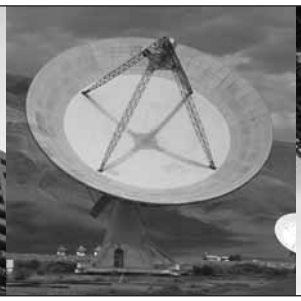
A STRATEGY PAPER FROM CENTER FOR DIGITAL GOVERNMENT

SOMETHING IN THE AIR

Government on the Go through Community-wide Wireless

Introduction: The New Infrastructure

Wireless connectivity has emerged as a vital public infrastructure, taking its place alongside landline networks, roads, bridges, water and sewer as the mission critical civic infrastructures. Wireless networks are now as important as their Industrial Age predecessors in contributing to the economic vitality of a community, yet less onerous to deploy and maintain.

Indeed, each era has been defined by the technology that attended it — from the stagecoach and the telegraph to the horseless carriage and the telephone; from roads, rails and radio to interstate highways, television and early modem-to-modem data communication; from the Arpanet[1] to the commodity Internet to Nicholas Negroponte's famous prediction that "what goes through wires will go through the air."[2] Negroponte's prediction has come to pass now, as we enter the era of community-wide wireless.

Hundreds of U.S. cities are currently building metro-scale wireless networks and more than 1,000 local governments worldwide have plans to do so.[3] The development will bring an estimated four year, four-fold increase in investments, growing to approximately $2 billion by 2007. By one estimate, wireless spending in the U.S. is expected to increase from an estimated $158.6 billion in 2005 to $212.5 billion in 2008.[4] In a separate estimate, META Group predicted that by 2007 or 2008, 65 percent of enterprises will deploy wireless applications, with mobile devices outnumbering traditional PCs.[5] The world is working toward creating a new, wireless infrastructure.

Governments are adopting these technologies to create community-wide wireless networks that, if you could see them, would look like a net or mesh covering an entire town, city or country. New, higher bandwidth technologies, such as mesh wireless networking, have helped spur this growth. A mesh wireless network is composed of wireless access points or nodes, placed throughout a community — on buildings, along streets on lamp-posts and at intersections on traffic signals. Data, voice and instructions are routed between nodes for continuous community-wide connection. The networking infrastructure is decentralized and simplified because each node only needs to transmit data as far as the next node. Wireless mesh networking provides an inexpensive broadband connection to mobile workers and remote areas.

Communities that have deployed mesh networking throughout their cities — in some cases, entire regions — have created a new technology infrastructure: community-wide wireless. This infrastructure inexpensively extends the reach of traditional wired networks and offers local governments a new opportunity to serve citizens.

This white paper will examine how governments can use community-wide wireless to change the way services are provided and to offer services never before possible. This paper will investigate the possibilities offered by wireless to mobilize the workforce, perform government functions faster, easier and cheaper, and provide services that are only possible through the use of wireless technologies.

Wireless at Work: The Stories of Public Service Delivery

When used by government, community-wide wireless liberates public services and public servants from government buildings and allows them to move about in their communities, to provide information or complete transactions when and where they are needed. Wireless helps government deliver on the long-held promise of doing the public's business differently. Services can now be delivered by wireless-enabled pubic servants who become the touch points in new or renewed civic relationships between citizens and their government.

Community-wide Wireless

As with many emerging practices, there is not a general consensus about the vocabulary to use to describe the developments. For the purposes of this paper, the term *community-wide wireless* describes the use of wireless technologies for civic purposes (see the sidebar, The Language Mesh: Making Sense of it All).

Communities have been building wireless networks for several years now. Cerritos, Calif., located 26 miles southeast of Los Angeles, is a small city of 51,000 and was perhaps the first municipality to build a wireless network. Built in 2003, the city's Wi-Fi network provides high-speed Internet access for residents in an otherwise unconnected region. Several other cities are also embarking on wide-scale build outs of community-wide wireless infrastructures — Philadelphia, Pa.; Dayton, Ohio; Grand Haven, Mich.; Hermosa Beach, Calif.; and Atlanta, Ga., are pursuing pilot programs around wireless capabilities or initiatives to provide wireless access to public employees and citizens.

Smart Valley, one of the largest government-led Wi-Fi efforts to date, comes from Silicon Valley. Smart Valley, an initiative including Joint Venture Silicon Valley Network (JVSVN) and the San Mateo County Telecommunications Authority (SAMCAT), seeks to create a high-speed wireless data network that will cover all of Silicon Valley. The Smart Valley initiative envisions a broadband canopy covering 1,500 square-miles, stretching from Fremont in the East Bay south to Gilroy, over the hill to Santa Cruz, and up the Peninsula to San Mateo (see the Center for Digital Government's strategic guide for communities on wireless for a more detailed discussion of wireless technologies and the strategies local governments are using to implement wireless networks.[12])

Perhaps one of the most compelling stories of community wireless occurred in the days after Hurricane Katrina. In those early

THE LANGUAGE MESH: MAKING SENSE OF IT ALL

The wireless standards and terms of art are often used interchangeably. There are significant differences, however, in both the technologies and in the capabilities of the networks. The following definitions help explain these differences.

Cellular Network: Cell phones communicate using a cellular network. A wireless telephone network connects radio frequencies transmitted by a mobile phone to a system of multiple cell sites (each multiple cell site consists of an antenna and a base station), then connects to a mobile telephone switch office, and ultimately to the public wireline telephone system. The network is called cellular because the system uses many base stations to divide a service area into multiple "cells." Cellular calls are transferred from base station to base station, as a user travels from cell to cell.[6]

Community-wide Wireless: Broadband wireless mesh networks that cover an entire city, town or region, and are available for either exclusive government use, or government and private use. As used here, the term does not distinguish between networks operated by a private company at a government's behest and networks operated by a government entity itself. The term is sometimes used interchangeably with *outdoor wireless.*

Hot Spots: Wireless access points found in public places such as airports, convention centers, hotels and coffee shops.[7]

Wireless: Electromagnetic waves rather than some form of wire carry a signal over part or all of a communication path.[8]

Wireless Fidelity (Wi-Fi): A set of product compatibility standards for wireless local area networks (WLAN) based on the IEEE 802.11 specifications.[9] Typically, landline Internet access (DSL or faster) is connected to a Wi-Fi transmitter that enables any device equipped with a Wi-Fi transceiver to send and receive data at broadband speeds. The working distance for most Wi-Fi devices is 300 feet. Beyond 300 feet, the throughput of the connection speed decreases.[10]

Wireless Mesh Networks: Mesh networking is a way to route data, voice and instructions between nodes. It allows for continuous connections and reconfiguration around blocked paths by "hopping" from node to node until a connection can be established. Mesh networks differ from other networks in that the component parts can all connect to each other.[11]

hours, all levels of government struggled to connect and communicate. The cell phone and landline telephone networks in the area were destroyed or overloaded. Pockets of people gathered in makeshift shelters around the Rayville, La. area could not find their families and loved ones. Mac Dearman knew what to do to help.

The owner of a forklift company in Rayville, Dearman had also created one of the first wireless networks in the area. With one of the towers used in his network still standing, Dearman cobbled together a makeshift phone system with a router, a computer, two Internet protocol (IP) phones and an antenna. Within an hour, he had the first wireless IP phone bank working at a church in Mangham, La. Within 24 hours, 11 families were reunited. In the days that followed, he set up 15 more wireless IP systems for area shelters. His efforts attracted volunteers and donations. Dearman and his band of traveling technicians set up wireless access at more than 25 sites throughout the area affected by the hurricane.[13] While Dearman's efforts closely approximate community-based networking efforts that characterized early Internet access efforts, his goal and solution parallels the purpose of community-wide wireless. In this case, community members used a wireless voice system to help people in peril who had no other means of communicating with loved ones they were separated from. Community-wide wireless can be used for many other things, including helping the nation's first responders.

Public Safety

The nation's first responders increasingly use wireless to enhance safety, extend and improve service delivery and increase productivity. In the inaugural Digital Communities Survey of state and local governments, 61 percent of respondents believed that public safety is the area where wireless technology is most likely to deliver the greatest public value.[14]

Another recent survey conducted by Crimson Consulting asked state and local law enforcement officers about plans for wireless. More than 500 respondents participated. Five percent of respondents in small organizations (fewer than 100 sworn officers) indicated their departments have wireless mesh networks installed and 18 percent have plans to acquire wireless. In departments with more than 100 sworn officers, 15 percent of respondents say their departments have wireless mesh networks and 30 percent have plans to acquire. Jurisdictions large and small are using wireless to get information to the police officer and firefighter on the scene.

With the help of wireless, police officers on the street can check criminal records, view mug shots, complete and file reports and access case files. For fire fighters on the scene, mobile geographic information systems (GIS) support incident strategy, fire perimeter mapping and decision making in combating wildfires. This is a leap ahead for public safety. Without wireless, the detailed and dynamic information would not be available at the scene.

Wireless can be used by police departments with only a handful of officers, or by the largest sheriff's department in the world. The police department for the small town of Cisco, Texas, has six officers to protect 3,800 townspeople. As law enforcement agencies nationwide, the department uses laptops in patrol cars and field reporting systems, allowing officers to spend their time patrolling the community.

Walla Walla, Washington, a town of 59,000, needed to unburden police officers from repeated trips to the police station and the tedious process of writing and filing reports. Captain Dan Aycock explains, "Police officers were spending an extraordinary amount of time coming in during shifts to complete reports." The city's community-wide wireless network provided the infrastructure the department needed to streamline reporting. Using its community-wide wireless network, Walla Walla implemented a field reporting system. The system allows officers to enter information about an incident into a wireless device at the scene and immediately load that information into the department's records management system. Driver's licenses can be electronically scanned at the scene, where data is loaded directly into the incident report. Captain Aycock explains the combined efficiencies of the field reporting system and the increased accuracy of the information has had a positive impact on the department. "Some officers were reluctant at first," says Aycock. "Now they don't know what they would do without the system."

Los Angeles County, with 2.5 million citizens, has the world's largest sheriff's department. The Los Angeles County Sheriff's Department (LASD) has 16,000 employees located in 125 facilities throughout the county. The department uses technology to manage approximately 356,000 incident reports each year,[15] access fingerprint images and digital mug shots, and provide tracking information for Los Angeles County Jail inmates.[16] Officers access federal, state, and local databases, such as the California Department of Motor Vehicles (DMV). Seeking to streamline its information infrastructure, LASD deployed a hybrid wired/wireless network. The network gives LASD officers and employees faster access to multiple information resources on a single network, enabling them to spend less time looking up information. Using the hybrid network, LASD has also replaced its traditional private branch exchange (PBX) phone system with an IP phone system, thus reducing costs for phone system management.

Public Health & Social Services

Health inspectors, social service caseworkers and health care providers are on

the go. They inspect restaurants, visit clients at homes and move from patient to patient in hospitals. Wireless networks and the applications that ride over them give public servants access to the information they need where and when they need it.

- In Harris County, Texas, mosquito control is now mobile in an effort to fight against mosquito-borne diseases. The county performs disease surveillance, monitors effectiveness of abatement efforts, and conducts pesticide resistance testing.

- After the Sept. 11 attacks, the New York City Department of Health and Mental Hygiene took a new look at how environmental and radiation scientists gathered data. Pen and paper were replaced by a wireless system designed to contain incident-specific data collection forms with GIS-based city maps. And instead of bringing a disk back from the field for sensor data uploads, the system provided GPRS[17] transmissions in real time.

- The Commonwealth of Pennsylvania is using wireless to detect, monitor and respond to the West Nile virus.

- The North Carolina Division of Public Health has decreased response time to hurricanes and other natural disasters through wireless data collection and response mobilization systems.

- The California Department of the Youth Authority (CYA) works closely with law enforcement agencies, the courts, district attorneys, public defenders, and a range of public and private agencies concerned with the problems of youth. A new mobile computer application cuts down on paperwork, allowing CYA agents more time to keep track of parolees.

- Hospitals are using wireless networks to reduce data recording errors and help staff work more efficiently. Electronic medical records systems can prevent errors, enforce standards, simplify record keeping and improve patient care. However, with traditional hard-wired entry points, staff members would be reduced to scribble notes by a patient's side and enter those notes into a computer by hand, hours later during a break. Health-care information needs to be up to date and available anytime, anywhere. Wireless, particularly Wi-Fi, solves the problem. Carts loaded with laptops and wheeled from room to room are needed so doctors and nurses can access medical records wherever they are.

- A new wireless system tested by the Seattle Fire Department reduces patient triage time in mass casualty incidents to 10 seconds, with patient data immediately visible to all incident command, including hospital staff.[18] The system eliminates the need for runners and radio communications and reduces the time needed to communicate vital information.

Building on this concept of wireless triage, the City of Tucson is using mobile technologies to bring a "virtual doctor" to the scene of an emergency and ride with a patient in an ambulance, en route to the emergency room. The program is called *ER Link* and is scheduled for initial deployment in mid-2006. ER Link will provide state-of-the-art video and patient telemetry[19] between ambulances dispatched in the field and the region's Level One Trauma Center emergency room. The project will use a Wi-Fi mesh network to continuously transmit patient telemetry and live, high-bandwidth video as an ambulance travels to the hospital. Jim Glock, director of Transportation for the City of Tucson, is enthusiastic about the new network. "This project is the first of its kind. It is very exciting to bring this application to life and to provide such a valuable service to our city," Glock says. "We hope to extend the use of this network to other valuable applications that not only assist our emergency services, but also help with our traffic signal operations and intersection monitoring, for safe and efficient transportation."

Public Works & Enforcement

Like public health officials and social service workers, code enforcement workers, construction inspectors, building inspectors and other public works and enforcement civil servants work in the field. Wireless solutions are saving time, improving efficiencies and improving the safety of citizens.

St. John's County, Fla., expanded its inspection system to include a wireless network and mobile devices. "It was a matter of sheer survival for us," says HT White, deputy building official of St. John's County Building Services Division. "We couldn't add enough people to keep up with the demand," White adds. The division used an automated inspection system for years, but inspectors had to return to the office periodically to enter inspection information into the system. To eliminate travel time, St. John's County implemented a mobile wireless solution. Now inspectors load their daily work onto a next-generation wireless device that lands somewhere between a notebook computer and a smart phone. Using the wireless device, inspectors connect to the building system from the field and record inspection results. White says the wireless system saves at least 24 hours each day in travel time alone. Equally as important, the division provides a better service to the contractor community.[20]

- The Code Compliance Division at the City of Riverside, Calif. improved enforcement of weed abatement codes. Inspection time has been cut by 50 percent with a full return on investment after just one year.

- The Elsinore Valley Municipal Water District in Southern California is updating data of approximately 4,000 fire hydrants using a handheld computer and a global positioning system (GPS) unit.

- The Boulder County Road Maintenance Department in Colorado implemented a new method of sign inventory maintenance using some of the latest mobile GIS software and hardware products. Now Sign Shop personnel carry pocket PCs containing an accurate and current digital map of more than 7,000 road signs.

- Laurens Electric Cooperative, an electric distribution utility in upstate South Carolina, uses wireless technologies to improve field crew productivity by eliminating the need for printed map books and by improving the data collection associated with asset management, redline staking and circuit inspections.

- Doña Ana County, New Mexico, is taking GIS into the field for code enforcement officers to crack down on solid waste dumping, while saving time, fuel and money.

- Edgecombe County, North Carolina, decided to map the entire water and wastewater infrastructure, both old and new, using mobile GIS. This database resides in the county's existing GIS.[21]

- Wireless transmitters called motes offer the promise of safer roads and bridges. As roads and bridges age, they develop structural stress points, or breaking points. These motes — tiny sensors embedded in the bridges — can help predict when structural stress points become dangerous and need attention.

The Golden Gate Bridge has an experimental sensor network of approximately 200 such devices, each containing an accelerometer that measures movement, such as vibrations caused by wind, traffic and earthquakes. By comparing readings from all the sensors, engineers can detect irregularities signaling structural weaknesses in need of repair.

The Decision Point

As the preceding examples show, forward-thinking governments are making use of this new infrastructure, community-wide wireless, across the range of government services. As community-wide wireless networks are becoming increasingly common in cities and towns, the next competitive differentiator will be how local governments use the tool. Government leaders can use wireless to change how services are provided, but wireless can also help leaders pursue a much more gratifying path of public service: transforming current services and creating new services.

As the wireless weave diagram shows, the value of wireless technology increases, moving left to right in the wireless weave. The tools of a mobile workforce — radios, e-mail, cell phones and personal digital assistants (PDAs) — provide the first level of value, improving efficiencies and safety by keeping government employees connected wherever they are and allowing flexibility in work locations.

At a minimum, wireless networks provide the means to mobilize the workforce. They provide anywhere, anytime communication and information access for public employees on the go. Workforce mobility is a priority business driver behind wireless broadband deployment. Wide-scale adoption of cellular phones, BlackBerry[22] handhelds, smart phones, PDAs, wireless laptops and tablet PCs makes it possible for average workers to do their jobs faster and better, and work becomes easier and more efficient with these devices. Wireless workforce mobility solutions extend the static work setting into a flexible, connected environment where employees can log in virtually anyplace, anytime. "It's a business driver," explains Dave Heck, the City of Tempe's assistant chief information officer in the Information Technology Department. "It's a big advantage to operate and conduct business without having to be behind a desk."

Wireless is also a public service, offering high-speed Internet access to citizens who may not otherwise have access. Increasingly, public libraries are providing free wireless access to patrons. According to the Wireless Librarian Web site, at least 119 libraries across the nation offer free wireless access. One of the most ambitious projects to provide free wireless access to library patrons was completed in December 2004, when the Chicago Public Library rolled out its wireless system at nearly all 79 library branches. Wireless provides laptop-toting patrons immediate access to electronic subscription-based services, such as research databases, encyclopedias and magazines, and the wealth of information on the Internet.

Liberating the systems that support city hall functions from hard-wired networks while maintaining connectivity is changing the way the public's work gets done. Police and fire field reporting systems, vehicle mounted wireless utility meter readers and building inspection systems give the added benefit of improved service delivery and greater productivity. In fact, the City of Philadelphia has to reevaluate all 600,000 land parcels within the city limits by 2007. This project was identified by the city as a priority for early use of the Wireless Philadelphia infrastructure. The wireless infrastructure makes this enormous task manageable.

The nation is only beginning to understand the greatest value of community-wide wireless. Community-wide wireless can improve public services by providing patient triage information instantly to an entire incident command staff. With wireless, live video of an injured person and future patient can be transmitted to a hospital from an ambulance en route. And wireless aids in public safety by providing structural information transmitted from wireless sensors embedded in bridges. The greatest value and greatest promise exist with converged wireless and hybrid networks of voice, video and data. These networks help deliver services to the public that are only possible with wireless technologies.

As organizations make decisions about where to invest limited resources and assess where the greatest public value lies, the question becomes the art of the possible. As the earlier examples illustrate, the greatest public value of wireless comes from developing those things that are uniquely wireless — those services that cannot be done any other way.

The Wireless Weave: Stronger Communities, More Responsive Government

The Responsibility of Being Unrestrained: Manageable Security Considerations

Well-behaved technology systems rely on well-behaved security programs. Like any other technology infrastructure component, this maxim is true of wireless networks. This is the nature of the information transmitted through the airways, especially as governments weave their way to uniquely wireless solutions. Security lapses can be embarrassing and costly. Adam Laurie, chief security officer of The Bunker, a secure collocation facility in the United Kingdom, conducted an experiment at Great Britain's Parliament. Walking through the lobby, he found 46 Bluetooth-visible phones in about 15 minutes. Through bluesnarfing,[23] he grabbed the address books and calendars from the phones.[24]

Wireless networks are vulnerable to similar attacks that occur with wired networks. According to Ira Victor, managing partner of Data Clone Labs' Information Security and Compliance Practice, poorly configured wireless LANs are vulnerable to hijacking, sniffing traffic, denial of service attacks and malware that bypasses firewalls. In addition, wireless network security programs need to account for unique risks, such as rogue access points.

Cautioning that security is a journey and not a destination, Victor offers specific, commonsense suggestions to secure wireless networks:

- Update the firmware and drivers on your access points and wireless cards.
- Install and configure the wireless access points and network cards.
- Reset administrator passwords to a strong password phrase and block wireless administrators.
- Enable wired equivalent privacy (WEP) and Wi-Fi protected access (WPA) with a strong password phrase.
- Filter media access control addresses.
- Shut off access points when they are not in use.
- "War walk" or walk the grounds to check the range of your wireless transmitter and adjust access point transmission power.
- Consider virtual private network (VPN) and proactive security measures such as "force field wireless" (paint and window film that reflects Wi-Fi signals).

Wireless security is the physical and logical extension of well ordered information security policies and practices. Wireless is different in kind and degree, but its vulnerabilities are best addressed in a manner consistent with those used to safeguard all other vital public infrastructures. Internationally known security technologist Bruce Schneier has long reminded us of the importance of thinking about security the right way. Too often, Schneier says, we try to avoid the threat rather than manage the risk.[25] Indeed, the tools, policies and protocols do exist to properly manage wireless risks.

The *Carpe Diem* Moment: Acting on Community-wide Wireless

With the dizzying pace of new generations of digital mobile technologies, it is easy to forget where we started. Wireless technologies can bring governments to constituents — closer to the places where real work happens. At its basic application, wireless technology is being used to bring public servants out of public buildings, into direct contact with the public through networks and communication tools for a mobile work force. Inherently wireless applications are woven into these wireless networks and help the wireless worker do the work of government. Field reporting systems, public health monitoring systems and fleet management systems bring the tools of government to the work place, improving service delivery and productivity. Finally, uniquely wireless systems and applications can be woven into service and work and bring value to the public that was not possible before a wireless implementation. Innovative systems that monitor infrastructure and provide patient data from the scene of an emergency help government provide services in ways that are only possible through wireless.

Effective government relies on nimble and robust infrastructures that meet today's service delivery needs and tomorrow's expectations. Community-wide wireless is delivering on the promise to do both in the laboratory of state and local government.

Endnotes

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[16] See the LASD Inmate Information Center Web site at http://app4.lasd.org/iic/ajis_search.cfm .
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[20] *Prove IT*, Center for Digital Government, 2006. www.centerdigitalgov.com
[21] Joint aggregation, op cit.
[22] BlackBerry is a registered trademark of Research in Motion, Ltd.
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