initial phase, which only covers the downtown area, the City has announced plans to expand the network to cover 147 square miles.

3.1.3. CHASKA, MN

Chaska, MN, a suburb of Minneapolis, has built a city-wide wireless mesh network that covers most of the city's 16 square miles. The network, which consists of 250 outdoor antennas, claims speeds of 1.5-3 Megabits per second and operates in the 2.4 GHz range. The project was financed with a private loan, but it is expected to make money after a few years of operation. The city will operate on a cost-recovery basis.[46] Chaska.net has over 2000 subscribers, with the basic residential rate being $16/month. The capital costs of the network were approximately $600,000 for the mesh network and $100,000 for fiber. Services were donated by the private sector. The network is not encrypted, which places limitations on the usefulness of the network for public safety agencies handling sensitive information.

3.1.4. HOUSTON COUNTY, GA

Houston County, GA has been trying to implement plans for a wireless network over the course of the last year. In May 2004, the Houston County Wireless Committee announced successful completion of tests for the wireless broadband technology.[47] Contracting with Siemens Business Services, test speeds of 5 Mbps were delivered over 12 miles. Houston County is also partnering with Intel and Alvarion, and it will use 5.8 GHz equipment.

However, plans for the network have largely been handed over to the private sector. Wireless committee chairman Matt Stone said, "I got the message from the committee and from the public in general that there was little if any political will for a publicly funded network even with the cooperative wholesale model."[48] No further advances have been made on the network.

3.1.5. CONCLUSIONS

As part of its initial assessment, Wireless Philadelphia used analyses conducted by Temple and Drexel Universities to come to the following conclusions about municipal wireless networks:[49]

- "There is significant evidence to suggest that efforts to serve underserved groups will only succeed with a comprehensive plan that includes broadband access, computers in the home, training, content, and a process that includes upfront involvement in decision-making and implementation."
- "It is unclear if, when, and at what price the private sector will provide such services and whether the services will provide universal or near-universal access."
- "The best-practices analysis shows that in the majority of cases, city governments have acted as the catalyst for projects to provide broadband access to residents. However, most projects are small or still under development. Although there is much we can learn from others, given the scale of the project in Philadelphia we will have to become leaders in the implementation."

- "Wireless access technology is maturing; however, it is already the most cost-effective solution for implementing broadband access (as compared to cable, DSL, and other technologies)."
- "The challenges of technology and the risks of implementing a project that is not a core competence of the City suggest that private industry should play a major role in the funding, implementation, and ongoing operation."

These conclusions are generally valid for municipal wireless networks as a whole, although Philadelphia is the first large-scale test case for a broad municipal network. The City of Atlanta has a total land area of 131.7 square miles. If the City were to invest in complete coverage, it would like require investments similar to those in the Wireless Philadelphia project.

There are a variety of different service options available for municipal wireless networks. Cities with expertise in service delivery have been able to sell service as a utility; others outsource this service to third-party ISPs. Given Atlanta's situation, it is this latter option that would be more favorable.

4. POLICY ALTERNATIVES

In this section we will investigate the possible policy alternatives available to the City of Atlanta regarding new telecommunications technologies. First, we will describe potential specific municipal applications of various technologies, including estimates about their importance to the City's future in terms of economic development, City finances, delivering services, and relevance to core City functions. Second, we will describe a range of possible actions that might lead to these outcomes. Because this topic is very broad, the list of policy alternatives will not be exhaustive; rather, it will attempt to cover the scope of policy options.

4.1. POTENTIAL SPECIFIC MUNICIPAL APPLICATIONS & USES

4.1.1. WEB-BASED PROCESSING

There are a number of services managed by the City for which the Internet and database management systems hold the potential for enormous efficiency gains. These services are often what is referred to by the phrase "e-government," which can be defined as the electronic provision of information and services 24 hours a day, seven days a week.[50] However, there is substantial variance in the quality of e-government services provided by cities today. Simply providing basic information online does not constitute effective e-government. There are a broad range of e-government functions that govern various government-client interactions. Below is a list of different transactions that may be achieved through investment in IT applications and staff.[51]

Internal functions: Employee benefit information, payroll systems, funds transfers, interdepartmental filings.

External functions: Providing information about local ordinances, regulations, and services provided; electronic form processing; electronic payment of taxes and fees; electronic bidding for City contracts; reservations use of City facilities.

All of these functions, though diverse, involve financial investments in the Department of Information Technology, which would be responsible for managing these systems. The aim of a truly electronic government is to eliminate the need for paperwork and physical trips to City facilities. Additionally, database applications may enable information management for data entered through wireless networks, such as readings on utility systems or road maintenance.

4.1.2. NETWORK ARCHITECTURE & INFRASTRUCTURE IMPROVEMENTS

The City's telecommunications infrastructure is a patchwork of legacy systems and privately-provided networks that have historically been managed in a decentralized fashion. The creation of the Department of Information Technology in 2003 partly solved this problem, but investments in new network architecture could result in increased stability, security, and reliability.

4.1.3. PUBLIC SAFETY

Providing effective services during emergencies is a crucial City function. New telecommunications technologies can have a dramatic impact on the ability of police, fire, and EMS personnel to serve the public. Many police departments across the country have been able to take advantage of wireless networks by using laptops while on patrol to receive and upload information related to suspected criminal activity. Additionally, emergency medical staff may be able to use wireless networks to access patient-specific medical information in the field. This could also greatly benefit people with disabilities who may be able to rely on municipal networks for enhanced independence and safety.

4.1.4. ELECTRONIC ARCHIVING & WEBCASTING

In addition to using online information-management systems to handle transactions, City websites could make more progress in hosting archives of City records and public meeting webcasts. Providing an electronic archive would enable citizens to have more easy access to records that must be provided upon request under the Georgia Open Records Act.[52] Providing access to this information electronically would be beneficial to citizens because it would save them the trouble and cost of filing an open records request, and it could also enable searching capabilities previously unavailable. The cost of archiving materials is relatively low, although it may be administratively difficult. However, making materials available to the public in the long run may reduce the administrative burden associated with complying with open records requests. The City has already demonstrated an ability to manage archiving with respect to webcasts of City Council meetings.

4.1.5. LOCATION IDENTIFICATION TECHNOLOGY

Location identification technology involves geography-based systems that enable critical information to be tracked in the context of its location. The two main systems that perform this function are GIS (geographic information system) and GPS (global positioning system). GIS is a

software tool that allows complex information to be mapped, searched, and organized in ways that enable an advanced understanding of different systems are geographically related. For example, a GIS map of Atlanta could integrate knowledge about street addresses, sewer systems, phone lines, fiber networks, bodies of water, and green space. An effective GIS system provides a spatial understanding of service delivery, which has the effect of improving efficiency and interoperability between diverse City departments.

GPS relies on satellite technology to give precise location coordinates for tracked objects. GPS can be used to track the location of City vehicles, which could result in significant gains for tracking emergency personnel in the course of their duties. The technology could also be used to track other service delivery vehicles and monitor the security of important equipment.

4.1.6. VOICE OVER INTERNET PROTOCOL

Voice over Internet Protocol ("VoIP") is an application of broadband technology that allows users to transmit and receive voice messages -- similar to traditional telephone communications (commonly called "plain old telephone service" or "POTS") -- over a data transmission network, specifically an Internet Protocol ("IP") based network.[53] VoIP technology groups digital voice data into packets suitable for transmission over an IP network. VoIP services may be, but are not necessarily, deployed across the public Internet.

Currently, VoIP service is being provided by third-party companies via a combination of the PSTN or fiber optic cable and the public Internet, using Session Initiation Protocol ("SIP"); and by cable multiple system operators ("MSOs") over their own private fiber optic networks using a Quality of Service ("QoS") philosophy wherein voice packets are given priority over data packets. It is unclear whether a VoIP standard based on SIP or QoS will become dominant. Although VoIP currently emulates traditional telephony, it is expected that in the near future typical VoIP services will combine voice, instant messaging, and video technologies to create enhanced telecommunications/information services.

Industry estimates suggest that VoIP will increasingly gain market share at the expense of established local telecommunications providers.[54] In 2004, the California Public Utilities Commission estimated that by 2008, VoIP may account for 25 to 40 percent of total intrastate telecommunications revenues in California.[55] Several states have attempted to regulate VoIP as a telecommunications service.[56] However, the FCC has asserted an "exclusive but limited federal jurisdiction over VoIP."[57] Thus, state and municipal ability to regulate VoIP services and providers is limited. However, because the FCC's ruling applies only to "entirely Internet-based VoIP service," the issue of whether "IP-enabled services" should be categorized as telecommunication services or information services remains outstanding. This issue centers on regulation of VoIP systems, but also implicates fee structure and ability to implement services. In addition to regulatory uncertainty, there a number of issues regarding VoIP:

E-911 / Advanced Emergency Benefits

> Implementation of a VoIP system carries with it the need to ensure that 911 emergency services are available without degradation of service quality to VoIP users. VoIP presents challenges, related chiefly to the fact that VoIP accounts are no longer tied to a physical

location, but it also offers significant potential benefits. Concerns include access of VoIP "E911" services to PSTN infrastructure to allow for Automated Number Identification ("ANI") and Automated Location Identification ("ALI"), which currently is necessary because direct connection to existing 911 systems typically is limited to "telecommunication service" providers, as opposed to "information service" providers. The Voice on the Net ("VON") Coalition and National Emergency Number Association ("NENA") have entered into a cooperative agreement intended to facilitate migration of emergency services to an E911 system.[58]

The immediate goals of this agreement are:

(1) Ensuring that 911 calls are routed to geographically appropriate public safety answering points ("PSAPs");

(2) Extending 911 functionality through VoIP systems, including automated callback (ANI) and ALI, even for "nomadic" VoIP applications; and

(3) Improvements/enhanced functionality based on technological capabilities of digital service when migration to an entirely IP-based E911 system occurs.

The enhanced functionality that proponents envision includes transmission of callers' medical records, medical status, language preference, maps of commercial buildings or multi-family dwellings, image/video of accident or crime scenes, etc. In comparison, the current 911 system generally is capable of transmitting only the caller's 10-digit telephone number, which is used to pull other information from separate databases (e.g., mapping that enables ALI).

Collection of Local 911 Fees

An issue related to E-911 implementation, but in this context significant enough to deserve separate mention, is the need for municipalities to ensure collection of local 911 fees. For example, only 75 percent of providers of residential VoIP service are collecting and remitting state and local 911 fees; the remaining 25 percent "indicate they will as they get essential trunk and database access."[59]

Universal Service Fund

Because VoIP services have thus far been determined to be "information services," and not "telecommunications services," VoIP providers are not required to pay into the Universal Service Fund. The FCC is currently considering changes to the USF contribution methodology, from one that requires contribution to based on end-user telecommunications revenue to one based on the number of connections to the public network. VoIP providers generally support such a number-of-connections based methodology, which would obviate the need to distinguish between "basic" and "enhanced" telecommunications services or "telecommunications" and "information" services.

Compliance with Capability to Implement Law Enforcement Requirements

VoIP providers also currently are not required to provide telephone call interception facilities for law enforcement and national security agencies under the Communications Assistance for Law Enforcement Act ("CALEA"). The FCC is currently determining whether and to what extent law enforcement requirements such as CALEA should be mandated.

Disability Access

There are significant questions regarding the accessibility of VoIP applications for people with disabilities. Some VoIP systems have had difficulty handling TTY transmissions (teletypewriters for the deaf and hard of hearing), although this is a technical problem that is somewhat easily fixed.[60] Unfortunately, market forces have rarely been successful in bringing about accessibility.[61] VoIP, however, presents a number of opportunities to integrate people with disabilities into the network by bringing about more advanced messaging services and integrating voice, data, and text. The FCC is investigating the issue of disability access.

Market entry by ISPs or large Internet portals

Some large ISPs such as America Online have entered the VoIP market by offering service bundled with email and instant messaging capabilities.[62] However, subscribers would need to provide their own high-speed Internet access. Thus, this business model is similar to that of Vonage, a leading VoIP provider. The impact on the market of these providers is unclear.

VoIP is unlikely to be a revenue source for the City under the current regulatory scheme and VoIP will likely cannibalize some of the existing franchise revenues from wireline providers as the market share increasingly shifts to VoIP; and significant issues exist regarding implementation of traditional emergency service capabilities (and to a lesser extent law enforcement capabilities) to VoIP because VoIP lacks a locater signal and VoIP payment of universal service fees is not mandatory.

Potential policy alternatives regarding VoIP for the City of Atlanta include: (1) upgrading internal telecommunications networks and shifting to VoIP; (2) attempting to levy a telecommunications fee on VoIP services. The first alternative may be best evaluated by the Department of Information Technology, which manages the City's telecommunications and would be able to make the technical judgments required for a successful transition to VoIP. Therefore, implementation of this policy at the City Council's level may involve requesting a report from DIT on the feasibility of transitioning to VoIP for the City and specifying the funds required to do so. The second alternative, designed to raise revenues for the City, would be difficult to recommend in the current regulatory environment, given the legal constraints facing the City and the difficulty administering such a policy.

4.2. NEW TECHNOLOGY INVESTMENT ALTERNATIVES

Below are eight distinct policy alternatives for the City of Atlanta to pursue. These eight alternatives were chosen as the most feasible of all possible options, given current legal and technological constraints. Each of these alternatives is sufficiently wide in scope so as to prevent

many options in itself, but the goal of this analysis is not to determine the precise amount or level of investment in a policy option. Rather, this analysis focuses on whether any potential investment is worthwhile, knowing that the uncertainty of the many variables infuses the analysis with imprecision. Listed with each alternative is a brief description of its purpose, opportunities, limitations, potential barriers to adoption, and implementation strategies. Table 2 summarizes the alternatives.

4.2.1. INVEST IN WEB-BASED TRANSACTION PROCESSING

Description: Web-based transaction processing uses the Internet to facilitate communication and service delivery between City officials and employees, customers, and clients. Focuses investment on enterprise resource planning.
Opportunities: Efficiency gains in human resources management, payment systems, permit requests, and other service processes.
Limitations: Investment in systems may be expensive, inflexible to changes in environment.
Barriers to Adoption: Availability of secure software systems, lack of technical support within departments.
Implementation Strategies: Centrally coordinate through Dept. of Information Technology.

4.2.2. INVEST IN ARCHIVING & WEBCASTING SERVICES

Description: Archive City records and open meetings in electronic databases accessible to the public online.
Opportunities: Searchable databases of City records, lower administrative costs associated with fewer formal open records requests, more open and accessible government for citizens.
Limitations: Added administrative costs of archiving relevant records, meetings; possibility of over- or under-inclusiveness of archives (regarding sensitive information).
Barriers to Adoption: Difficulty of creating uniform standards for archival across different departments and media; lack of sufficient electronic scanning equipment for paper files; legal issues associated with protecting personally identifiable and sensitive information not subject to disclosure requirements.
Implementation Strategies: Centralize planning and management of archive database by Dept. of Information Technology or other appropriate office; develop specialized implementation plans for each City department; have coordinating office evaluate compliance on regular basis.

4.2.3. INVEST IN A WIRELESS LOCAL AREA NETWORK (WLAN)

Description: Creating a wireless local area network (WLAN) using the Wi-Fi standard either through a partnership with the private sector or through municipal management. The network would create areas of seamless wireless Internet coverage inside most buildings and on public streets and allow for interconnection with private Wi-Fi hot spots in Atlanta.
Opportunities: Enhanced services by public safety officials; increased productivity for mobile business professionals; another provider of Internet access service for citizens; long-term revenues may be possible based on successful business plan.
Limitations: Wi-Fi standard may be eclipsed in future years by emerging higher-speed protocols; security concerns for public safety use; high costs of deployment.

Barriers to Adoption: Difficulty engaging in private partnership or establishing a business plan; lack of political will for support; technical implementation problems.
Implementation Strategies: Create a special task force or committee to manage the project.

4.2.4. Invest in a Wireless Municipal Area Network (WMAN)

Description: Creating a wireless municipal area network (WMAN) using WiMAX wireless technologies, either through a partnership with the private sector or through municipal management. The network would create a seamless wireless Internet zone through most or all of the City.
Opportunities: Enhanced services for public safety officials; increased access to broadband Internet by residents; long-term revenues may be possible with a successful business plan.
Limitations: Lack of interconnectivity with other wireless networks; high costs of deployment; WiMAX standard may be eclipsed by other protocols.
Barriers to Adoption: Difficulty engaging in private partnership or establishing a business plan; lack of political will for support; technical implementation problems.
Implementation Strategies: Create a special task force or committee to manage the project.

4.2.5. Upgrade City network infrastructure

Description: Invest in City telecommunications infrastructure, acquiring ownership of crucial networks, upgrading systems to take advantage of emerging technologies such as VoIP.
Opportunities: Operations cost savings; less dependence on telecommunications providers.
Limitations: Unclear objectives motivating some infrastructure investments.
Barriers to Adoption: Difficulty in establishing clear objectives for investments.
Implementation Strategies: Managed by Dept. of Information Technology.

4.2.6. Invest in GPS equipment for public agencies

Description: GPS equipment enables real-time tracking of vehicles and other mobile assets and helps with navigation.
Opportunities: Increase the effectiveness of police and other public safety officers; better accountability for public service vehicles or other assets.
Limitations: Relatively high costs of equipment; useful only for specific location identification or navigational purposes.
Barriers to Adoption: Changes in protocol for public agencies integrating GPS into their modi operandi.
Implementation Strategies: Each department or agency should develop their own implementation plans based on an independent assessment of their needs.

Table 2: New Technology Investment Alternatives					
Alternative	**Description**	**Opportunities**	**Limitations**	**Barriers to Adoption**	**Implementation Strategies**
Web-based processing	Facilitates communications and service delivery through Internet-based databases	Efficiency gains in human resource management, payment systems, permit requests, etc.	Investment may be expensive, inflexible	Availability of software, lack of technical support	Centrally coordinate through Dept. Information Technology
Archiving/webcasting	Archiving and recording City records and meetings online	Searchable databases; lower administrative costs complying with open records requests; more accessible, open government	Added expense, time; difficulty in maintaining records consistently	Difficulty of creating standards; lack of equipment; legal issues	Centralize planning and management of archive database; specialized implementation for each department
Wi-Fi network	Creating a wireless LAN using the Wi-Fi standard that covers public spaces and underserved areas and interconnects with private hot spots	Enhanced services for public safety officials; greater productivity for mobile professionals; added competition for Internet access; potential revenues	Standard may become outdated; securing network for public safety use may be difficult; high costs of deployment	Difficulty engaging private partnership or establishing business plan; lack of political support; technical problems	Create a special task force or committee to oversee the project
WiMAX network	Creating a wireless MAN using the WiMAX standard that covers public spaces and underserved areas	Enhanced services for public safety officials; added competition for Internet access; potential revenues.	Lack of interconnectivity with other wireless networks; high costs of deployment; standard may become outdated.	Difficulty engaging private partnership or establishing business plan; lack of political support; technical problems.	Create a special task force or committee to oversee the project
Upgrade City network infrastructure	Upgrade and acquire control of City internal networks	Operations cost savings; less dependence on third-party telecommunications providers	Lack of clearly defined objectives	Difficulty defining objectives; technical problems	Coordinate through Dept. of Information Technology
Invest in GPS equpment for public agencies	Use GPS equipment for location identification of City vehicles, mobile assets	Increase effectiveness of police/emergency officers; increased accountability	High costs of deployment; inflexible uses	Implementing changes in protocol to accommodate GPS	Manage through individual departments based on needs assessments
Build a fiber network for Atlanta Public Schools	Connect Atlanta Public Schools with an fiber optic network for data management and educational technology	Long-term efficiency gains from expanded network capabilities; advanced instructional opportunities	High deployment, maintenance costs	Acquiring rights-of-way; securing funding	Put out a request for proposals and select a contractor for the project.
Subsidize private broadband for underserved areas	Subsidize private broadband Internet service for people in underserved areas of the City, either directly to residents or to service providers	Broadband service brought to parts of City where it was previously unavailable	Potentially high cost of subsidies required; service provision fails to guarantee actual use by targeted populations	Struggles among ISPs to receive subsidies; lack of political will	Create high-level task force to devise implementation strategy; put out RFP to seek bids from ISPs

4.2.7. BUILD A FIBER NETWORK FOR APS[2]

Description: Connect Atlanta Public Schools with a fiber optic network for data management and educational technology.
Opportunities: Long-term efficiency gains from expanded network capabilities; advanced instructional technology opportunities for enhanced learning, collaboration with colleges and universities.
Limitations: High deployment and maintenance costs;
Barriers to Adoption: Acquiring rights-of-way; securing funding sources.

[2] Although the Atlanta Public School system is a separate unit of government from the City of Atlanta, it is included in this report because the Mayor has included improvement of education as part of her economic development goals, citing the need for collaboration with APS. Further, investment in potential fiber network for APS would require collaboration with the City.

Implementation Strategies: Put out a request for proposals to select a contractor for the project.

4.2.8. Subsidize Private Broadband Internet for Underserved Areas

Description: Increase broadband Internet service provision in Atlanta by subsidizing service in underserved areas, either through a direct subsidy to residents or by contracting with service providers to service the areas.
Opportunities: Brings broadband Internet service to parts of City where it was previously unavailable.
Limitations: Potentially high cost of subsidies required; service provision fails to guarantee actual use by targeted populations.
Barriers to Adoption: Struggles among ISPs to receive subsidies; lack of political will.
Implementation Strategies: Create high-level task force to devise implementation strategy; put out RFP to seek bids from ISPs.

5. Evaluation/Assessment

There are a number of important considerations in evaluating the various policy alternatives. The four potential problem formulations addressed above provide us with some guidelines, and practical considerations regarding the implementation of policies also are important. In this section, eight evaluation criteria are described, and they are applied to the eight policy alternatives. The result is an evaluation matrix that rates the policies' compliance with the criteria on a five-point scale. Finally, various weights are applied in a "scorecard" approach, yielding recommendations based on the weighting assumptions.

5.1. Evaluation Criteria

5.1.1. Innovativeness & Adaptability

One factor that should be considered in the evaluation process is the innovativeness of the technology and the potential future applications that could be gained from investing in the service. Investing in a specific technology may leave the City with few options in the future if the need for that technology disappears or is obsolesced by competing technologies. On the other hand, choosing to invest in a broad-based platform that allows for greater flexibility and adaptability is likely to be a better investment, given the rapidly changing telecommunications environment.

It is often difficult to tell, however, which technologies will be flexible and which ones will not. This is particularly the case with standards-based technologies in the wireless industry. Compatibility concerns have made long-term capital investment riskier in the wireless industry than for fiber, for example. The criterion of potential applications and innovation is one that is primarily used to differentiate policy alternatives; the long-term risk that is factored into investment decisions is usually less important for standard, shorter return-on-investment modeling.

5.1.2. AFFORDABILITY

Affordability is a key concern for evaluation of policy alternatives. Sound municipal planning requires staying within a budget, and the City's budget often does not afford the luxury of expensive investments, even if mitigated by long-term gains. Affordability of a policy alternative is measured in context; large expenditures may be affordable if they result in significant cost-savings or if they replace other large expenditures that would exist without that policy. Therefore, affordability measures more than simply the cost of the policy.

5.1.3. REVENUE POTENTIAL

Declining revenues from telecommunications contracts and fees due to a shift away from traditional services have had a real impact on the City's revenue stream. This has led to a hope that new technological investments by the City could lead to new revenues that fill this gap. Much of this potential will come from right-of-way agreements for telecommunications providers in the City. However, few other avenues for raising City revenues exist. This is one factor that will play an important role in the evaluation process.

5.1.4. FEASIBILITY OF IMPLEMENTATION

New policies must not only be approved but implemented, and therefore the feasibility of implementation is an important consideration. This criterion has a number of dimensions, all of which are related to the ease or difficulty with which a new technology policy may put into place. Relevant questions to consider include: does the City have the adequate expertise to implement the policy? Will the policy have undesirable (spillover) effects on other systems? Will the policy generate significant opposition that will make its adoption less effective? The issues of technical efficiency, administrative capacity, and political viability are all present in this part of the evaluative framework.

5.1.5. POTENTIAL ECONOMIC DEVELOPMENT IMPACT

Because economic development is an important priority for the City, and because the goal of telecommunications infrastructure is to enable growth, the potential impacts of policy decisions on the economy should be incorporated into policy decisions. Although forecasts of economic impacts are often uncertain, some policies have clear economic development goals, whereas others focus on internal savings. There are both qualitative and quantitative aspects to this criterion. The importance of this criterion is a value judgment of the policymaker.

5.1.6. IMPACT ON CITY POPULATION

This criterion examines the impact that the policy will have on the population of Atlanta as a whole. This criterion is intended to capture to some extent the benefits received by citizens, which may translate into political support or opposition to the chosen policy alternative. Policies that cater to minority interests at the expense of the majority are likely to fare poorly with this criterion.

5.1.7. RELEVANCE TO CORE CITY FUNCTIONS

There are some tasks that cities are ill-equipped to handle, and there are others that are crucial to their operation. This evaluation criterion favors policy alternatives that serve core city functions, including basic operations and emergency/public safety agencies. Although economic development is an important goal of the City, it is more peripheral to the City's main purpose as a political entity.

5.1.8. LIKELIHOOD OF SUCCESS

This criterion attempts to measure the uncertainty of policy outcomes. Some investments are riskier than others, and this is an important variable to consider in policy evaluation. Risks are evaluated based on judgments about the reliability of technology, possible impact of the technology, and the administrative risks associated with a project.

5.2. SCORECARD ANALYSIS

Table 3 shows a policy evaluation matrix, or scorecard, that shows the policy alternatives on one axis with their performance on the various criteria along the other. In this evaluation matrix, each policy alternative was assessed on a five point scale according to its compliance with each criterion. The points on the scale are low, low-moderate, moderate, moderate-high, and high. The matrix is color-coded according to the ratings for ease of reading.

Table 3: Policy Evaluation Matrix/Scorecard

Policy \ Criterion	Innovativeness	Affordability	Revenue Potential	Feasibility of Implementation	Potential Economic Development Impact	Impact on City population	Relevance to Core City Functions	Likelihood of success
Web-based transactions	Low-Moderate	Moderate-High	Low-Moderate	Moderate-High	Low-Moderate	High	Moderate-High	Moderate-High
Archiving & Webcasting	Moderate	Moderate	Low	Moderate-High	Low	Moderate-High	Moderate	Moderate-High
WLAN (Wi-Fi)	Moderate-High	Low-Moderate	Moderate	Low-Moderate	Moderate-High	Moderate-High	Moderate	Moderate
WMAN (WiMAX)	Moderate-High	Low	Moderate	Low	Moderate-High	Moderate-High	Moderate	Low-Moderate
Upgrade infrastructure	Moderate	Moderate-High	Low	Moderate-High	Low	Low	Moderate-High	High
GPS	Low-Moderate	Low-Moderate	Low	Moderate-High	Low	Low-Moderate	Moderate	Moderate-High
Fiber for APS	High	Low	Low-Moderate	Low-Moderate	Moderate	Low-Moderate	Moderate	Moderate-High
Subsidize broadband	Low	Low-Moderate	Low	Low-Moderate	Moderate	Moderate	Low	Moderate

A brief explanation of the ratings for each policy alternative is given below:

5.2.1. WEB-BASED TRANSACTIONS

The innovativeness of web-based transactions is low-moderate because most investments will be focused on specific transactions and affiliated software packages that are not likely to be adaptable to unanticipated opportunities. However, there is some flexibility. Investments in this category are mostly affordable because they tend to pay for themselves in terms of cost-savings from efficient organization, although some applications may be expensive. There is little

opportunity to raise revenue from transactions, except through processing fees. Feasibility of implementation is fairly high because technical problems are relatively small and there are few actors involved in the implementation process. The likely economic impact of these processes is low-moderate because the few businesses will be dramatically affected by the reduction in costs of doing business with the City. The low complexity of these applications may enable them to provide valuable services to businesses, resulting in gains to efficiency and competitiveness. There is a potentially high impact on the city population because nearly everyone receives City services, and because web-based transactions affect internal efficiency, they are highly relevant to core city functions. Finally, there is little risk associated with investments.

5.2.2. Archiving & Webcasting

Archiving and webcasting services are relatively small in impact and easy to implement. The affordability of the program depends on the magnitude, and there is some flexibility in procedures that enables a moderate level of innovativeness. There is little or no revenue potential, except perhaps for minor processing fees. Since records must be kept already, archiving processes should be relatively easy to implement. This policy option has a potentially high impact on citizens but very small impact on the economy. It is somewhat related to core city functions, especially as pertains to official government documents such as ordinances and City Council resolutions.

5.2.3. WLAN (Wi-Fi) & WMAN (WiMAX)

Wireless Internet networks offer a high level of innovativeness in terms of the applications that can be used on them. Wireless networks are expensive to deploy, although Wi-Fi has an existing market that increases its affordability slightly over WiMAX. There is a moderate potential for revenue, although this depends heavily on a good business plan, and even then, any joint venture would be unlikely to turn large profits. A municipally-backed wireless network presents many implementation problems, although Wi-Fi still benefits from being an established standard, whereas WiMAX is still being tweaked. Overall, these wireless networks offer the largest potential economic development impacts of any of the proposed policies, and their impact on City residents would fairly high, although this depends on the quality and scope of the networks. To the extent that public agencies can use the network to further important public goals, the wireless networks are relevant to core City functions. Successful deployment of Wi-Fi networks in other cities gives Wi-Fi the edge over WiMAX in terms of risk, although neither policies have high likelihoods of being successful.

5.2.4. Upgrading Infrastructure

Like archiving, this is a fairly low-impact project. Improvements in City telecommunications networks will likely allow for a moderate amount of flexibility in the future, and the process of upgrading the networks may be targeted so as to be fairly affordable, although this obviously depends on how the policy is implemented. There is no revenue potential from upgrading networks, unless excess capacity is leased to third parties, though this is unlikely. It should be fairly easy to implement because of the loose goals defined, allowing for some flexibility. This project is highly relevant to the core security and support functions of the City.

5.2.5. GPS

Because it is a specialized application for a specified purpose, GPS modules are not highly adaptable to future applications. They also do not stimulate revenues or have significant economic impact. They would, however, have a tangible impact on City residents, and they would likely be easy to implement with few risks involved in the process. The main problem with GPS is that it is relatively expensive for casual use; careful planning can make GPS tracking systems affordable.

5.2.6. Fiber for APS

Fiber is the most adaptable to future applications because of the high bandwidth it maintains, which offers many opportunities for the present and the future. Fiber is expensive, however, and building a fiber network could be a difficult process to implement. There is a moderate potential impact on economic development, since the network could enhance collaboration among educational institutions. This project would have a low-moderate impact on the City population as a whole.

5.2.7. Subsidize Broadband

This policy offers little innovativeness for the future because the subsidies would be focused on residents who would invested in their existing technology. Subsidizing broadband Internet would cost a lot of money in order to be effective in reaching underserved populations, although whether this is truly "affordable" would ultimately be a political decision. However, implementation of this scheme would be challenging, and there would be no opportunities for revenue collection by the City. There would be a moderate potential economic development impact since advanced telecommunications capabilities were reaching new areas of the City, and this could have a moderate impact on City residents as a whole.

5.3. Comparing Alternatives

By examining the scorecard, we can view the strengths and weaknesses of the various policy alternatives and determine what choices are worth pursuing, given different motivations for policy action.

First, we can see that the final option listed, subsidizing broadband Internet service, ranks below the other alternatives in every evaluation criterion. This clearly makes it the least attractive option in the matrix. Second, we can compare the two mutually-exclusive policy alternatives, WLAN (Wi-Fi) and WMAN (WiMAX). Although they are fairly similar in their ratings, WLAN (Wi-Fi) rates slightly higher in three categories: affordability, feasibility of implementation, and likelihood of success. Unless these three evaluation criteria are discarded by policymakers as irrelevant, this scorecard analysis suggests that Wi-Fi networks would be a better technology to invest in at the present time.

Thus, just from this first glance at the evaluation matrix, we can discard two policy alternatives as inferior to the others. The remaining policy alternatives appear to each have positive and negative attributes, so further analysis is required to help establish priorities.

5.3.1. WEIGHTING THE CRITERIA

There is some debate among policy scholars as to the appropriateness of weighting criteria in a scorecard analysis to make conclusions. However, value weighting is implicit in every policy analysis, and using weights in this case will allow policymakers to consider how their values align with the values chosen for this assessment.[63] I will be even more thorough by displaying a series of weighting schemes and explaining possible value judgments associated with them.

5.3.2. EQUAL WEIGHTING

If we assumed that all eight evaluation criteria were equally valid (a naïve assumption), we could assign scores to the ratings (1-5, with 1 = low and 5 = high) and add the scores for each policy alternative. In Table 4, we can see just this outcome.

Table 4: Policy Evaluation Matrix/Scorecard: Equal Weights

Policy \ Criterion	Innovativeness	Affordability	Revenue Potential	Feasibility of Imple-mentation	Potential Economic Development Impact	Impact on City population	Relevance to Core City Functions	Likelihood of success	**Sum**
Web-based transactions	2	4	2	4	2	5	4	4	**27**
Archiving & Webcasting	3	3	1	4	1	4	3	4	**23**
WLAN (Wi-Fi)	4	2	3	2	4	4	3	3	**25**
WMAN (WiMAX)	4	1	3	1	4	4	3	2	**22**
Upgrade infrastructure	3	4	1	4	1	1	4	5	**23**
GPS	2	2	1	4	1	2	3	4	**19**
Fiber for APS	5	1	2	2	3	2	3	4	**22**
Subsidize broadband	1	2	1	2	3	3	1	3	**16**

Under the equal weighting scheme, we see that Web-based transactions receives the highest score of 27, while WLAN comes in second with 25, and both Archiving & Webcasting and Upgrade infrastructure tie for third place with 23 points. If policymakers were to give equal weight to all eight criteria described here, they would prioritize these policies in just that order. Unfortunately, the equal weighting scheme has a number of problems. Not all relevant factors are included. And the scoring system, based on the five-point scale, is a crude indicator of relative performance. A score of "moderate" on affordability may not actually be worth three times as much weigh as a score of "low." These problems with the scorecard method do not give us much insight into the differences between aggregate scores that are similar—what is the difference between 27 (the highest score) and the median score of 22.5?

We can use the scorecard approach to probe this question by assuming unequal weights. We might expect some policymakers to have special biases, so we can act based on these potential positions to weight the variables in the analysis.

5.3.3. A "FISCALLY CONSERVATIVE" WEIGHTING

Imagine a fiscally conservative policymaker, whose concerns about wasteful spending adjust the weights to the criteria such that more emphasis is placed on the affordability, potential revenue, and likelihood of success criteria. This policymaker is also concerned that the policy promotes economic development, so this is also weighted heavier to reflect this position.

Table 5: Policy Evaluation Matrix/Scorecard: Fiscally Conservative Weights

Policy \ Criterion	Innovativeness	(3x) Affordability	(3x) Revenue Potential	Feasibility of Imple-mentation	(2x) Potential Economic Development Impact	Impact on City population	Relevance to Core City Functions	(3x) Likelihood of success	**Weight-ed Sum**
Web-based transactions	2	4	2	4	2	5	4	4	**49**
Archiving & Webcasting	3	3	1	4	1	4	3	4	**40**
WLAN (Wi-Fi)	4	2	3	2	4	4	3	3	**45**
WMAN (WiMAX)	4	1	3	1	4	4	3	2	**38**
Upgrade infrastructure	3	4	1	4	1	1	4	5	**44**
GPS	2	2	1	4	1	2	3	4	**34**
Fiber for APS	5	1	2	2	3	2	3	4	**39**
Subsidize broadband	1	2	1	2	3	3	1	3	**31**

To reflect these values, we can triple the weight assigned to the affordability, revenue, and likelihood of success criteria and double the economic development weight. The result is Table 5. Under this scoring system, the total values for the policy alternatives have differentiated somewhat. Web-based transactions investments score the highest, with 49 points, and WLAN comes in second with 45 points. A close third is upgrading infrastructure, but there is another gap before the fourth-place option. Thus, the top choice for the fiscally conservative policymaker would likely be the web-based transactions, with WLAN and upgrading infrastructure second and third, respectively.

5.4.4. A "HIGH IMPACT" WEIGHTING

Imagine a second policymaker who is more interested in choosing a policy that will have a high impact on the City. This policymaker wants to ensure that the chosen policy has a big potential for City revenues, has a large economic development impact, and affects as many Atlantans as possible. Thus, she weights these criteria three times as strong as the others. She is also concerned that the policy will be adaptable to future conditions, so she doubles the weight to the innovativeness criterion. And finally, she wants to ensure that the policy is relevant to core City functions, so she doubles that criterion as well.

Table 6: Policy Evaluation Matrix/Scorecard: High Impact Weights

Policy \ Criterion	(2x) Innovativeness	Affordability	(3x) Revenue Potential	Feasibility of Imple-mentation	(3x) Potential Economic Development Impact	(3x) Impact on City population	(3x) Relevance to Core City Functions	Likelihood of success	**Weighted Sum**
Web-based transactions	2	4	2	4	2	5	4	4	**51**
Archiving & Webcasting	3	3	1	4	1	4	3	4	**41**
WLAN (Wi-Fi)	4	2	3	2	4	4	3	3	**54**
WMAN (WiMAX)	4	1	3	1	4	4	3	2	**51**
Upgrade infrastructure	3	4	1	4	1	1	4	5	**36**
GPS	2	2	1	4	1	2	3	4	**32**
Fiber for APS	5	1	2	2	3	2	3	4	**44**
Subsidize broadband	1	2	1	2	3	3	1	3	**32**

The result is shown in Table 6. This time, WLAN emerges as the leading policy option, followed by web-based transactions and WMAN which tie for the second-most points. Of course, since WMAN and WLAN would not be pursued at the same time, the top two policy choices would be WLAN and web-based transactions. Note that these are the same top-scoring alternatives chosen by the "fiscally conservative" weighting and by the equal weighting scheme. This suggests that these policies would be highly ranked regardless of the weighting system chosen by the decision maker.

6. RECOMMENDATIONS

Given the evaluation process described above, the City of Atlanta's best choices for investment in new telecommunications technologies involve improving its e-government services through better web-based transactions and investing in a wireless local area network that can be used by residents and businesses, much as it has begun to do so with Biltmore Communications' Fastpass network. Both of these policy options should be carefully analyzed by the City, and proper resources should be devoted so as to ensure that these tasks overcome the obstacles that face them. The investment in web-based transactions is less fraught with risk than other projects, and although it may seem small compared to creating new or upgrading old networks, the return on the investment is high. By contrast, development of a seamless wireless network is difficult, although the benefits could be large. The City must recognize this as an investment in new technology and help it flourish through guidance and appropriate funding.

The City of Atlanta should also consider some of the lower-cost policy alternatives that have important impacts on the City's future vitality. Foremost among these is upgrading network infrastructure. Although the impact on the external City is low, there could be important gains in network security and stability that will help the City adapt to future telecommunications challenges. This is increasingly important as the communications world shifts towards Internet Protocol-based services. A fiber network for the Atlanta Public Schools is another attractive

policy option, if there is money for the initial build-out. The long-term benefits to APS make this an investment worth carefully investigating. The City should also carefully examine a policy to archive its records electronically. The benefits of this policy are much more difficult to capture than the costs, but it scored highly in the analysis.

The other policy alternatives investigated are inferior choices, which is not to say that they do not deserve any attention. It is just that they are less likely to be wise investments in new technologies than the highly-rated choices such as WLANs and web-based transaction processing. GPS technology may be worth funding for police in particular, although this is a narrowly-focused application, which partly explains why it did not fare very well in this analysis.

Given limited resources, the City should prioritize its investments in new technologies where they will have the greatest impact. Currently, this is in the areas of enterprise resource planning and wireless network deployment. The City of Atlanta should focus on these two areas of investment opportunity for future growth.

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