

digital 4sight   
*an itemus company*

# GOVERNMENT ENCOUNTERS the HYPERNET

# INTRODUCTION



Decision-makers operate in a world being reshaped by one of the fastest adoptions of technology in human history — the Internet revolution. Governments are working on many levels to harness the power of first-generation Internet technology to improve the delivery of public services, improve the efficiency and integration of public institutions and structures and deepen the role of citizens in public policy-making. Indeed, the continuing relevance and authority of governments is linked to their ability to meet rising expectations for openness, accountability, effectiveness and efficiency in the public sector. Many seek to do so by harnessing the transformative power of new technologies.

We are at the beginning of a long road. Today's Internet is the first stage of an accelerating evolution in the power and pervasiveness of information and communications technologies. Wave after wave of innovation will dramatically change the nature of this networked infrastructure. Hand-held devices and wireless connectivity are taking commerce, services and interactive applications off the desktop and turning them mobile. Broadband access is accelerating. And we will soon see the impact of billions of computers embedded in every object from home appliances to automobiles, an invisible infrastructure pervading every facet of our lives. The next generation of the Internet will be so different from the way it is today that Digital 4Sight has given it the unique name of the Hypernet. Will governments be prepared for the Hypernet and the far-reaching social, political and economic issues that will arise?

Digital 4Sight believes the emerging Hypernet will present a new set of challenges and opportunities for governments that require deeper exploration of both the issues and potential applications of this phenomenon. This paper distinguishes the Hypernet from the Internet, posits broad trends and issues and examines the effects of early experimentation

and applications in the business world and the realm of everyday life. It also explores unique implications for government, including a range of Hypernet applications with the potential to revolutionize everything from the toolset for frontline government workers to monitoring environmental quality to citizen interaction with politicians. Ultimately, it argues that the Hypernet requires serious and dedicated attention by government policy-makers, and not be treated as simply a mobile extension of the World Wide Web. Genuinely ubiquitous, all-pervasive computing power is coming, and government can and should be in the forefront of understanding the implications.

	INTERNET	HYPERNET
<b>Technology</b>	Convergence – common enabling platform	Divergence – fragmented interlocking Webs
<b>Access</b>	PCs, dial-up	Smart devices, wireless, always on
<b>Scale</b>	Millions of end-points	Billions of end-points
<b>Penetration</b>	Sporadic, intrusive	Ubiquitous, quiet computing
<b>Computing Universe</b>	Cyberspace	Physical space
<b>Networks</b>	Managed, hub-and-spoke	Ad-hoc, peer-to-peer
<b>Information</b>	Islands of data	Networks of data, global digital nervous system
<b>Demographics</b>	North American, European and limited Asian-Pacific	Global, cosmopolitan

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## The Hypernet

The Hypernet is a network of networks. It includes people, objects, agents, computing devices and businesses in a global, open, intelligent, interoperable environment. This emerging "meta-network" has four distinguishing features:

- **Wireless.** Unlike the Internet, the Hypernet does not depend on fixed wires or networks. Rather, the Hypernet will emerge in full-force as emerging technologies such as Bluetooth, 3G networks and "guerrilla" infrastructures (for example, 802.11 wireless LANs and mobile peer-to-peer networks) become the dominant vehicle for Internet connectivity for people and "informed objects".
- **Mobility.** A proliferation of new devices including mobile phones, PDAs, wearable computers and digital music players offer users portable access to Internet content, services and applications. This powerful combination of wireless connectivity and handheld devices has severed the once exclusive relationship between the PCs and the Internet.
- **Ubiquity.** The long-term effect of Moore's Law<sup>1</sup> is a reduction in the cost and physical size of computing power to the point where intelligent devices can now be embedded in everything from bicycles to cereal boxes to organic life. Within a short period of time the Hypernet will become ubiquitous as billions of everyday objects in the home, the office, the factory and the urban environment are equipped with wireless connectivity and computational capacity.
- **Scale.** The scale of the Hypernet will dwarf today's Internet. Three core factors come into play. First, the economics of cheap devices, mobile connectivity and inexpensive network technologies will help

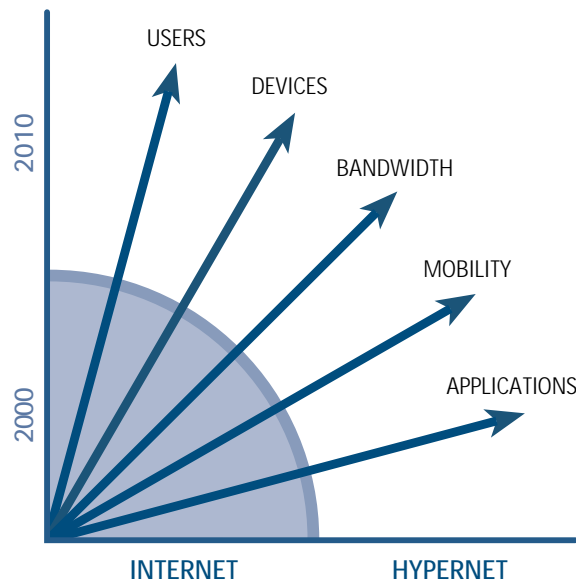
extend access to new demographic groups and under-served regions in both the developed and developing world. Second, the network effects stimulated by self-organizing peer-to-peer applications that enable rich interpersonal communications and interactivity will attract more users and drive higher volumes of Internet traffic. Finally, the proliferation of smart or "informed" objects that can interoperate and interact with each other will lead to unprecedented levels of complexity and activity in the global network.

HYPERNET PROPERTY	EMERGENT PHENOMENON	IMPACT ON GOVERNMENT	EXAMPLES/ APPLICATIONS
Wireless	Cheaper connectivity, increased penetration	Wider, more inclusive demographic of users	<ul style="list-style-type: none"> <li>• More services delivered online</li> <li>• Citizen engagement through polling or voting</li> </ul>
Mobility	Information anytime, anyplace	Empowered field force with mobile smart devices	<ul style="list-style-type: none"> <li>• Health care professionals</li> <li>• Emergency services Inspectors</li> </ul>
Ubiquity	Increasing granularity of information	Richer real-time model of the world available to policy-makers	<ul style="list-style-type: none"> <li>• Environmental policy-making, monitoring and enforcement</li> <li>• More effective targeting and personalization of services</li> </ul>
Scale	Collaboration, self-organization	New forms of global organizations: fluid, complex and adaptive	<ul style="list-style-type: none"> <li>• Emergency response/ disaster relief teams</li> <li>• Social/protest movements</li> <li>• Global democratic assemblies</li> </ul>

## KEY TRENDS IN THE HYPERNET

### Key Trends in the Hypernet

As the Hypernet gathers momentum, trends set in motion when the Internet emerged will both accelerate and take on new dimensions driven by the unique demographics, economics and social behaviors that will define the Hypernet. Governments will face tough challenges -- greater complexity, time-compression and diminishing privacy are among the issues that will confront decision-makers. There will also be new opportunities for governments to exploit some of the forces unleashed by the Hypernet such as collaborative technologies, new forms of organization and an increasing granularity of data about the world around us.



Digital 4Sight has identified a set of key high-level impacts of the Hypernet on social, political and economic activity. Our intention is to stimulate critical thinking about how can governments exploit the properties of the Hypernet and address the challenges and emerging trends.

### Accelerated disruptions

Human societies have always been punctuated by periods of great change that not only cause people to think and behave differently, but also give rise to new social orders and institutions. In many instances these changes are driven by disruptive technologies — technologies such as the printing press, the automobile and the telephone that penetrate societies to fundamentally change their culture and economy.

The Hypernet — an internetworked collection of disruptive technologies — is the most robust platform for facilitating and accelerating new creative disruptions yet. People, knowledge, objects, devices and intelligent agents converge in many-to-many networks where new innovations and social trends spread with viral intensity. Government agencies that have scrambled to come up with legal and policy responses to new phenomena like Napster should expect much more of the same — at an increasing rate — in the future.

### Granularity

Our knowledge of the world is limited by the quality of the information we gather about events around us. When the devices we use to capture and process such data are sparsely distributed and intermittently connected, we get an incomplete, and often outdated, snapshot of the real world. The Hypernet allows us to cull staggering quantities of data from a plethora of connected intelligent sensors and devices throughout our natural and built environments. Research and pilots in university and private labs around the world are demonstrating the feasibility of embedding — in all kinds of objects and environments — low-power intelligent wireless sensors that measure everything from temperature to movement to chemical composition and report that information back to us on a real-time basis. Within a few years, obtaining granular information about the behaviors of entire

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populations of people will be cost-effective and increasingly accurate and timely.

These technological breakthroughs will enhance our capacity to produce a much richer virtual model of the world. Understanding of the ecological effects of global climate change, for example, will improve as remote sensors placed in sensitive natural environments give us instant access to current indicators and are fed into real-time modeling programs. The granularity and timeliness of the data will help establish greater certainty about the causes, current and future impacts and the appropriate policy responses. Similarly, more comprehensive data from the users of government services could provide public officials with richer feedback on how to improve or target services or programs. The ability to obtain granular digital information about people, populations or physical objects and places, however, will not come without risks that these technologies will be used by dubious parties to violate privacy, commit crime or even exercise forms of social control.

### Time compression

As information is collected more frequently, most significant events will be reported and recognized in real-time. Accelerated decision-making will be an issue for all organizations, but particularly for governments that are already criticized for sclerotic processes, yet feel the pressure to ensure appropriate deliberation takes place on major issues. Businesses will be forced by competitive pressures to speed up their operations as the flow of information (orders, customer feedback, money, materials, people, etc.) through the firm increases by orders of magnitude. For governments, time-compression will increase the social and economic uncertainties brought on by the speed of change. Evidence of time-compression can be found in almost all aspects of life, but particularly in the acceleration of economic activity, whether production, exchange or consumption.

Policy-makers will need to implement more effective decision-support systems (e.g. intelligent agents and simulation software) and processes for probing, monitoring, and assessing information about the rapidly changing environment. A robust predictive capacity would enable governments to begin formulating responses before trends and patterns emerge as full-blown issues that demand a hasty response.

### Complexity

In addition to more frequent decisions (time-compression) and more information to process at each decision point (granularity), the Hypernet expands the network of interactions to incorporate many more elements or participants with many relationships (complexity). Some examples are:

- global trade and commerce when millions of small and medium-sized businesses from the developing world gain access to global markets through new low-cost computing and communications infrastructure;
- increasing political, legal and economic interdependence fostered by a rise in transnational communications;
- social movements that mobilize millions of supporters around the globe using digital networks; and
- the formation of new international alliances and organizations like ICANN where a diverse global constituency uses the Internet to elect members of the board.

These Hypernet-enabled phenomena are creating a much more Byzantine reality for decision-makers. In addition to sophisticated systems for processing information, modeling trends and supporting decision-making,

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governments will require much more extensive networks of partners to help understand and manage the relationships and dynamics of the massive webs of interactivity that the Hypernet produces. Adopting a more reflexive network approach that facilitates continuous negotiation between key stakeholders would allow policies to be adjusted to changing circumstances and help negate the paralyzing effects of complexity and uncertainty. Governance of the complex world of biotechnology, for example, could be improved by forming digitally enabled policy webs of government officials, industry leaders, scientists, NGO representatives and ordinary citizens that use leading-edge collaboration tools in an open and transparent forum to deliberate on policy options.

### Collaboration

The Hypernet is giving rise to an exciting range of new collaborative mechanisms. Some examples of these technologies include Bluetooth technology that enables machines or computers to share tasks and even "talk" to one another; peer-to-peer technologies that groups of individuals can use to establish ad-hoc networks; enterprise application integration software and XML that enable organizations to integrate their business processes, share data and collaborate in real-time; and location-based services that facilitate users finding someone or something in proximity with a common purpose or task to accomplish.

Over time, collaborative mechanisms will extend throughout social and political systems, corporate supply-chains, workplaces, homes and countless other environments. Governments should be piloting the use of these collaborative technologies to increase cooperation among departments and levels of government and between government agencies and an array of outside partners. Overcoming the organizational rigidity, territoriality and

inertia that have inhibited collaboration in the past, however, will be key to benefiting from these technologies in the future.

### New forms of organization

The collaboration enabled by Hypernet technologies will drive the creation of new forms of organizations that lean towards self-organization rather than hierarchy. Why? First, the advantages (some would say requirement) of hierarchical coordination are muted in a world that is characterized by increasingly dense, extended, and rapidly changing patterns of reciprocal interdependence. Second, the more individuals are able to collaborate with one another the less they will be dependent on established institutions and hierarchically managed processes.

In the social and economic spheres, self-organizing systems are becoming abundant. Collective action, for example, is becoming less labor-intensive as people can identify and link-up with others around the world, or perhaps more importantly, with people nearby. People that share similar goals, values or interests can readily form just-in-time organizations with no identifiable center or locus of control as witnessed in protests at World Trade Organization meetings and Organization of American States summits. In the economic sphere, factories will self-organize as robots with embedded rules assemble products without human intervention. Automobile manufacturers such as Honda are already piloting these "next generation manufacturing systems" and report an 87 percent reduction in operating costs and 50 percent increase in the mean time between failures.

Self-organizing systems have several advantages in some circumstances. First, they are more adept at managing complexity and handling anomalies and exceptions because intelligence and decision-making power is distributed

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throughout the system, enabling innovation to occur organically. Second, self-organizing systems are more scalable – they tend to grow exponentially rather than linearly. Finally, like the Internet itself, they are robust to the extent that they are capable of resisting local failure: if one "node" in the network fails, the system itself will not collapse.

Governments that learn to embody self-organization in aspects of their work can cultivate some significant efficiencies and advantages. Indeed, the complexity of Hypernet-enabled environments may be best resolved by incorporating self-organization into policy-making processes. The early stages of the policy-making process such as issue identification, knowledge gathering and synthesis, for example, could be opened up to a representative sample of academics, think tanks, lobbyists, ordinary citizens and other participants who contribute ideas, policy options and new research to a policy database and collectively rank or prioritize those materials for elected officials.

### Transparency and privacy

The increasing number and growing accessibility of connected mobile devices capable of recording and transmitting information will drive quantum leaps in information available about everyone and everything. We are quickly moving into an era in which access to even the most powerful surveillance technologies — including high-resolution satellite imagery — will extend from a handful of government agencies to a much broader audience.<sup>2</sup> Such tools can as easily be applied to humanitarian uses such as tracking the flows of refugees to decide where emergency services are needed as they can to support uses such as illegal espionage.

With the intrusion of technology into virtually every facet of life come serious risks of privacy and security abuses. An individual's online purchases, correspondence and daily movements can now be tracked by organizations — whether criminal networks, government agencies or private companies — with access to the data stored in or captured from mobile devices and smart cards. The proliferation of sensors and video cameras will monitor the comings and goings of people on an unprecedented scale.

Privacy legislation that addresses private and public uses of personal information, combined with adequate monitoring and enforcement mechanisms is a starting point. With the technological capacity for wide-scale privacy infringements already in place however, it is unclear whether government policies alone will do much to prevent abuses. Consumers will play an important role in pressuring the private sector (including mobile carriers, technology vendors and companies that deliver products and services through the Hypernet) to design and enforce the use of more robust security systems and privacy policies for mobile services and networks. Promise also lies in the creation and adoption of new technologies that safeguard an individual's privacy in the wireless world — much like Zero Knowledge's Freedom software has done for Internet users.

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## The Hypernet affects economic activity and everyday life

### Guerilla Infrastructures

Guerilla infrastructures are ad-hoc networks that enable user devices to communicate directly with one another and even route network traffic. These peer-to-peer networks bypass centralized hub-and-spoke systems and take advantages of resources — storage, cycles, content, human presence — available at the edges of the network. While telecommunications giants such as Verizon Wireless have spent as much as \$9 billion in auctions for a slice of the 3G spectrum, some guerilla operators claim they can provide broadband connectivity at a small fraction of the cost. Mesh Networks, a developer of "mobile routing peer networks," estimates that it could create a city-wide network for \$120,000 to \$130,000 as opposed to cellular infrastructure, where a base station alone costs \$200,000.

While still in their infancy, guerilla networks have the potential to:

- *Decrease costs of access and promote universality:* Access to free unlicensed spectrum and low start-up and maintenance costs for operators make guerilla networks a low-cost alternative to 3G or dial-up access to the Internet.
- *Rapidly scale-up the network:* The self-configuring property of ad-hoc networks and the fact that users actually carry the infrastructure with them enables network operators to rapidly and inexpensively expand the reach of their networks.
- *Provide high-bandwidth connectivity:* Guerilla networks typically provide between 1Mbps and 11Mbps data transfer rates. 802.11 networks, for example, already deliver 11Mbps, while 3G networks will deliver 384kbps.
- *Foster interactivity:* The peer-to-peer architecture of guerilla networks will drive significant increases in collaboration and interaction among users, machines and applications.

Guerilla infrastructures are suitable for areas without network infrastructure such as rural communities, underserved urban areas and much of the developing world. Governments could play a role in supporting guerilla infrastructure by making public buildings available for installation of wireless transmitters. However, the ad-hoc and decentralized nature of guerilla networks, and the fact that they primarily use unlicensed spectrum, will make it difficult for governments to regulate or police the content and services that these networks deliver.

### Person-to-Person Payments

Person-to-person payment (P2P) systems are a new development in online transactions that enable consumers to send and receive electronic payments directly, bypassing established financial and credit institutions such as Visa and Mastercard. A leading example is PayPal — an increasingly popular P2P payment system for the Internet. This system enables users create an account and transfer funds to any other individual with a valid email address. This revolutionary process has been one of the most rapidly growing financial services in recent history, with six million new users in 20 months prior to February 2001 and 20,000 new accounts created daily. PayPal is currently working to extend its success into physical world payments with mechanisms that would turn every mobile device into both a credit card and a processing terminal.

P2P payments offer both potential threats and new opportunities for governments:

- *Clock-speed:* P2P payments are dramatically increasing the clock-speed of monetary transfers. Cash transfers that would normally take several hours or days are now nearly instantaneous. With millions of individuals and organizations exchanging electronic currency,

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governments should prepare themselves to assess and manage the macro-economic consequences of the explosive growth of person-to-person payments, which totaled \$6 billion in 1999.<sup>3</sup>

- *Monetary policy:* Typically, the amount of currency in the system is limited by a government's management of the supply of currency within a fractional reserve system that allows them to influence interest rates and inflation rates. Commercial banks operate within the system by adhering to certain reserve requirements. If digital payment systems, on the other hand, begin lending or creating money using a distinct, unregulated fractional reserve system, the government's ability to manage the money supply and set economic policy will be limited.
- *Fiscal policy:* While different from jurisdiction to jurisdiction, most governments rely on sales or value-added taxes on a variety of goods and services for revenue. While cash has traditionally offered tax-avoiders a safe haven, P2P systems are a new twist. They could even be a more attractive alternative if they are viewed as less risky than carrying large sums of cash.

### Mobile Services: NTT DoCoMo's i-Mode

i-Mode is the mobile Internet service of NTT DoCoMo, Japan's largest mobile telephone service provider. Subscribers, equipped with an i-Mode enabled handset, send email, download games and cartoons, and surf more than 40,000 i-Mode Web sites. Since launching in 1999, the service has attracted more than 22 million subscribers, and is growing by one million subscribers a month, making it Japan's largest ISP. More than half of the world's mobile Internet users are i-Mode subscribers.

The service has succeeded by focusing on subscribers' ease of use and providing an "always on" system. Handsets come preconfigured, and the subscriber never has to log on to use i-Mode services. These factors contribute to i-Mode's popularity as a "niche time" activity: subscribers spend a few minutes on i-Mode while waiting for a train or riding an elevator. The user easily navigates through a menu of content and service providers and pays per packet of data downloaded, rather than time elapsed

i-Mode is significant to governments for two reasons:

- *Accessibility:* i-Mode helps bridge the digital divide: increasingly, citizens will connect to the Internet not through PCs, but through much less expensive mobile telephones. In every part of the world except North America, mobile phone penetration outstrips PC penetration. In the US, the fastest growing segment of mobile phone users is 18- to 24-year-olds who do not attend college. Internet connections will spread further and faster among populations that have access to an i-Mode-like service.
- *A new service delivery channel:* i-Mode proves, contrary to much Western commentary, that a small, low-speed interface can satisfy users' needs. i-Mode operates at 9.6 mbps, a far cry from speeds promised by 3G services, but fast enough to deliver email messages, text-based content, and simple animation, and certainly fast enough to deliver government information and some government services.

## APPLICATIONS FOR GOVERNMENT

## Applications for Government

The Hypernet brings the potential for innovation to all facets of government. In the following case studies we examine a range of Hypernet phenomena in the public sector. While these case studies represent the early stages of the Hypernet revolution in government, they point to important priorities for government research, investment and piloting.

## Wireless services and frontline work

Taking advantage of the wireless and mobile properties of the Hypernet can lead to greater convenience for citizens and new efficiencies for government service agencies. This is the lesson learned in several early-stage public sector initiatives deploying wireless technology in their operations. Mobile access to information and services are already benefiting many government operations that deploy a field force. Wireless access to government agencies through a mobile phone or PDA, on the other hand, is enabling citizens to conveniently obtain government information and services, any time and any place.

**The mobile field force**

Public emergency services such as police, paramedics and fire personnel are among the most obvious beneficiaries of Hypernet technologies, linking them to critical data while they are mobile. While wireless networks are already common in public-safety organizations, the New York City police department took an innovative step by issuing police officers with a mobile computer small enough to wear on a belt. The minicomputers come equipped with keyboards and display screens and use wireless transmitters to link them to the Police Department's central computers. This technology will make data such as outstanding warrants, traffic infractions, and addresses of parolees

available quickly and quietly to officers on foot patrol or investigating a crime scene, eliminating the need to wait to access a patrol car computer. According to early reports, the police have already had some success with these devices. In the pilot phase, officers used the minicomputer to do a background check on an individual they confronted for drinking in public — the man turned out to be wanted for a triple murder in St. Louis.<sup>4</sup> The NYC Police Department will equip two hundred officers with the new computers as the first phase of a plan to deploy the technology widely across the police force.

A host of other public sector fieldworkers such as building inspectors and social services caseworkers also stand to benefit from the Hypernet. Beginning in June, 2001, outreach workers for the homeless in Atlanta Georgia will have immediate access to detailed information and resources through their mobile phones or PDAs that will vastly improve the effectiveness of their outreach activities and services. The Wireless Outreach Worker project builds off a successful Internet application developed by Pathways Community Network — the PATHWAYS COMPASS the system — by adding the mobile functionality. With wireless infrastructure and devices, outreach workers will be able to search a secure, Internet-enabled database/communications system for client histories, look for available resources, and make electronic referrals from the street.<sup>5</sup>

**Wireless services**

It's just a matter of time before most government services that can be delivered to Internet-connected PCs will also be delivered to mobile devices of all types. Citizens will be able to use these devices to perform basic transactions such as changing an address or renewing a driver's license; search for government information about everything from patents to

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building codes to phone numbers; and access more sophisticated services such as health care and education.

*"A logical, near-future step is to deliver some, if not all, government services through mobile devices. As the delivery pipe gets bigger for wireless, you'll see more sophisticated services."*

Rodney Willett, general manager of VIPNet

The State of Virginia is currently a leader in using wireless technology to deliver government services and information. While not yet ready to offer transactions, Virginia's mobile information services are a first step in a long-term plan to use mobile devices as another delivery channel for most, if not all, of its services.

- *Lobbyist in a Box* is an interactive application that makes it possible for citizens, legislators, lobbyists, government agencies and their staffs to track the progress of the bills as they move through the legislative process. Through this service, bill status information provided by Virginia General Assembly's Division of Legislative Automated Systems (DLAS) can be obtained immediately with a few keystrokes on any mobile device. The DLAS information system includes the bill number, sponsoring patron, a brief summary and last action for each bill.
- The *Polling Locator* enables individuals to use their devices to locate polling places on election days. In the near future, Virginia will equip

this application with a GPS locator that will show the location on a map in addition to telling them the name and street address of the polling station. The polling-place locator application also links users to information about state and federal elected officials.

- *Election results.* In a related web-clipping application, an election results tracking application enables citizens to track election returns for statewide races on election night using a mobile device. For users keen to know the results but not in the vicinity of a television or radio, the returns are automatically updated as local registrars submit data across the state.
- The *Complaint Topic Selector* helps users determine the proper agency or office to assist an individual with the resolution of a consumer complaint. Using a keyword search, users will be fed a list of related agencies through hand-held devices. The Office of Consumer Affairs at the Virginia Department of Agriculture and Consumer Services serves as the central clearinghouse for the collection, evaluation, investigation or referral of consumer complaints. This application is credited with trimming the response times of consumer-assistance agencies
- The *License Status Verification* tool gives wireless users access to a Web-based application that allows Virginia residents to check the license status of health care professionals in the state. Residents can determine if a healthcare professional's license is valid and if disciplinary actions have been taken against the person. Citizens may also search for licensed professionals in their geographic areas by entering a ZIP code.

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Other mobile applications include Virginia's *Commonwealth Calendar* — a calendar used by all state agencies to post meeting announcements required under state law.

**Future vision**

Virginia is considering options for transactions through mobile devices. "That's the kind of convenience people want," said Rodney Willett, general manager of VIPNet, which maintains Virginia's Web site. "They're certainly doing stock transactions that way. Why not do your government transactions on the fly as well? There are a number of transactions already out there interactively on the Web. A logical, near-future step is to put some, if not all, of those on the mobile device. As the delivery pipe gets bigger for wireless, you'll see more sophisticated services."<sup>6</sup>

### The user-to-physical world network: Remote sensing and environmental policy-making

One of the greatest barriers to effective environmental policy-making has been a lack of current and convincing data about the impacts of human activity on ecosystems. Policy initiatives have been held back by years because of the length of time it can take to go out into the field to collect data, analyze it and complete a thorough environmental assessment that will satisfy critics. All of this is about to change.

The ability to conduct detailed studies of the environment will be transformed radically by developing and deploying sensor networks supported by a wireless infrastructure. This is the proposition put forth by a group of researchers at the California Institute of Telecommunications and Information Technology (Cal-IT2) and many other research institutes that are developing the technology to produce — for the first time — a continuously

updated data set about environmental quality from any location in which the sensors are placed. According to Cal-IT2, everyone from local environment ministries to global organizations will soon possess the tools and information to "detect and forecast climate variability, manage natural resources, preserve and restore ecosystems, and carry out crisis management." In the long-run observers predict the emergence of a "global digital nervous system" that will enable future societies to monitor the environment on a global scale.

**How it works**

While sensors are not new, the idea of connecting them to the Internet has been overlooked because of the high costs (and the potential environmental disruption) of installing conventional landlines. The development of wireless connectivity has opened the door for widespread distribution and networking of sensors. For example, sensors could be embedded in marine environments to detect the changing chemical composition of the water body, at points-of-source to measure air pollutants or in the polar ice cap to assess global climate change.

Wireless sensor networks combine a range of new innovations including microsensor technology, low power signal processing and computation, and wireless networking capabilities into relatively low-cost compact systems. Microsensors come in many varieties depending on the task, but in general, they employ a "sensor interface" that will recognize a signal from the environment whether seismic, infrared, thermal, acoustic or chemical. When the sensor registers an event the computer processor decides whether it is significant and a wireless modem sends a short message packet via radio frequency back to a central database.

## APPLICATIONS FOR GOVERNMENT

*"The Hypernet bridges the physical world and the global information infrastructure to provides us with unprecedented knowledge of and control over our "informed" planet."*

### Current state

Many of the technologies and processes outlined above are still in pilot stage. Cal-IT2's first environmental pilot project will be targeted at California's costal environment and over the next four years, Cal-IT2 will work with a variety of partners to define and deploy the Southern California Wireless Environmental Sensor Network and Information System. The network of sensors will extend from the Sierra Nevada mountain range on the east to the outer limits of the southern California continental shelf on the west. The pilot will test several types of sensors:

- Low-cost meteorological and hydrological sensors that collect watershed data to provide a real-time view of California's watersheds;
- Wave-monitoring sensors that make available immediate estimates of regional coastal currents to applications including emergency response to oil and sewage spills, understanding pollution disbursement from point sources, and predicting sediment transport along the coast;
- And biosensors that capture data about physical, chemical, and biological processes that can be applied to a range of biological detection problems, including those important in monitoring beach pollution.

The data streams from these widely distributed sensors will be integrated with historical data archives and sophisticated computational models of environmental processes. This rich information resource combined with the development unprecedented capabilities to analyze enormous data sets will enable more effective decision-making and crisis management capacities. Policy-makers will have more accurate information about current and future environmental quality with which to set policy and even tailor it to individual jurisdictions. Cal-IT2's ambition is to produce a prototype architecture that can be replicated in other regions on a variety of scales.

### Future vision

The applications of wireless sensor networks are not limited to the environment. Sensor networks could be embedded in civil infrastructure and manufacturing equipment to provide mechanical engineers with feedback about costs and quality problems. Sensors placed in troubled human organs could alert medical patients, ambulance services and medical professionals to physiological irregularities and initiate an appropriate response. Wireless sensors scattered by airdrops could provide situational battlefield intelligence. As these technologies mature we will witness a profound evolution in the Hypernet — one that bridges the physical world and the global information infrastructure and provides us with unprecedented knowledge of and control over our "informed" planet.

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## Wireless democracy and advocacy

The phenomenon of e-democracy is gradually emerging as a major force in politics. Candidates equip themselves with increasingly sophisticated Web sites; email is a growing form of political communication; alternative media, advocacy Web sites and Internet-enabled campaigns are proliferating; and governments are experimenting with various forms of online citizen engagement. However, many democratic institutions have been slow to adjust to new global realities and address the declining public faith in traditional democratic rituals. While just one element of a healthy 21st century democracy, collaborative Hypernet technologies will make important contributions to the way citizens and organizations engage in democratic processes. By creating new channels for citizen engagement, enabling new forms of advocacy, improving access to information and extending the reach of global information infrastructure to groups which have not had access to the first-generation Internet, the Hypernet will help move democracy into the digital era.

*"Using the Internet only to present decisions that have already been made does not increase the citizen's ability to influence matters very much . . . The real possibilities lie in opening policy preparation to public evaluation and discussion."*

Jouni Backman, Member of the Finnish Parliament

**Wireless citizen engagement in Finland**

It's not surprising that the first example of wireless citizen engagement is

occurring in Finland — currently the world leader in mobile phone penetration at approximately seventy per cent of the population. Taking advantage of the high percentage of users, the Finnish government is promoting innovative ways for citizens to use their mobile phones to help elected officials stay in touch with public opinion. According to Jouni Backman, Member of the Finnish Parliament, "Using the Internet only to present decisions that have already been made does not increase the citizen's ability to influence matters very much . . . The real possibilities lie in opening policy preparation to public evaluation and discussion."<sup>7</sup> In 1999, Finland introduced a system that enables citizens to use their mobile phones to vote once a week on a matter being handled in Parliament. Although the vote is not binding, it provides a barometer on public opinion that is difficult for politicians to ignore.

The system provides a model of how simple, nearly ubiquitous technologies such as the mobile phone present opportunities to increase the level of citizen engagement in the political process. While the depth of input that can be transmitted by SMS technology is shallow, it serves as an effective, user-friendly mechanism for polling large populations — a first step that can be expanded into deeper public consultations when broadband networks and devices are more widely available. Virtual question periods, collaborative filtering, online brainstorming and citizen juries are among many effective engagement processes that could be enabled by broadband wireless technologies at local, national and international levels.<sup>8</sup>

**Amnesty International – the SMS-enabled campaign against torture**

Civil society organizations like Amnesty International are pioneering the use of wireless technology to enable their advocacy processes. For almost 40 years, Amnesty has organized campaigns against torture through a slow but usually effective process of reaching out to supporters and organizing mass

## APPLICATIONS FOR GOVERNMENT

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letter-writing campaigns. The Hypernet is enabling Amnesty to improve the speed, efficiency and ease with which they can mobilize their membership in time-sensitive situations by turning every supporter's mobile phone, pager and computer into a real-time advocacy tool.

Amnesty currently manages a series of "stop torture" campaigns in nearly 78 countries where supporters can opt to receive SMS text messages on their mobile phone, notifying them of urgent appeals for people that are at risk of being tortured.<sup>9</sup> The US Chapter, Fast Action Stops Torture (FAST), explains that "As soon as we hear about an imminent threat of torture, FAST instantly sends out an alarm to our network of activists around the globe. Mobile phones ring, pagers buzz and computers chime, instructing activists by the thousands to sign electronic letters of protest — we can bring an individual's plight to the attention of the world within minutes."<sup>10</sup> Users can sign and transmit an online petition with their mobile phone. Amnesty International then leverages its experience in gaining media coverage, publications and lobbying, with the support of individual members gathered in a matter of hours instead of weeks.

### People Power II – SMS in the Philippines

Nearly all accounts of the downfall of the former president of the Philippines, Joseph Estrada, point to the crucial importance of the mobile phone in the rapid mobilization of citizen protesters. According to one college student in Manila, "The power of our mobile phones and computers were among the things that lit the fuse which set off the second uprising — the People Power Revolution II."<sup>11</sup>

Introduced in the latter half of the 1990s, mobile phones became remarkably popular in the Philippines around 1999. Professor Vincente Rafael of the

University of California, San Diego suggests there are a number of reasons.<sup>12</sup> Getting a landline phone in the Philippines is difficult and expensive — and service is erratic. Additionally, mobile phones cost far less than personal computers — only one percent of the population own a PC. By contrast, over 6.5 percent of the population, or five million people, own a mobile phone. The vast majority of Filipino users buy pre-paid phone cards and use "texting" — sending SMS messages — as the preferred mode of communication now that vendors have introduced free or low-cost text messaging as part of their regular service. Filipinos send 52 million text messages every day — more than 10 daily for every mobile phone owner.<sup>13</sup> The economics of mobile phones make this form of wireless communication more accessible, reliable and affordable than regular telephones or computers.

*"In revolutions, people used to say, 'Keep your powder dry'. Now they say, 'Keep your cell phone charged'."*

Professor Alex Magno

Mobile phones were effective in spreading rumors, jokes and information that steadily eroded the legitimacy of President Estrada while his impeachment hearings proceeded. Bypassing the mainstream TV or radio, mobile phone users became broadcasters, receiving and transmitting both news and gossip. As Professor Vincente Rafael of the University of California, San Diego explains, "the telephone shares the capacity of other telecommunication technologies — to reveal what was once hidden, to repeat what was meant to be secret, and to pass on messages that were not meant for those outside of a particular circle."<sup>14</sup>

## MOVING AHEAD: THE TRANSITION TO THE HYPERNET

During the trial, mobile phones were once again instrumental, this time in rallying hundreds of thousands of Filipinos together to stage a peaceful civilian coup.

One participant in the first People Power revolution that overthrew Ferdinand Marcos in 1986, Professor Alex Magno, sums up the significance of SMS messaging in his assessment of the events: "Now," he says, "I wonder how we managed these things without cell phones. Being an archipelago, we needed four weeks' lead time in order to set things up in 1986. We'd send out messengers on the inter-island ships and, if they got picked up on the way by the Marcos people, we'd lose a city... Now we can send messages in real time - to the north of Luzon, to the Visayas. Four and half million people are transmitters and receivers, and then they pass it on to all the people around them... In revolutions, people used to say, 'Keep your powder dry'. Now they say, 'Keep your cell phone charged'."<sup>15</sup>

#### Future Vision

E-democracy has received neither the attention nor the resources devoted to electronic service delivery. Indeed, most of the attempts to use wireless technology to facilitate deeper or more effective citizen involvement in political issues have occurred outside of government. Through the grassroots efforts of Filipino protestors, Amnesty International's wireless alerts, and other initiatives like them, new models of wireless democracy and advocacy will emerge that can serve as a model for governments looking for wireless citizen engagement strategies. Lack of universal access is clearly one factor in preventing significant government investments in e-democracy. The wireless e-democracy initiative in Finland however, demonstrates that broader access to Hypernet technologies — coupled with the will power on the part of the governments to open themselves up to wider citizen involvement — will make the potential for true e-democracy a reality.

#### Moving Ahead: The Transition to the Hypernet

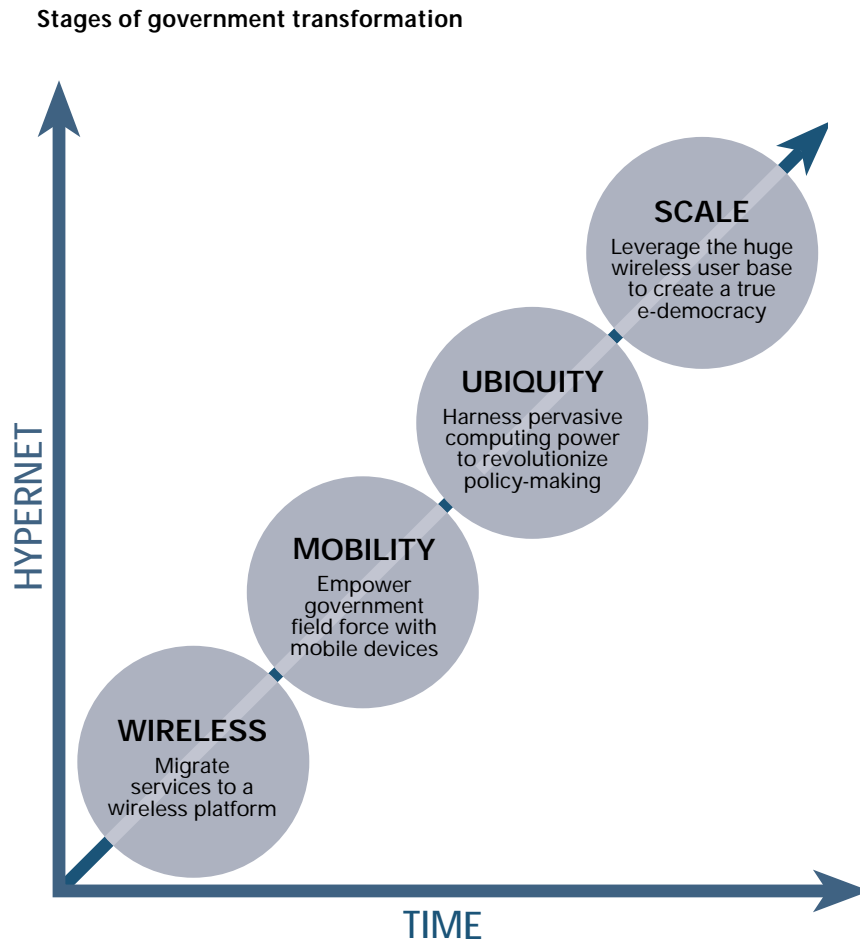
The four distinguishing properties of the Hypernet – wireless, mobility, ubiquity and scale – are on a rapid trajectory to change the fundamental nature of networked information infrastructure. The wireless Internet audience in Japan has already reached 36.94 million people as of March 2001, up by nearly 300 percent from the year before.<sup>16</sup> Sixty-eight percent of Europeans, or 168 million people, will access the Internet through a wireless device by 2005,<sup>17</sup> while revenue from wireless Instant Messaging in Europe will climb from 1 million euros to 760 million euros between 2001 and 2005.<sup>18</sup> The number of North American wireless Web users is forecast to reach 137 million in 2005,<sup>19</sup> while the number of wireless Internet users worldwide will top 730 million, easily outstripping the number of individuals accessing the Web through PCs at 62.1 percent of the total market.<sup>20</sup> Bluetooth is also on the rise, with 1 billion Bluetooth-equipped devices forecast to be shipped in 2005, at which point, pervasive and ubiquitous computing becomes a reality.<sup>21</sup> These social, economic and technological trends will transform the Internet along every key dimension: users, applications, devices, mobility and bandwidth.

Governments in the early stages of moving services, communications, business processes and policy-making onto the Internet are unlikely to perceive the need to rush into development of wireless or broadband offerings. Indeed, the target of moving all public services online is, for most governments, another three to five years in the future. However, lessons learned about the implementation of government online projects around the world suggest now is the time for governments to gain a comprehensive understanding of the policy implications and potential applications of the phenomenon we call the Hypernet.

## MOVING AHEAD: THE TRANSITION TO THE HYPERNET

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the extent of changes required in the organizational, political, technological and cultural structures of government became clear. Governments have moved beyond the "let a thousand flowers bloom" approaches of the early days of innovation and experimentation to more systematic strategies and rigorous project planning and implementation. However, by the time current e-government strategies are realized, the Hypernet will have significantly transformed the social, economic and technological landscape upon which those strategies were originally based.

Altering the course of e-government to prepare for a future of wireless and pervasive computing will have significant benefits for governments and end-users. Government agencies should take this opportunity to start designing, planning and piloting new Hypernet initiatives. Policy-makers should be researching the space in anticipation of emerging policy issues, ranging from privacy in a world of ubiquitous computing to intellectual property protection in ad-hoc wireless networks. By starting now, governments will be well positioned to fully leverage the potential of the Hypernet to the increase the efficiency of government operations, improve the convenience of electronic services and extend the depth and reach of e-democracy.

– Anthony Williams

Government online projects have turned out to be more complex, expensive and time-consuming than many governments expected. As "e-government" evolved beyond organizing a simple Web presence to areas such as digitizing information, transforming internal processes, knowledge management, integrating services and transversing traditional departmental boundaries,

## ENDNOTES

- 1 Moore's Law was coined by Intel co-founder Gordon Moore in 1965 when he observed that computing power (measured by the number of transistors per square inch on integrated circuits) was doubling every 18 to 24 months.
- 2 The current cost of high-resolution satellite images is approximately \$1000 - \$4000 for a single image with a resolution of 10 meters to 1 meter. Barring government intervention, this price can be expected to fall if the technology improves and the market for satellite imagery grows. See, Yahya A. Dehqanzada and Ann Florini. *Secrets for Sale: How Commercial Satellite Imagery Will Change the World*. (Washington: Carnegie Endowment for International Peace, 2000).
- 3 "New wave of e-money options hits the web." *American Bankers Association, ABA Banking Journal*. August 2000.
- 4 Thomas Lueck, "Patrol Officers to Carry Minicomputers on Gun Belts." *New York Times*, May 24, 2001.
- 5 The Wireless Outreach Worker application is being developed in partnership with Ericsson and the Pathway Community Network itself is a collaborative effort amongst 28 social service agencies, working together with non-profits, local governments and volunteers. The Network's mission and occupation is developing and operating secure, high tech systems that enable social services agencies to operate more effectively and efficiently.
- 6 Shane Peterson, "Government to Go." *Government Technology*, May 2001.
- 7 Speech by Jouni Backman, Member of the Finnish Parliament, *Parliaments in the Information Society*, Paris, November 18, 1999.
- 8 Online citizen juries and panels: Ordinary citizens are chosen on a random or representative basis to serve as policy jurors or advisors on an issue. Jurors use the Web to hear evidence, ask questions and deliberate to arrive at policy recommendations. Permanent advisory bodies could consist of a representative cross-section of citizens that use the Web to debate ideas and share information. Digital Brainstorming: Bringing together policy actors and citizens to have real-time, moderated online brainstorming sessions to identify new policy issues or needs. Virtual question periods: Making political representatives available online for regular question and answer periods with their constituents. Alternately, parliamentary sessions could be opened to questions from citizens through SMS or wireless video feeds. Collaborative filtering: Harnessing the collective wisdom of a wide range of participants by using rating systems and collaborative filtering to help limit the quantity of information and inputs in the policy-making process to the best available sources of information.
- 9 See the Stop Torture Campaign homepage: <http://www.stoptorture.org/>
- 10 Interview via email correspondence with Marwan Farah, Online Campaign Organizer for Amnesty International.
- 11 Uli Schmetzer, "Cell Phones Spurred Filipinos," *Chicago Tribune*, 24 January 2001.
- 12 Vicente Rafael, "Generation Text: the Cell Phone and the Crowd in Recent Philippine History," April 30, 2001. [http://communication.ucsd.edu/people/f\\_rafael.cellphone.html](http://communication.ucsd.edu/people/f_rafael.cellphone.html)
- 13 Richard Lloyd Parry, "In revolutions they used to say 'keep your powder dry.' Now they say 'keep your cell phone charged.'" *The Independent*, Jan 23, 2001.
- 14 Vicente Rafael, *ibid*
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- 16 Japanese Ministry of Posts and Telecommunications, June 12, 2001. <http://www.mpt.go.jp/data/index-e.html>
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- 19 Gartner Dataquest, June 7, 2001. <http://www3.gartner.com/IndexHomePage.jsp?=-dq>
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