

Mobile App Trends in Government



Table of Contents

Executive Summary	2
Introduction to Mobile Apps	7
The Growth of Mobile Apps.....	7
The Emergence of Government Apps.....	9
Location-Based Services.....	11
How Mobile Devices Help Bridge the Digital Divide.....	11
The State of Mobile Apps in Government	13
Mobile Apps in the Federal Government.....	13
Mobile Apps in State Government.....	16
Mobile Apps in Local Government.....	17
Enterprise-Focused Apps	18
Enterprise-Focused Apps in the Federal Government.....	18
Enterprise-Focused Apps in State and Local Government.....	19
The Road Ahead for Enterprise-Focused Apps.....	20
Citizen-Oriented Apps	22
Citizen-Oriented Apps in the Federal Government.....	22
Citizen-Oriented Apps in State and Local Government.....	24
The Road Ahead for Citizen-Oriented Apps.....	27
Mobile App Design Considerations	29
Three Types of App Design.....	29
The Road Ahead for Mobile App Design.....	32
Recommendations for Government Mobile Apps	33
Recommendation One: Optimize Online Services for Mobile Devices.....	33
Recommendation Two: Provide Open Data Based on Common Standards.....	33
Recommendation Three: Assess Feasibility of Standard Data Structures Across and Within Agencies.....	34
References	36

Executive Summary

Apps are programs designed specifically for mobile devices—smartphones, tablets, and wearables. A novelty when Apple first introduced them for iPhones in 2008, apps have become staples of modern life, thanks to explosive growth in mobile device use. There are close to 4 million apps available through major gateways such as the App Store (for Apple’s iOS devices) and Google Play (for Android devices). Billions of downloads now fuel a burgeoning app economy that has redefined the purpose of phone ownership; nearly 90 percent of a mobile user’s time is now spent on apps (Khalaf, 2015).

The prevalence of mobile devices across virtually all sectors of society presents new opportunities in the public sector. Schadler, Bernoff, and Ask (2014) argue that the mobile environment has triggered a shift in the mindset of citizens. Today’s individual approaches the world with the expectation, “I can get what I want in my immediate context and moments of need.”

The proliferation of apps is also narrowing the digital divide with regard to access to online services. Ownership of smartphones, and dependence on them for Internet access, is especially high among minority groups. Low-income households are more likely than high-income households to depend on smartphones for online access. Hispanic adults and African Americans of all ages spend more time on apps than the average user. The accessibility of smartphones for traditionally underserved populations highlights both the importance and the potential of delivering social services through apps.

There are two broad types of government apps that are discussed in this report:

- Enterprise-focused apps are mainly for internal use within a public organization. They are accessible only to employees and operate within secure firewalls established by the organization.
- Citizen-oriented apps are intended for external use. They are accessible to anyone who seeks to use government services.

The State of Mobile Apps in Government

Mobile Apps in the Federal Government

The Obama administration’s 2012 Digital Government Strategy laid out a broad digital plan to harness information technology in federal agencies. Premised on four core principles, the strategy explicitly envisaged doing mobile “right” from the beginning. Those principles are:

- To create an information-centric government that focuses on open data and content
- To establish a shared platform within and across agencies
- To take a customer-centric approach in presenting data
- To build required security and privacy measures upfront

The federal strategy required agencies to expose high-value data and content of at least two exist-ing customer-facing systems through Application Programming Interfaces (APIs), which allow apps to access public agency data online in order to provide value-added services in real time. Government data is a high-value resource; the core strength of the federal digital strategy lies in leveraging that resource to spur customer service innovation. All new federal agencies’ systems, underlying data, and content must comply with open data and API policies.

Mobile Apps in State and Local Government

Because they follow their own mandates and policies, state and local (county/city) governments vary in their level of adaptation to the mobile environment. Yet customer service improvements are critical at these levels of government, as state and local agencies are the direct service providers for citizens on a day-to-day basis

(schools, hospitals, law enforcement, public works, transportation, etc.). Hence, the most successfully innovative state and local governments are those that have created mobile apps to facilitate citizen engagement.

State government apps. State governments are increasingly adapting to the mobile technology age. According to the NASCIO (2014) survey, about 60 percent of state CIOs considered mobile device compatibility and app generation to be essential or high priority. Unfortunately, nearly half described their mobile access management as mostly or totally fragmented. About 36 of the 50 states' main portals are mobile friendly (Ziadeh, 2015).

Local government apps. Levels of adaptation to the mobile environment vary greatly among local governments. Large cities and counties often have mobile apps; their websites, however, may not be mobile friendly. About half of the 10 largest city and county governments' root websites passed the Google Mobile-Friendly test. The Vision Internet (2015) survey of local governments also showed that about half of the respondents provide mobile-friendly citizen services.

Enterprise-Focused Apps

In the federal government. Customized, agency-developed, enterprise-focused apps for internal organizational use are in their very early stages of emergence. One of the first federal government enterprise uses of mobile devices (which pre-dated the development of mobile apps) was the Computer Aided Personal Interview (CAPI) solution, implemented in 2012 by the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS). CAPI's integration of mobile device use increased fieldwork efficiency while maintaining a high level of data quality and security.

In state and local governments. Among state and local government agencies, current realities mirror those at the federal level: enterprise-focused apps are emergent rather than prominent. Routine human resource functions lend themselves to mobile optimization. Informational apps, such as directory search tools and operating procedure manuals, enable employees to access reports, data, and strategic guidelines in real time. For example, with the City of Los Angeles's InsideLA app, employees can instantly review pay stubs, IT service tickets, and more.

The transformational power of strategically envisioned mobile device use lies in re-engineering field processes to promote greater integration of efforts between line workers in the field and back-office workers. Field case management, road and rail infrastructure maintenance, vehicular fleet management, supply chain management, and inventory control are just some of the areas with potential efficiency gains from mobile use. The Pennsylvania Department of Transportation's Posted and Bonded Road app, for example, replaced manual paper-based reports, reducing field workers' administrative duties.

The road ahead for enterprise-focused apps. Though still in the nascent stages of growth at all levels of government, enterprise-focused apps have the potential to play a central role in revamping the workings of the public sector. Indeed, enterprise-focused apps represent a lucrative growth area in private businesses already, especially among sales forces (Columbus, 2015; Kerschberg, 2015). Opportunities abound to transform internal operations with location-based services available anywhere in real time.

Enterprise-focused apps could enhance government productivity in several ways, including:

- Aiding in the management of mobile assets
- Increasing employee productivity, especially in the realm of routine or simple tasks that require cursory examination
- Reducing back-office administrative demands on field workers
- Providing opportunities for collaboration and networking between public agency field offices

Citizen-Oriented Apps

Citizen-oriented apps are more prevalent than enterprise-focused apps at all levels of government. These apps serve as mechanisms of innovation to improve delivery of public services and better engage the public in decision-making processes.

Citizen-oriented apps in the federal government. As a result of the 2012 Digital Strategy, most federal agencies have at least one type of citizen-oriented app. There are five categories of federal citizen-oriented apps:

- **Information and news service apps** provide information about the agency's services, offer the latest news, or share agency data (e.g., the White House app and the Department of Commerce's BusinessUSA mobile app).
- **Client services apps** provide "on the go" services (e.g., the Internal Revenue Service's IRS2go app, the GSA's per diem app, the Transportation Security Agency's myTSA app).
- **Crowdsourcing apps** solicit user-volunteered information that would otherwise be costly, impractical, or impossible to obtain in real time. Examples include the myTSA (crowd-sources the wait time in security lines from passengers), the Department of Energy's Lantern Live app (crowdsources gas fueling stations during an emergency), and the Federal Communications Commission's Speed Test App (crowdsources broadband speed).
- **Health and safety information apps** are being used by the Federal Emergency Management Agency (FEMA), Food and Drug Administration (FDA), and the Department of Health and Human Services (HHS) (among other agencies), to provide information on disaster assistance, drug shortages, and HIV/AIDS, respectively.
- **Educational apps** offer entertaining ways to explore various aspects of a theme and are trending toward gamification. Such apps include NASA's Comet Quest, the Library of Congress's Aesop for Children, the National Archives and Records Administration's DocsTeach, and the Smithsonian Institution's Access American Stories.

Citizen-oriented apps in state and local governments. Citizen-oriented apps provided by state and local governments fall into four categories:

- **Information apps on parks, recreation, and leisure activities** are oriented toward tourists (e.g., park guides developed by ParksByNature Network in many states). Innovative apps utilize Quick Reader (QR) codes for interactive park navigation and augmented reality to overlay virtual reality and enrich the park experience.
- **Traffic and transit information apps** function in real time and place. The 511 apps offered by state departments of transportation (DOTs) give current highway traffic conditions so drivers can adjust their routes accordingly.
- **Public engagement apps** include 311 apps, which give citizens an access point to obtain non-emergency services (e.g., pothole or streetlight repair). Open 311 makes 311 app use possible in cities without 311 call centers, through third party vendors such as Accela's PublicStuff, CitySourced, QScend, SeeClickFix, and others.
- **Third party civic apps** are developed by citizen groups, nonprofit agencies, and private sector entities using local government data. Public agencies have successfully employed app competitions and hackathons to spur development such apps.

The road ahead for citizen-oriented apps. In the years ahead, government at all levels will move toward:

- **Increased support of citizen-oriented apps to enhance public services.** Government agencies should assist in developing and supporting citizen-oriented apps that improve the quality and delivery of public services. Mobile service provision has the potential to drive such improvements while reducing agency costs.
- **Increased use of an embedded approach for citizen-oriented apps.** Public agencies should take an embedded approach to citizen-oriented apps by providing a public service contextually. In such an approach, public agencies would embed their apps within other mobile services already in wide use by citizens.
- **Increased availability of APIs for third-party citizen-oriented apps.** Public agencies are vast repositories of data in the public domain. Providing APIs to make that data more accessible is a critical step in the development of third-party mobile apps. APIs are standard protocols for accessing public data, which can be used in apps to provide value-added services.

Mobile App Design Considerations

An app must be customized to fit the specific features of the type of device on which it is most likely to be used (wearable, smartphone, or tablet). Small devices have “go anywhere” portability, but have limited screen space for presentation and user interaction. Wearables are therefore appropriate only for personalized user needs. Smartphones are used for a range of communications and social networking activities, including location-based services. Tablets are ideal for field-based activities. Furthermore, because operating systems vary among mobile devices, multiple versions of an app are needed.

There are three types of app designs from a software perspective:

- **Native apps** are downloaded onto the device itself and take maximum advantage of its hardware features (e.g., camera, etc.).
- **Web apps** are websites using responsive web design features so that the same app may be accessed from, and optimized for, different types of devices.
- **Hybrid apps** combine the features of native and web apps. Similar to native apps, hybrid apps are accessed through app gateways and installed onto a device. However, these apps are developed with cross-mobile device features so they can work across different platforms.

The road ahead for mobile app design. With the proliferation of mobile devices, public agencies need to explicitly adopt a “mobile first” strategy. Federal, state, and local government agencies should strategically assess their existing online services and engage the public to help identify those that would be most valued on various mobile devices. App design should proceed with a keen awareness of the strengths and limitations of each type of device.

Recommendations

The report concludes with the following three recommendations:

- **Recommendation One: Optimize Online Services for Mobile Devices.** Government agencies should strategically assess their online services for mobile optimization. Mobile devices are ubiquitous and accessible to populations that were traditionally underserved. Hence, they offer unprecedented opportunities for government agencies to engage the public and provide public services more efficiently and equitably.
- **Recommendation Two: Provide Open Data Based on Common Standards.** Public agencies are treasure troves of public domain data that they collect in pursuit of their missions. Proactive open data policies make that data available in machine-readable formats based on common standards. A proactive approach ensures the creation of a range of mobile apps that are socially useful.

- **Recommendation Three: Assess Feasibility of Standard Data Structures Across** and Within Agencies. Standardization of the structure of databases enables different public agencies to share their data in a consistent way. Apps can then use data from different agencies, with little or no customization across jurisdictions. For example, the Local Inspector Value-Entry Specification and the General Transit Feed Specification are data standardization systems for restaurant inspections and transit agency data feeds, respectively. They have facilitated the development of several value-added apps for food safety and transit.

Introduction to Mobile Apps

The Growth of Mobile Apps

Mobile devices, including mobile phones, tablets, e-readers, wearables, and hybrid devices, have become commonplace over the last decade. These devices are enabled for over-the-telephone (cellular), broadband (e.g., wi-fi), or a combination of communications connections. Mobile devices around the world number about 7.4 billion, exceeding the global population of 7.2 billion in 2014 (CISCO, 2015). The adoption of mobile devices has grown dramatically in just a few years:

- The share of Americans owning cell phones rose from 83 percent to over 91 percent between 2011 and 2014 (Pew Research Center, 2015).
- Smartphone (i.e., phone with Internet capabilities) ownership went up from 35 percent to 64 percent (Pew Research Center, 2015) during the same time period. Tracing agency comScore reported a 77 percent smartphone subscriber market share in 2015 (Lella, 2015a).
- Mobile-phone-only households (i.e., households without landlines) have steadily increased, from 34 percent to over 45 percent between 2011 and 2014 (Blumberg and Luke, 2015).
- Tablet ownership increased from 8 percent in 2011 to over 42 percent in 2013; e-reader ownership went up from 12 percent to 32 percent during the same period (Zickuhr and Rainee, 2014).

Wearables represent the next frontier for mobile device growth. Apple began selling the Apple Watch in 2015. Google Glass is being re-introduced for workplaces (e.g., healthcare, energy, manufacturing) after its first version was withdrawn from the marketplace in early 2015 (Barr, 2015). In addition, a variety of biometric and location-aware wearables (such as badges, bands, etc.) have emerged.

Mobile apps are programs created specifically for mobile devices that combine both communications and computing capabilities. The portability and connectivity that such devices offer makes mobile apps a distinct realm of software development. Apps utilize a mobile device's hardware features, such as the camera and geographical positioning system (GPS).

Apps first emerged for the Apple iPhone, introduced in 2007. The app market burgeoned with the launch of Apple's App Store in 2008. Apps have since emerged for smartphones, tablets, hybrid devices (e.g., phablets), and wearables (such as the Apple Watch). Over 97 percent of mobile devices in the United States run on two operating systems, Apple's iOS and Google's Android (Figure 1). Windows phones were introduced in 2011 and account for less than a two percent of the share of the mobile market; Blackberry comprises less than one percent.

The evolution of the world of mobile apps is proceeding at a dizzying pace. Apps are available for download through a variety of gateway stores, including:

- Google Play
- Apple's App Store
- Microsoft Windows Store
- Amazon

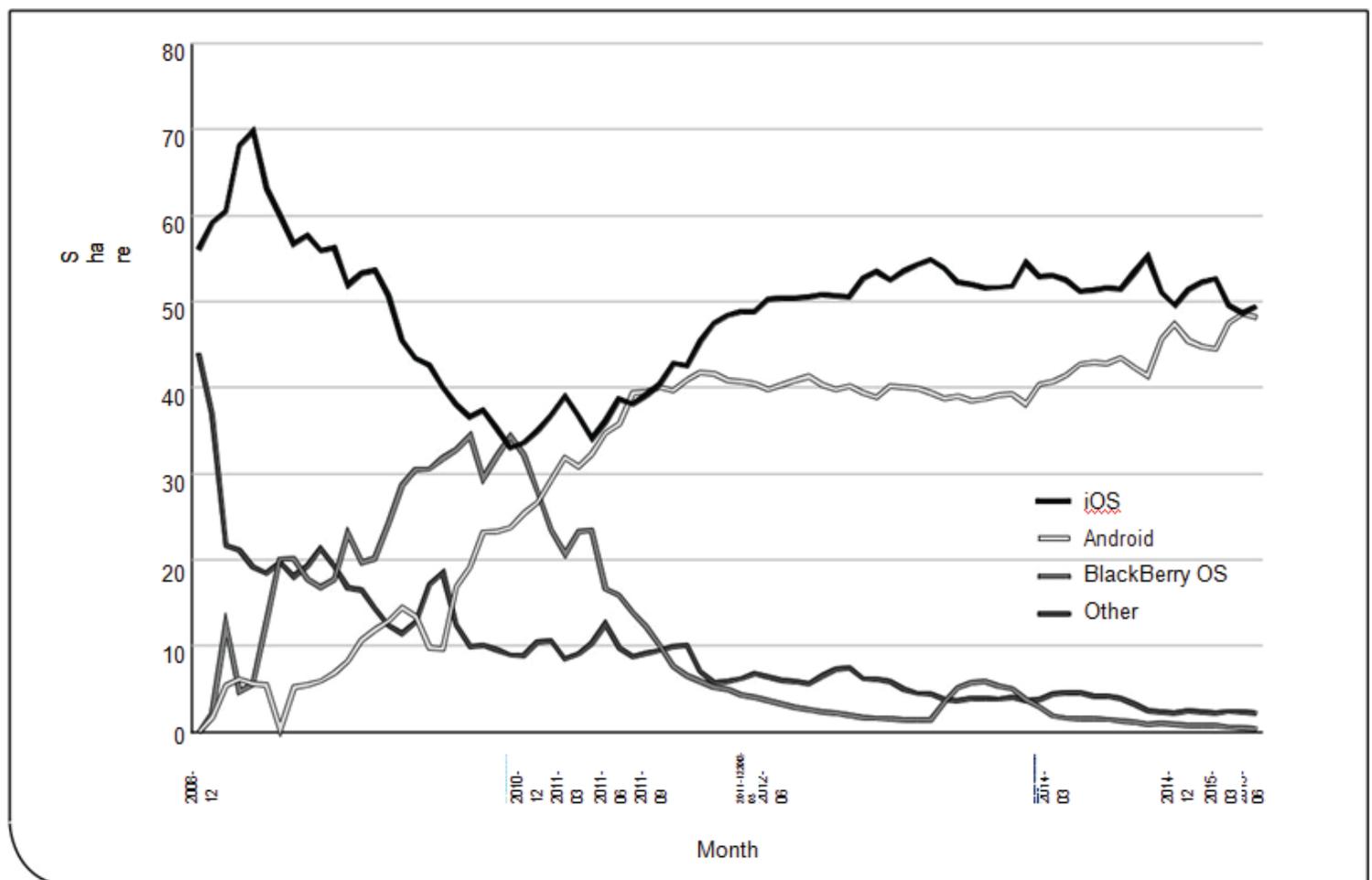
Together, these gateways house nearly 3.97 million apps. Google Play (with 1.6 million apps) and the Apple's App Store (1.5 million apps) account for about 78 percent of available apps. The Microsoft Windows Store and

Amazon host about 19 percent of apps, while Blackberry accounts for three percent. App downloads are projected to grow from nearly 64 billion in 2012 to nearly 268.7 billion in 2017. Associated revenues are expected to grow from \$18 billion to \$77 billion during the same period (Shen and Blau, 2013).

App gateways play a crucial role in the discovery, distribution, and use of apps. In addition to the aforementioned prominent gateways, there are proprietary gateways for the operating systems of various manufacturers (e.g., Blackberry World, Mozilla's Firefox Marketplace, Palm's WebOS apps, Samsung's Galaxy and Tizen stores).

Culturally, the app phenomenon has become so predominant that it spawned Apple's mantra of "there's an app for that," which both acknowledges and celebrates the ubiquitous use of apps for problem solving. The average smartphone owner has 36 (as per Google, 2015) to 42 apps (as per Nielsen, 2014b) on the device, and accesses about 26.7 apps per month (Nielsen, 2015). According to comScore (2014), more than half of digital media time (which includes both mobile and desktop use) is spent on apps. Apps for social networking (e.g., Facebook, Instagram), game playing, and entertainment (e.g., YouTube for videos, Pandora for music) are used as pastimes, although significant time is also spent on communication (e.g., e-mail, instant messenger) and location-based apps (e.g., Google Maps) (Beard, 2014; comScore, 2014).

Figure 1: Share of Mobile Operating Systems in the U.S., 2008–2015



Source: Global Stats, http://gs.statcounter.com/#mobile_os-US-monthly-200812-201506

On average, nearly 90 percent of a mobile device user's time is spent on apps (Khalaf, 2015). As comScore (2015) reports, "Mobile app usage exploded on its way to becoming the majority of all digital media activity." Although apps have thus far been principally oriented toward smartphones and tablets (including hybrids, such as phablets), they also hold good prospects for wearables as that market grows. The Apple watch debuted in April 2015 with about 3,000 apps; by June 2015, that number had grown to over 6,300 (App Annie, 2015a).

The Emergence of Government Apps

The growth of mobile devices and apps presents new opportunities in the public sector. Mobile-specific functions comprise a distinct subset of e-government functions, premised on electronic delivery of services. Whereas e-government enables anytime access to public e-services, mobile government provides “anytime, anywhere” government services on demand. Citizens often require services in an instant from public agencies, highly contextualized to the person and the location. They need information on the go, a reality that is now shaping how public agencies deliver that information.

Mobile devices have transformed consumer behavior into a series of intent-rich micro moments, when “we reflexively turn to a device to act on a need we have in that moment, to learn, discover, find, or buy something” (Forrester Research, 2015). Location-based service apps harness the device’s real-time location information to give customized personal services in the immediate vicinity.

In 2015, mobile users surpassed computer users for the first time in Google searches in the U.S. (Dischler, 2015; Lella, 2015). In response to the trend, Google changed its algorithms in April 2015 to include mobile-friendly sites and relevant app content (through app indexing) in search results (Makino, Jung, and Phan, 2015).

Mobile devices now account for over one-third of the traffic on U.S. government websites— about 28 percent from smartphones and 7.5 percent from tablets.¹ According to Pew Internet Research, 40 percent of smartphone users employ the device to look up government services or information (Smith, 2015). Smartphones are significant for public employees as well: nearly two-thirds of federal agency leaders indicated that agency-issued smartphones would have the greatest impact on improving workplace performance (NAPA and ICF, 2015).

It is important to note that government agencies have embarked on new strategies for mobile device use. A popular mantra is “mobile first,” meaning that access to government information and services should be predicated on the use of mobile devices from the beginning, rather than centered initially on traditional computer-based access and later adapted for mobile operating systems.

Types of Government Apps

There are two broad types of government apps, according to their use: enterprise-focused apps and citizen-oriented apps.

- **Enterprise-focused apps** are mainly for internal use. They are accessible only to a public organization’s employees and operate within a secure firewall established by that organization. The apps could be restricted to employer-provided devices; a bring-your-own-device (BYOD) approach requires compatibility with both employer-provided and employee-owned devices. Enterprise-focused apps could potentially transform an organization through revised processes and procedures, especially in an agency’s field operations.
- **Citizen-oriented apps** are intended for external use. They are accessible to anyone who seeks to use public services. Hence, these apps need to be compatible across different devices citizens commonly use. These apps facilitate “anytime, anywhere” citizen engagement with government organizations (e.g., through crowdsourcing and social media) for innovative service delivery and improved decision-making processes.

1. <https://analytics.usa.gov/>, accessed on July 31, 2015

The use of mobile devices in any fashion inherently provides growth opportunities for a range of public sector functions, including the development of new mechanisms for delivering services. With their unique ability to capitalize on the strengths of mobile technology, apps are the core element of mobile government. The transformational power of mobile lies in taking electronic processes into the field. In the future, mobile access could replace paper-based processes that e-government initiatives could not make electronic, such as fieldwork activities conducted outside the office. Indeed, mobile devices hold the promise of re-engineering field processes themselves, creating a greater degree of integration between office-based and field activities.

Mobile-specific tools—such as Quick Response (QR) codes, which are two-dimensional matrix bar codes that can be read with a mobile app—provide new modes of interaction with the public. Lorenzi, et al. (2014) show that QR codes in parks facilitate park navigation, incentivize park use through gamification, increase safety for park goers, disseminate information more effectively and accurately than traditional signage, and improve feedback. The ubiquity of mobile devices has made possible volunteered geographic information (Goodchild, 2007), in which citizens act as sensors, reporting through social media networks on real-time events in their immediate vicinity (e.g., Twitter). According to Pew Research, 67 percent of smartphone owners utilize their phones to share pictures, videos, or commentary about events happening in their communities (Smith, 2015). Such information crowdsourcing enables government service providers to effectively target the contextual needs of the people and the place (e.g., in transportation management, public works).

Mobile apps also hold the promise of becoming a key part of a “smart city” ecosystem, in which delivery of city services is enabled through information and communication technologies and location-based sensors (e.g., radio-frequency identification systems) (Townsend, 2013). The smart city is characterized by the Internet of Things (IoT), in which objects are Internet-connected (machine-to-machine connections). Among many other benefits, smartphone apps and the IoT can facilitate new ways of managing city services (e.g., automated meter reading for water usage). For citizens, a smartphone can aid with navigation within a “smart city” through location-based services (Clarke, 2013).

Privacy and Security Concerns with Mobile Apps

Certain caveats must be recognized for public sector use of mobile devices and apps. Individual privacy is a major concern. For example, map and navigation apps on mobile devices collect data to provide consumers with location-based services (e.g., car companies collect location data to provide turn-by-turn directions, which could also be shared with traffic information providers). While consumers benefit from location-based services, information sharing could also compromise their individual privacy. Consumer tracking, identity theft, threats to personal safety, and surveillance are all potential problems. Adequate safeguards must be in place for privacy protection (Government Accountability Office, 2012; 2014).

Mobile security is another area of concern. Wireless Internet connections are not generally as secure as wired connections. Mobile apps give rise to the same security concerns as any other online connection. Vulnerable coding of mobile apps, lost mobile devices, and the accessing of sensitive data over insecure wireless connections could all compromise enterprise security. Mobile apps need to be thoroughly vetted and devices must be subject to appropriate enterprise security measures.

Location-Based Services

Location-based services harness real-time location information to give customized personal and neighborhood-level services. Popular location-based services include those that provide turn-by-turn navigation for drivers or locate businesses near the user. These services support the operation of other apps in multiple ways, employing Geospatial Web 2.0 platforms (e.g., ArcGIS online, Microsoft's Bing Maps, Google Maps, Nokia's Here, Mapquest, Yahoo Maps, Open Street Map) to pinpoint the user's location and provide local services. For example, FourSquare and Yelp have become popular apps to locate businesses of interest (restaurants, bars, etc.) in a neighborhood. These apps crowdsource customer reviews of quality, pricing, and other aspects of each business. They have the potential to overlay advanced technologies like augmented reality to provide additional location-specific information about the physical environment. Augmented reality combines virtual reality with real world features (e.g., overlaying a picture or video with virtual information in real time); platforms for such mobile apps include Layar, Wikitude, and Metaio. Although still evolving, augmented reality features could be useful for tourist education, infrastructure maintenance, public works projects, zoning, and other activities (Graham, Zook, and Boulton, 2013; Liao and Humphreys, 2014; Lin et al., 2014).

Location-based services offer essential features for the new sharing economy. Mobile apps are ideal for coordination within the new sphere of shared services. People living in the same geographical community can share information and services, such tips on obtaining domestic help, rides, and yard work assistance. The services are hyperlocal; consumers directly engage with each other within the neighborhood (Fowler, 2015; Botsman and Rogers, 2010; Gansky, 2010). Prime examples of the sharing economy are Uber and Lyft, platforms allowing riders and drivers to connect with each other. A person requiring a ride uses an app to make the request, which is then routed to an available Uber or Lyft driver nearby. Other location-specific, on-demand services have arisen across a range of economic activities: ordering food delivery from local restaurants (e.g., DoorDash, GrubHub, Sidecar, SpoonRocket); getting assistance with daily chores such as cleaning, handyman jobs, and shopping (e.g., Clutter, Instacart, Postmates, TaskRabbit); securing peer-to-peer car rental (e.g., Getaround); booking accommodations with independent hosts (e.g., Airbnb, Couchsurfing, Homeaway); and arranging a local experience with independent insiders (e.g., Vayable) at a destination.

Mobile Devices Help Bridge the Digital Divide

The proliferation of mobile phones is also narrowing the "digital divide" with regard to access to the Internet. Households have become increasingly mobile-dependent, using phones for both communications and Internet access. Dependence on smartphones for Internet access is especially high among minority groups. According to Pew Internet (Lopez, Gonzalez-Barrera, and Patten, 2013), about 86 percent of Hispanics and 90 percent of African Americans owned a cell phone in 2012, compared to 84 percent for whites. Smartphone penetration was 49 percent, 50 percent, and 46 percent, respectively, among the three groups. African American and Hispanic adults spend more time on apps than the average user (Nielsen, 2014b).

Smartphones have reduced the digital divide across income categories as well. Low-income groups depend on smartphones for online access at significantly higher rates than high-income groups. Nearly 60 percent of households below the poverty line were wireless-only in 2014, compared to 41 percent of households above the poverty line (Blumberg and Luke, 2015). About 13 percent of Americans from low-income households (household income below \$30,000 per year) are smartphone dependent for Internet access, compared to only one percent of those in high-income households (income above \$75,000 per year) (Smith, 2015). The greater accessibility that smartphones provide for low-income households raises the prospects for delivering social services through apps. Of course, a digital divide still exists across age groups: 77 percent of seniors own cell phones, but only 18 percent of those seniors own a smartphone. Only about 27 percent of seniors use social networking sites (Smith, 2014).

Application Programming Interface (API): A Key Ingredient of Mobile Apps

An API is a set of software codes that enables computers to exchange information between different software programs. Using an API, an organization can expose its data to any user over the Internet. A user (e.g., computer programmer) needs to obtain an API key from the organization to access the specific information. Mobile apps use APIs to access data from several organizations to provide value-added services in real time and place. Private firms benefit because the added value attracts more customers. Public agencies benefit through citizen co-production (e.g., additional services created by civic groups using the agency's data). There are three types of APIs:

- Private (organization limits the users)
- Open (organization does not restrict the users)
- Hybrid (combining elements of both private and open APIs)

Public sector APIs are generally open because the data is in the public domain. The JavaScript Object Notation (JSON) is a commonly accepted format for APIs to return data. Other formats include comma delimited (CSV) and eXtensible Markup Language (XML). APIs have become the next growth frontier for interoperability between devices and systems. There are over 14,000 APIs, according to [programmableweb.com](http://www.programmableweb.com) (<http://www.programmableweb.com/apis/directory>).

The State of Mobile Apps in Government

Mobile Apps in the Federal Government

The Obama administration's 2012 Digital Government Strategy laid out a broad plan to harness information technology in federal agencies. The strategy explicitly laid a path for adopting emerging digital technologies, including doing mobile "right" from the beginning. It stressed that high-quality digital government information and services should be available anywhere, anytime, on any device.

The Policy Framework

The federal government's digital strategy is organized around four principles:

- Create an information-centric government that focuses on open data and content. Data must be made freely available in device-agnostic ways through APIs for interoperability and openness. Decoupling data from the presentation paved the way for exploiting the capabilities of all devices to access and harness data.
- Establish a shared platform within and across agencies. Much of this task fell on the General Services Administration (GSA), which was charged with establishing a central resource for sharing solutions, source code (the "build once, use many times" model), and training across various technologies (open content management systems, APIs, etc.). The federal Chief Information Officers Council (CIOCC) and the Office of Management and Budget (OMB) assisted in the process.
- Take a customer-centric approach to presenting data. Federal agencies were required to optimize at least two existing priority customer-facing services for mobile, and expose high-value data and content of at least two existing major customer-facing systems through APIs. The customer orientation implied improving customer-facing mobile services and implementing performance and customer satisfaction measuring tools.
- Build in security and privacy upfront when adopting new technologies. The federal strategy recognized the unique challenges of the mobile world:
 - Mobile devices elevate the risk of device misplacement.
 - Wireless connectivity poses security challenges.
 - Bring-your-own devices (BYOD) may not be compliant with enterprise security systems.
 - Public open data made available must conform to federal legal privacy requirements.

The core strength of the federal digital strategy is that it presumes government data as a resource that can be leveraged to spur customer service innovation. All new federal agency systems and underlying data and content have to comply with the open data and API policy. Subsequent policies such as the Making Open and Machine Readable the New Default for Government Information (President's Executive Order of May 9, 2013) provided additional guidelines to make open data a default policy. The U.S. Digital Services Playbook, released in 2014, outlined 13 key "plays" drawn from private and public sector best practices that agencies can follow to effectively build digital services, including mobile apps.

The Governance Framework

The federal government also established a support structure within GSA for building a digital government:

- Office of Citizen Services & Innovative Technologies (OCSIT) plays a leadership role in identifying and applying new technologies.

- 18F Program is an in-house “tech startup” that serves as a consulting service internal to the government to create digital services and public-facing applications.
- Digital Government Division (digitalgov.gov) houses mobile-oriented solutions as a part of its suite of support systems, which include:
 - Content management systems -- Digital analytics programs
 - Crowdsourced mobile testing -- Mobile apps registry
 - Social media registry
 - Negotiated terms of service agreements that are federally compatible

Current Use of Apps in the Federal Government

Federal apps are catalogued on Github, an open source repository. (They were previously located in the now-defunct Federal Mobile Apps Directory under usa.gov, the federal government-wide portal.) The Github catalog lists 289 mobile apps (as of July 2015). Of the 76 federal agencies that have developed apps, 58 have developed one to four mobile apps, and 19 have developed five to 15 apps.

10 agencies had 10 or more apps listed:

- Animal and Plant Health Inspection Service
- Centers for Disease Control and Prevention
- Department of Defense
- Department of Education
- Department of Health and Human Services
- National Center for Telehealth and Technology
- National Institutes of Health
- National Aeronautics and Space Administration
- Department of Veterans Affairs
- Smithsonian Institution

Their apps cover a range of platforms, with 84 iOS-only apps, 69 mobile web apps, and 13 Android-only apps; 77 apps are developed for both iOS and Android, and 35 apps are for multiple operating systems (operating across Android, Blackberry, iOS, and Windows platforms). In addition to creating apps, federal agencies have also made progress with respect to development of APIs. About 96 agencies have API developer hubs with about 420 public APIs now operating.² However, there are 1,927 federal APIs as per data.gov, the central repository for all agency APIs. The Environmental Protection Agency accounts for about 75 percent of the APIs in the data.gov inventory.³

2. <http://18f.github.io/API-All-the-X/pages/status>, accessed on July 31, 2015.

3. http://catalog.data.gov/dataset?res_format=api, accessed on July 31, 2015.

Overall, the adoption of digital tools in general, and tools for the mobile environment in particular, remains in an infancy stage within federal agencies (GBC, 2015; Fiorenza, 2013). Many individual agency websites are still not mobile optimized. In a 2015 report, Fretwell (2015) noted that the four federal websites with the most traffic—Internal Revenue Service’s IRS.gov, National Oceanic and Atmospheric Administration’s Weather.gov, Office of Personnel Management’s USAJobs.gov, and National Park Service’s NPS.gov—were not mobile friendly. (NPS.gov has since been mobile optimized.) In a test conducted by the author on 15 federal executive departments’ domain root websites in July 2015, six did not pass the Google Mobile-Friendly test: Departments of Defense, Homeland Security, Housing and Urban Development, Transportation, Treasury, and Veterans Affairs.

About 17 percent of federal agencies have a presence in the app world and 22 percent of them have public APIs. (There are about 438 federal agencies as per the Federal Register.) According to a Government Business Council (GBC, 2015) survey of federal managers, only 23 percent of respondents indicated they use mobile apps to serve their customers. In addition, 81 percent said they have at least one digital-related skill deficit in their agency, including mobile app development. An earlier GBC (2014) study also showed slow progress toward the implementation of a digital government strategy. Federal agency officials described very limited use of apps: only about 37 percent of the respondents agreed that their agency uses mobile apps to serve external customers (i.e., citizen-oriented apps); the share fell to 30 percent for internal customers (i.e., enterprise-focused apps).

According to another survey by Fedscoop (2014), only one-third of respondents acknowledged that their agencies provide online access to high-quality digital government information on mobile devices. Agency APIs are also not of uniformly high quality (see Lane (2014) for a review of the quality of federal agency APIs). Although agencies are required to post their APIs on data.gov, there are interagency inconsistencies.

Barriers to Rapid Adoption

The top barriers to incorporating digital tools are:

- Limited or declining IT budgets
- Security and privacy concerns (GBC, 2015)

In addition, there are the following organizational barriers:

- Lack of digital skills within the agency
- Limitations of legacy systems
- Cultural resistance
- Unclear long-term vision, which impedes achievement of digital strategy goals (GBC, 2014)

Many agencies do not have the budget or staffing resources to develop enterprise mobile apps and the stores to distribute them (Fiorenza, 2013). Organizationally, a 2015 GAO study revealed a lack of centralized mobile device and service management. Of the 15 agencies having the highest-reported annual telecommunications spending, only five had a complete inventory of mobile devices and associated services; only one agency (GSA) had documented procedures for monitoring spending on mobile strategies. Despite the challenges, federal agencies are steady in their progress toward adopting new mobile technologies, thanks to a broad federal policy framework and support structure.

Mobile Apps in State Government

State governments are also increasingly adapting to the mobile environment, although progress is not as steady as it is at the federal level. About 36 of the 50 states' main portals are mobile friendly (Ziadeh, 2015). According to the National Association of State Chief Information Officers (NASCIO) survey of state CIOs in 2014, nearly 60 percent of state CIOs considered integration of mobile devices and development of apps to be essential or high priority in their strategic agenda and IT operational plans. At the same time, nearly half considered their mobile technology management to be mostly or totally fragmented (NASCIO, 2014). Troublingly, the share expressing this opinion about fragmentation had not changed since the 2012 survey (NASCIO, 2012), indicating little progress in enterprise-focused mobile management. Moreover, only 30 percent of the CIOs considered their organizations to be ready to deploy and support mobile devices and applications, although 72 percent of them said that their agencies allow BYOD (NASCIO, 2012).

All states have at least one mobile app. The NASCIO catalog shows 327 apps, of which 299 are iOS-enabled and 242 are Android-enabled. Twenty-eight states have one to five apps; 22 states have between six and 14 apps; and three states—California, Utah, and Virginia—have 15 or more apps.

State governments have created innovative apps to facilitate citizen engagement. Utah was the first state to create an app for iPhone in 2009, enabling users to check the licensure status of professionals in the state; it also created the first app for Google Glass to send transit notification on the spot (Newcombe, 2014). Arkansas launched the first government app for the Apple Watch, epitomizing personalized delivery of government services. Called Gov2Go, the app provides customized digital government information, allowing the user to set reminders and receive notifications for government transactions, such as property tax payments, vehicle registration renewals, etc. (Williams, 2015).

The most common types of citizen-oriented apps at the state level are for parks (89), traffic (60), and safety (34), which together account for 56 percent of all state government apps. The pattern reflects the results of a state CIO survey in 2012, in which nearly four in five CIOs expressed a belief that parks and traffic apps were most popular with citizens (NASCIO, 2012). The next five most common types of apps are: wellness (19), development (15), comprehensive (12), benefits (11), and legislature (10). There are also apps for state agencies (9), voting (6), taxes (5), employment (5), and the state economy (5). The "other" category encompasses a broad range of apps, including apps for businesses, licensing, and tax matters.

A few state governments have made important strides in creating and deploying public APIs. According to the federal website data.gov, there are over 3,000 state government-sponsored datasets that can be accessed through APIs. (Nearly 98 percent of the datasets are available in JSON format.⁴) These datasets, however, originate only from five states (Hawaii, Illinois, Maryland, New York, and Oregon). Most other state governments have yet to offer publicly accessible APIs. California and Utah are interesting exceptions. California offers API databases as Google Fusion tables for some demographic, healthcare, and industrial data. Utah offers three types of APIs that can be used across the Utah.gov database (search, location, and public notices).

4. http://catalog.data.gov/dataset?organization_type=State+Government&q=-aapi+api+OR++res_format+percent3Aapi, accessed on July 31, 2015.

Mobile Apps in Local Government

The top 10 most populous cities in the country—New York City, Los Angeles, Chicago, Houston, Philadelphia, Phoenix, San Antonio, San Diego, Dallas, and San Jose—have at least one mobile app, with an average of about four apps. The author’s mobile friendliness test in July 2015 (using the Google tool) showed that the root domains of New York City, Los Angeles, Houston, Phoenix, and San Jose are mobile optimized; the rest are not. Similarly, the top 10 most populated counties—Los Angeles County, CA; Cook County, IL; San Diego County, CA; Riverside County, CA; Dallas County, TX; Harris County, TX; Maricopa County, AZ; Miami-Dade County, FL; Orange County, CA; and San Bernardino County, CA—have at least one app each. The mobile-friendliness test showed that the websites of the first five counties listed are mobile optimized.

A recent survey of local governments by Vision Internet (2015) also shows a similar finding: nearly half of respondents said that their organization provides mobile-friendly citizen services. Yet only about one-third of the respondents rated their organizations’ websites as effective. Thus, there is much room for local governments to improve their mobile-friendliness. Local government officials do recognize the significance of adapting to the mobile world, however. According to the Vision Internet (2015) survey, local government respondents considered the top three advantages of mobile device use to be:

- Citizen convenience
- Expanded communications outreach
- Savings on time and human resources

At the same time, they indicated budgetary, security, and usability challenges in the use of mobile apps as a tool for delivering government services.

Mobile apps at the local level are principally citizen-oriented; enterprise-focused apps for internal employee use are in the emergent phase. County and city apps are commonly related to transit and requests for public services. Transit apps provide information about bus and train schedules in real time. Public service request apps allow citizens to initiate and follow up on a request (e.g., reporting graffiti, street repair issues, or broken street-lights). These apps are hyperlocal in nature, aimed toward improving the service experiences of citizens. Several cities and counties also provide tourism and recreational information through apps, detailing the leisure and entertainment activities that visitors can enjoy. Cities and counties are closer to the communities they serve than state or federal agencies, and must be responsive to those communities’ immediate needs. Providing location-based services with information specific to the mobile user’s context is essential.

Several cities have been at the forefront of the open data movement. Boston, Chicago, Houston, New York, Philadelphia, Portland, San Francisco, and Washington, D.C. have all made their data publicly available. Following the lead of the federal and state governments, some cities and counties provide APIs for accessing these public datasets online. According to data.gov, there are over 3,085 datasets that can be accessed through these APIs. (Nearly 88 percent of the datasets are in JSON format.⁵) Most of these datasets, however, originate from only five cities (Chicago, Los Angeles, New York, San Francisco, and Seattle) and three counties (Cook County, IL; Montgomery County, MD; and King County, WA).

5. [http://catalog.data.gov/dataset?organization_type=X+Government&q=-aapi+api+OR++res_format percent3Aapi](http://catalog.data.gov/dataset?organization_type=X+Government&q=-aapi+api+OR++res_format+percent3Aapi) (where X is City or County), accessed on July 31, 2015.

Enterprise-Focused Apps

Enterprise-focused apps are developed to promote efficient and effective achievement of an organizational mission. They can streamline existing practices and have the potential to transform internal administrative procedures. The apps operate securely within the organization's firewall, as they must to in order to meet the enterprise's security standards. While enterprise-focused apps could operate across a range of functions, their most significant current use lies in streamlining internal field operations. Smartphones and tablets can be used off site, interacting with the organization's database systems instantaneously, enabling front-line workers to obtain and report information in real time directly from the field. First responders (firefighters and other emergency workers), foster care caseworkers, law enforcement officials, and field inspectors (planning and zoning, health, etc.) all benefit from enterprise-focused apps.

Enterprise-Focused Apps in the Federal Government

Customized, agency-developed, enterprise-focused apps for internal organizational use are in their nascent stages of adoption among federal agencies. The Department of Agriculture, NASA, the State Department, and the GSA have been among the early government leaders in the implementation and exploitation of enterprise-focused apps.

Fieldwork Apps at the Department of Agriculture

One of the earliest enterprise-focused uses of mobile devices in the federal government was the Computer Aided Personal Interview (CAPI) solution implemented in 2012 by the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS). Although not a mobile app, CAPI illustrates the use of tablets for fieldwork. NASS, which compiles agricultural data from all states, employs thousands of field enumerators to conduct annual surveys. Tablets ease the data collection process, as enumerators do not have to carry paper and later manually upload data. The agency-provided tablets securely upload data to the NASS's Electronic Data Reporting System; the data is available for review within a few hours (Kleweno and Hird, 2012). The mobile use of CAPI increased fieldwork efficiency while maintaining a high level of data quality and security.

Productivity, Utility, and Reference Apps at the National Aeronautical and Space Agency (NASA)

NASA is a leader in the development of enterprise-focused apps (as well as citizen-oriented apps). The Center for Internal Mobile Applications (CIMA), an in-house mobile application management system, manages the apps@NASA app store. The store hosts internal mobile apps and NASA data for use on both agency-issued devices and personal devices. The 20 internal apps in the store are enterprise-focused, comprising:

- **Productivity apps** that allow mobile, collaborative working (e.g., ExplorNet) and conferencing (e.g., Extended Voice System)
- **Utility apps** that facilitate teleworking (e.g., WebTADS) and remote job monitoring (e.g., myNAS)
- **Reference apps** that include emergency procedures handbooks, human resource policies, NASA employees' contact information, buildings on campus, etc.

Food Inspection Apps at the Food and Drug Administration (FDA)

The Food and Drug Administration's Field Investigator Tool with Mapping (FIT-MAP) is an exemplary enterprise mobile app that enhances field investigators' efficiency. Investigators can directly report on agricultural products from the field. The app is aimed toward reducing the occurrence of food-borne illnesses (Cheeseman and Trujillo, 2014). The Food Safety Modernization Act of 2011 mandated the creation of a proactive early warning system for preventing food-borne diseases. Recent episodes had demonstrated the

need for improved methods to contain outbreaks: the 2006 E. Coli outbreak due to spinach contamination, the 2011 *Listeria monocytogenes* outbreak due to cantaloupe contamination, and the 2013 *Cyclospora cayeta-nensis* outbreak due to salad mix/cilantro contamination.

FIT-MAP allows FDA inspectors to report directly from a farm through Personal Identification Verification (PIV)-enabled Windows mobile devices. Inspectors can upload photos, site documents, and geo-code data about the farm's product (Otto, 2014). The tool can be utilized for surveys, inspection, and/or tracking of any FDA regulatory investigation information. The app enables the FDA to monitor food products from across the country in real time, and thus supports predictive analytics for proactive interventions across the agency to contain any occurrence of food-borne diseases. The app received the Best Business Investment Award in the 2015 Mobile Application Fair hosted by the American Council for Technology and Industry Advisory Council (ACT-IAC).⁶ FIT-MAP has advanced through the pilot test phase and is currently under evaluation by the agency as a field inspection tool.

Fleet Management Apps at the State Department

The enterprise-focused apps for fleet management used by the U.S. Department of State (e.g., Mobile Driver) benefit drivers and fleet managers alike (Ziadeh, 2014), demonstrating how effectively apps can be used to manage mobile assets in real time. Apps such as the Integrated Logistics Management System (ILMS), which tracks the State Department's 14,000 vehicles spread over 176 countries, allow flexible use of the department's fleet. Employees can use the Mobile Driver app to record trip information, review assigned trips, and manage reassignments and transfers in real time, with no need for a clipboard or additional paperwork. In addition to improving fleet management data quality, the app allows consulate personnel to rate their satisfaction and digitally sign for deliveries.

Fleet Management Apps at the General Services Administration (GSA)

Similar to State Department apps, the GSA's FMS2GO app extends the agency's Fleet Management System (FMS) capacity, making possible the management of over 200,000 vehicles in real time. FMS2GO connects with the FMS database through an API. The app aids drivers in managing and recording their inventory on site and at delivery locations, thus improving supply-chain management. The mobile device's camera and microphone enable barcode scanning and voice recognition. All communications through the mobile app are secured via secure socket layer (SSL) connections.

Enterprise-Focused Apps in State and Local Government

Enterprise-focused apps are still emerging among state and local government agencies as well. Routine human resource functions such as electronic approvals provide opportunities for mobile optimization. Employees can use informational apps in real time on location. Informational apps include searchable directories, digital operating procedures manuals, and other instantly accessible content management systems. Such content is typically already accessible online, but systems need to be optimized for mobile devices.

The City of Los Angeles's InsideLA provides a good example of an enterprise-focused mobile app. Accessible only to city employees via a secure login system, the app features an employee directory (CityFone), an IT ticketing system to request and administer IT issues, and connectivity with other internal web apps.

The transformational potential of mobile devices lies in the re-engineering of field processes, centered on a more complete integration of the efforts of front-line staff and office personnel. Mobile asset and employee management tools provide good opportunities in this regard. The typical limitation is lack of availability of

6. <https://actiac.org/custom-links/14853/69677/70998>

broadband network connections in the field, which can be overcome by an asynchronous connection (i.e., the app uploads data whenever a broadband connection is available).

Field case management, road and rail infrastructure maintenance, vehicular fleet management, inventory control, and supply chain management are all areas that have potential efficiency gains with mobile use. The Pennsylvania Department of Transportation's (PennDOT) Posted and Bonded Road (PBR) mobile application provides an illustration. Regular surveys and audits of the posted and bonded roads are required for timely repair and maintenance. The mobile system reduced field workers' administrative duties by eliminating the need for manual, paper-based reports. Data is uploaded and available in real time over wireless broadband. (If a wireless connection is not available, the data is synchronized with the PennDot database when a connection is obtained). The PBR app also allows the user to record and upload photos of road conditions. Finally, by reducing intervening human errors, the electronic process increased survey data quality.

The Road Ahead for Enterprise-Focused Apps

Government Needs to Prioritize Enterprise-Focused Apps

Enterprise-focused apps centered on internal organizational process and productivity improvements are currently underdeveloped, yet show great potential. Enterprise-focused apps are still in the nascent stages of growth in all agencies across all levels of government, yet they can greatly improve agencies' internal operations or even outright transform them. Most clearly, opportunities abound to develop enterprise-focused apps to streamline field activities through the provision of location-based services in real time.

Many organizations have already begun to use cloud-based mobile solutions for communications tasks such as e-mail, file sharing, and other daily tasks. Enterprise-focused apps are aimed toward enhancing performance of organizational tasks and promoting collaboration in pursuit of productivity improvements, primarily by serving as an interface that allows access to the organization's proprietary (and secure) data and content information from any location. Enterprise-focused apps are a lucrative growth industry in the private sector as well, as businesses are increasingly adopting them for productivity gains, especially among the sales force (Columbus, 2015; Kerschberg, 2015)

Enterprise-focused apps could enhance public sector organizational productivity in several ways:

- Enterprise-focused apps can aid in the management of mobile assets. For transit agencies, apps such as the Department of State and GSA apps discussed above can assist in managing the vehicular fleet, facilitating deployment and routing of vehicles in real time with greater flexibility. In addition, remote sensor technologies to evaluate vehicle condition could provide cost savings for fleet repair and maintenance.
- Enterprise-focused apps can assist in increasing employees' productivity. The apps allow employees to work from anywhere, anytime, behind secure firewalls. Routine and simple human resource tasks that require cursory examination (e.g., some of the approval processes in payroll and benefits transactions) are well suited to execution on mobile devices.
- Enterprise-focused apps are crucial for field workers to reduce their administrative onus (as PennDOT's PBR app has done). In the past, employees (e.g., case management workers, law enforcement officers, and surveyors) had to return to their home offices to file field reports on their activities. Enterprise-focused apps allow employees to upload data and reports directly from the field, greatly reducing time spent on back-office work. Even if a broadband network connection is not available in the field to enable such direct filings, well-designed apps synchronize field data once a connection is obtained. Such direct filing not only increases efficiency, but also improves data integrity and quality.
- Enterprise-focused apps provide opportunities for collaboration and networking between different field offices of a public agency, since employees working on the same issue at different branches use the same app. The app can assist employees in getting information out to the field in real time, which can be crucial,

especially in emergency management and law enforcement.

Enterprise-focused apps should be role-based to address user needs and task-oriented toward a specific issue or set of issues. These apps should be native (i.e., installed on the user's mobile device) because employees will use them to conduct their daily tasks. Development of apps should proceed with the understanding that enabling staff to work offline introduces security vulnerabilities that must be addressed. Commercial off-the-shelf solutions may be available for addressing a general task, whereas custom-made apps are needed to address an organization's specific needs.

Because enterprise-focused apps still represent uncharted territory for many public organizations, their development requires new approaches. The agile method is a well-regarded model (Kyte, Norton, and Wilson, 2014), emphasizing a small team-based approach with incremental steps and multiple iterations, with high value placed on the user interfaces and interactivity of the apps. Front-line workers should ideally be involved in app design and development. End users' early involvement is critical for an app to be user-friendly and helpful in solving problems. Hackathons, which are used for developing customer apps, typically entail teams of software developers and designers competitively engaged in app creation over short time periods. Internal hackathons with teams consisting of software developers and operational staff could promote the creation of enterprise-focused apps customized to the organization's tasks and mission. Organizational leaders can facilitate productive collaboration by providing a supportive environment for a hackathon event (Altringer, 2013).

Government Organizations Need to Develop Policies for Enterprise-Focused Apps and App Management

As discussed previously, security and privacy are the topmost concerns of agency officials when dealing with mobile devices. Mobile devices pose security risks for several reasons.

Agencies often allow a BYOD plan, which is convenient for employees but may not meet enterprise security standards. If any device is lost, the privacy of the agency's records could be compromised. Mobile wireless systems could also be susceptible to security breaches if security protocols are not followed. An enterprise mobile device and app management strategy is a key requirement for ensuring organizational security and privacy of records. At the federal level, the Federal Risk and Authorization Management Program (FedRAMP) provides a central, standardized approach to security assessment, access authorization, and monitoring of devices. However, federal departments and agencies independently manage their employees' devices and apps. As a GAO (2015) report showed, agencies lack centralized mobile device and service management. Agencies at the state and local government levels also exhibit a fragmented approach to mobile device and app management.

Finding and downloading apps is another challenge for government users. The iOS App Store and Google Play are the two major app gateways; most apps are developed for iOS and/or Android devices. Commercial app gateways have their own policies regarding hosting a government-sponsored app. The iOS App Store has more stringent requirements than Android for approving apps. Apps developed by an agency need to be hosted in an app store in order for employees to be able to download and install them. (Mobile devices are distinct from desktop and laptop computers in this respect. Users cannot install applications directly; apps must be downloaded from the appropriate store.) With the large number of apps available, locating the best enterprise-focused apps becomes a challenge.

Using an enterprise approach to mobile device and app management (MDAM) addresses the challenges of app security and discovery. With an MDAM system, all devices are brought under one management umbrella, ensuring the security of devices and the privacy of agency data. The system can also host agency apps, making it easier for employees to find and acquire them, with the reassurance that all the apps meet enterprise security standards. There are many commercial MDAM vendors that provide such solutions.

Citizen-Oriented Apps

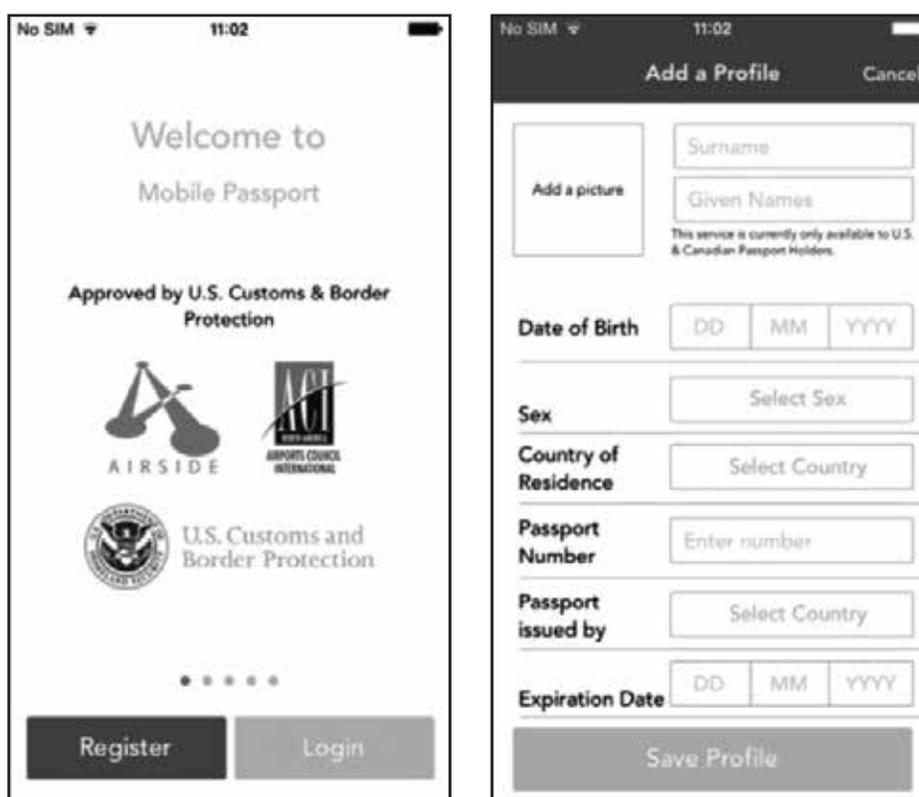
Many government organizations use citizen-oriented apps to foster real-time public engagement for both service and decision-making process innovation. Often, citizen-oriented apps provide real-time information that serves an immediate purpose in a specific location (e.g., a transit app to provide information on bus and train schedules). Apps typically draw on information available through the public agency's data sources; government data therefore plays a crucial role in enhancing citizen services. These apps are often co-produced in collaboration with citizen groups and civic organizations.

Citizen-Oriented Apps in the Federal Government

Citizen-oriented apps are more prevalent than enterprise-focused apps in the federal government. As a result of the 2012 Digital Strategy, most federal agencies have at least one citizen-oriented app. Five distinct categories of citizen-oriented federal apps can be identified:

- **Information and news services.** The first type of citizen-oriented app shares agency news or provides information based on agency data. The White House app, for example, provides live video streaming of White House events with the president, featured videos and photos, and the latest news from the White House blog and newsroom. The Department of Commerce's BusinessUSA app consolidates the U.S. federal government's business information and resources for small businesses. The data-rich Census Bureau offers three apps that utilize census data:
 - The dwellr app provides neighborhood-level statistics to help individuals explore where they want to live, using the Census's American Community Survey.
 - America's Economy provides real-time updates for 20 key economic indicators from the U.S. Census Bureau, Bureau of Labor Statistics, and Bureau of Economic Analysis.
 - The Census Pop Quiz app tests knowledge about the states, drawing on the Census's American Community Survey.
- **Client services.** The second type of citizen-oriented app provides client services on the go. The IRS2go app from the Internal Revenue Service enables individuals to check their refund status, find free tax preparation assistance, and sign up for helpful tax tips. The GSA's per diem app allows users to verify per diem amounts for different locations. Many federal agencies also provide information about client services regulated by that agency. Examples include the Federal Motor Carrier Safety Administration's QCMobile (which provides safety performance information for all commercial motor carriers) and SaferBus (which provides safety performance information for motor coach and bus companies). The Transportation Security Agency's myTSA app provides real-time operating statuses for U.S. airports.
- **Crowdsourcing.** The third type of citizen-oriented app is a crowdsourcing app, which is used to obtain volunteered information from users. Examples include:
 - The myTSA app allows passengers to crowdsource the wait time at airport security gates, helping other passengers to plan their airport arrival times.
 - The Department of Energy's Lantern Live app allows people to crowdsource information on gas fueling stations during an emergency, which can be used by others to locate open stations.
 - The Federal Communications Commission's (FCC's) Speed Test app measures the broadband speed of communications networks, automatically uploading the information to the FCC for evaluation of the country's broadband performance.
 - NOAA's apps, which empower citizens to become scientists. The National GeoPhysical Data Center CrowdMag app records and uploads background magnetic field data from different locations so that NOAA can track Earth's changing magnetic fields. The Meteorological Phenomena Identification Near the Ground (mPING) app allows people to submit weather observations to the National Severe Storms Laboratory database. Citizens can report the location of dead or stranded sea creatures via the Dolphin and Whale 911 app. Crowdsourcing thus generates information the agency could not have gathered on its own.

The Customs and Border Patrol's Mobile Passport App



The Customs and Border Patrol's Mobile Passport app is an exemplary app that benefits users by offering shorter wait times, and benefits the agency by providing efficiency gains due to a streamlined process and lower operational costs.

The agency launched its Mobile Passport app to streamline the traveler inspection process by allowing travelers to submit passport information electronically with a smartphone. Using the app, qualified travelers create a profile with their passport information (name, gender, date of birth, country of citizenship, etc.). Travelers then complete the declaration form by selecting the arrival airport and airline, taking a self-picture, and answering the customs declaration questions. Once travelers submit the declaration form, they get an electronic receipt with an encrypted QR code to show to airport agents (along with their passports) upon arrival.

The app supports CBP's mission to process travelers safely and efficiently while enhancing security and reducing operational costs; at the same time, it improves customer service by reducing wait times. It is also a mobile-centric solution that embodies the principle of "anytime, anywhere, on-demand" government. The project was piloted at Atlanta's Jackson airport in 2014, and then expanded to Miami, and Seattle, and Chicago's O'Hare airport (Sampson, 2015). The app's success has prompted the CBP to further expand the program to 20 airports by 2016 (CBP, 2015).

- **Health and Safety Information.** The fourth type of citizen-oriented app provides health and safety information. The Federal Emergency Management Agency (FEMA), the Food and Drug Administration (FDA), and the Department of Health and Human Services (HHS), have developed apps to provide information on disaster assistance, drug shortages, and HIV/AIDS, respectively. The FEMA app, for example, gives customized emergency safety information, alerts from the National Weather Service, and general safety tips. Citizens can also use the Disaster Reporter feature of the app to report damage and recovery efforts by uploading and sharing photos, and the Disaster Assistance feature to apply for assistance.

- **Educational Services.** Drawing on the popularity of game apps, this fifth type of citizen-oriented app often features fun approaches to exploring aspects of a theme, with an aim toward gamification. This category includes apps developed by NASA—Comet Quest; the Library of Congress—Aesop for Children; the National Archives and Records Administration—DocsTeach; and the Smithsonian Institution—Access American Stories.

Citizen-Oriented Apps in State and Local Government

As is the case in the federal government, citizen-oriented apps are more prominent than enterprise-focused apps in state and local governments. The citizen-oriented apps at these levels of government can be classified into four categories:

- Apps providing information on parks, recreation, and leisure activities
- Traffic and transit information apps
- Public engagement apps
- Third-party apps for government

Apps Providing Information on Parks, Recreation, and Leisure Activities

These apps are mainly oriented toward tourists, providing directions, a schedule of activities, and information on amenities and the historical features of a place. Almost every state has an app providing such information about state parks. The ParksByNature Network, for example, has developed official park guides for several states.

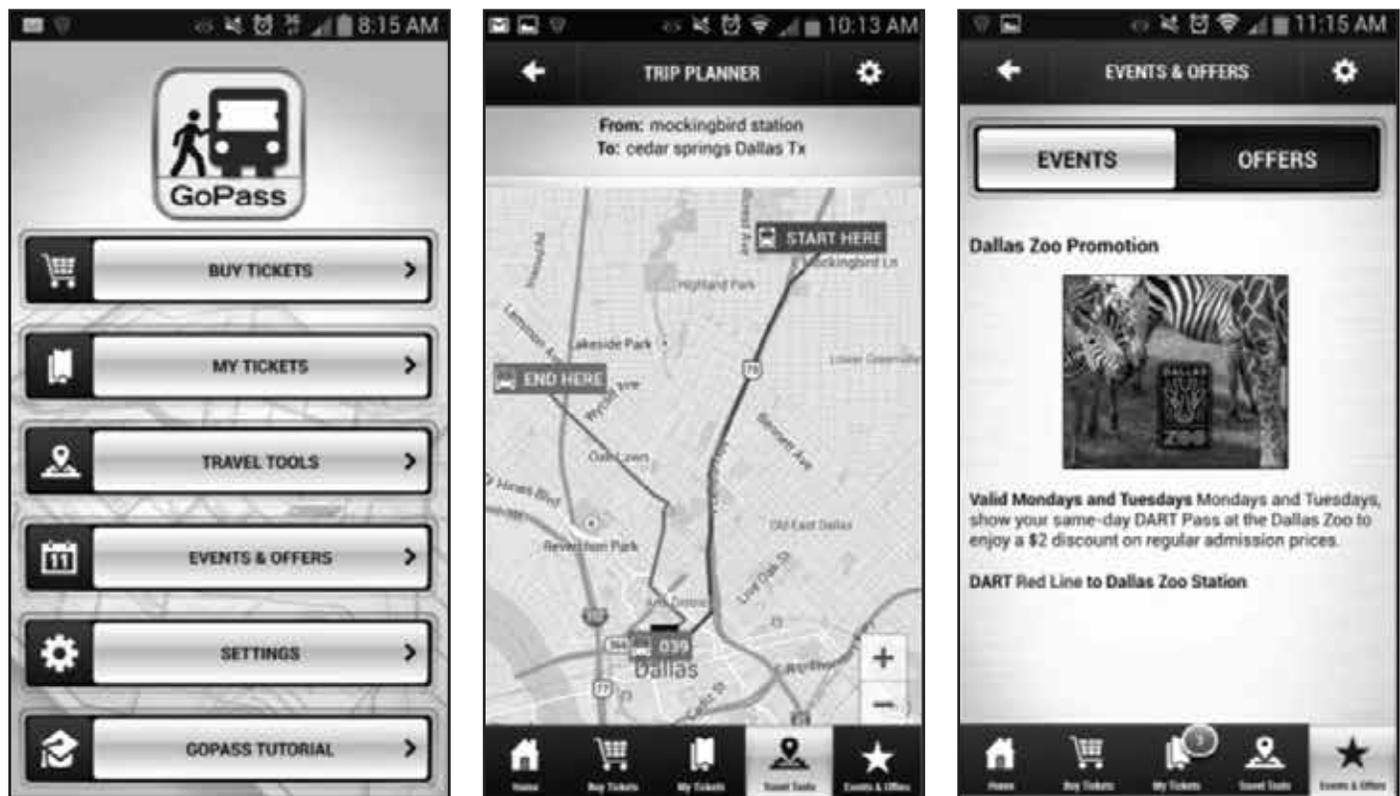
Local governments also provide citizen-oriented apps to guide tourists (e.g., San Antonio Official Travel Guide), promote active recreation (e.g., Utah County Trail Guide, Summit County's To the Trails), and provide information on public art and spaces (e.g., Portland's Public Art PDX). Exceptional apps, however, combine QR codes and/or augmented reality to enhance a visitor's experience of a place. The app for Camp Lawton, Georgia, is exemplary in this respect. Visitors can scan QR codes of exhibits using a smartphone or tablet and receive additional information, including multimedia presentations, interactive tables, and external links. The QR codes can also serve as a waypoint system for park navigation and as the basis for making a game out of historical sites (Lorenzi et al., 2014). The app also employs augmented reality, a technique by which virtual reality can be overlaid onto the visual display generated by a smartphone's camera. Visitors are thus able to experience a 3D reconstruction of the Camp Lawton prison stockade, situated precisely in its historic real-world location (Georgia Department of Natural Resources, 2014).

Traffic and Transit Information Apps

Traffic and transit information apps are commonly developed by state and local agencies. State-level departments of transportation (DOTs) are at the vanguard of informational app development for state and other highways (Transit Cooperative Research Program, 2011). State DOTs have traditionally provided traffic information through 511 systems; hence, they already have all the data that users seek readily available. Indeed, in many states, traffic apps are called 511 apps (e.g., Iowa 511, Kentucky 511, Minnesota 511). Many county and city governments offer similar transit- and traffic-oriented apps.

An innovative approach for public transit agencies is to use mobile apps as a means of providing boarding tickets. The mobile approach increases a transit agency's efficiency by reducing the need to install and maintain ticket booths for the sale of paper tickets; it also increases flexibility for the passenger to acquire and use tickets on demand.

Mobile Transit Tickets



Dallas-area transit agencies collaborated to introduce the mobile transit ticketing system in 2013. Riders use GoPass, a mobile app, for commuting across three transit agencies: Dallas Area Rapid Transit, the Fort Worth Transportation Authority, and the Denton County Transportation Authority (Rich, 2013). After registering with their cellphone numbers and credit card information, commuters purchase tickets with the app. They then activate a pass from the mobile digital wallet before boarding, which can be done without an Internet connection.

The pass's color code indicates an active or expired status to fare inspectors. A countdown timer ensures the time validity of the ticket. The app also offers additional location-based services for planning trips, including use of Google Transit to check real-time bus and train arrivals. The app is convenient for travelers because they can eschew waiting in line; they buy tickets at their convenience and use them on demand. At the same time, the app improves transit agency efficiency by reducing the need to maintain expansive ticket machine booths.

Recently, the GoPass app was integrated with Uber, so travelers can arrange motorized transport for their first or last mile on demand (Wilonsky, 2015). Mobile transit ticketing apps provide an interesting illustration of mobile use that benefits both the customer and the public agency. App-based ticketing systems have now been adopted by transit agencies across the U.S., including the Massachusetts Bay Transit Authority, Trimet (which serves Portland and surrounding areas), the Los Angeles Department of Transportation (LADOT), the San Diego Metropolitan Transit System, and New York City's Metropolitan Transit Authority, among others.

Often, transit apps are provided by third-party vendors, building on a city government's transit data feeds and APIs (e.g., Chicago's TransitGenie). Transit feeds are in a standard format—General Transit Feed Specification (GTFS)—used by Google Transit. This standardization has enabled third-party developers to create a customized app for any locality. Portland's transit agency (TriMet), for example, showcases 56 apps that were developed using the agency's GTFS data. Additional creative endeavors include apps for custom travel such as Boston's Where's My School Bus, which helps parents track their children's school bus in real time, and parking apps that enable users to find the nearest parking facility and pay for parking facility use.

Public Engagement Apps

Both public agencies and commercial vendors have developed public engagement apps. The most common apps in this category are related to 311, a centralized number through which local governments field non-emergency service requests (e.g., fixing a pothole or a streetlight). Over 300 local governments have 311 call centers. In large cities, they serve as crucial one-stop service access points: New York City had over 28 million customer contacts through 311 in 2014. Service requests can now be made via mobile apps, social media, online chats, phone calls, e-mails, text messages, and in-person visits. The use of mobile apps has particularly grown since the emergence of Open 311, a standardized protocol for customer service request data. Over 30 cities have adopted an Open 311 service; the protocol has given rise to a surge in the creation of "311 mobile apps" by third-party commercial vendors, including SeeClickFix,

311 Citizen-Oriented Apps for Public Engagement and Citizen Relationship Management

Apps for reporting non-emergency issues:

- *Accela's PublicStuff*
- *CitySourced*
- *Connected Bits*
- *Fix311*
- *Qscend*
- *SeeClickFix*

Apps for other aspects of public engagement and citizen relationship management include:

- *CityVoice*, a location-based call-in system for collecting, sharing, and understanding community feedback
- *Citizeninvestor*, a digital platform centered on engaging citizens through the use of a crowdfunding approach to supporting government projects
- *Streetmix*, which allows citizens to mock-up future plans for areas and share them with city officials and planners
- *Textizen* and *YouTown*, which are platforms for civic dialogue and customer relationship management

PublicStuff, and CitySourced, all of which could be used for service requests in any municipality. Contractual arrangements with cities that lack 311 centers enable private vendors to bring online service request functionality to such locations (e.g., SeeClickFix serves 290 cities, Accela's PublicStuff about 200, CitySourced about 100 cities).

Third-Party Civic Apps for Government

Third-party apps are not directly produced by public agencies; rather, they are co-produced in cooperation with citizen groups, nonprofit organizations, or commercial enterprises. Civic apps are location-based services that are useful for civic engagement and idea generation at the local level. The availability of open data in some communities has spurred civic innovation by encouraging citizens and nonprofit groups to develop leading-edge mobile solutions. Several cities, such as Portland, New York, and Washington, D.C., have sponsored civic competitions premised on the use of open data and APIs, sparking the generation of a wide range of innovative apps. Local government agencies have also held public hackathons in which designers, data specialists, programmers, and project managers collaboratively work on specific local issues, drawing upon agency data. Hackathons are also supported by social enterprises such as Code for America, MindMixer (now mySidewalk), and Open Knowledge Foundation. Code for America Brigades are local volunteer groups that bring together community members to solve problems using technology. Although they create meaningful flashpoints of creativity, hackathons have significant limitations. The solutions generated may not be relevant or useful to the local government over the long term, and are often not sustainable without continued support from civic groups (Gordon-McKeon, 2013; Schrier, 2013). Code for America has catalogued about 30 apps for local services and civic engagement.

Local governments could also take advantage of commercial location-based services to provide innovative value-added services to citizens. San Francisco and New York began collaborating with Yelp in 2012 to put the safety inspection ratings of local restaurants on the Yelp mobile platform. Los Angeles, Raleigh, and Evanston, Illinois have since followed suit (Hickey, 2015). A collaboration among these communities resulted in Local Inspector Value-Entry Specification (LIVES), an open data standard for municipalities to publish restaurant inspection information. The data standardization has helped spur the development of additional apps for food safety in public eating places based on inspection data. The HDScores app provides restaurant scores in 27 states; What the Health grades restaurants in 10 states (Shueh, 2015).

Some social networking groups are geographically organized, which could benefit local communities and their public agencies. Nextdoor, for example, is an online platform that provides services to 54,000 geographically defined neighborhoods. Only verified residents within specified neighborhood boundaries can view Nextdoor postings. Over 750 local government agencies, such as police and public works departments, provide community-specific information through these online neighborhood services. Location-based social media engagement also empowers citizens to provide agencies with critical information for law enforcement and public safety purposes (Crump, 2011; Grimmelikhuijsen and Meijer, 2015).

The Road Ahead for Citizen-Oriented Apps

Increased Support of Citizen-Oriented Apps to Enhance Public Services

Government agencies should assist in developing and supporting citizen-oriented apps that enhance the public services they provide. Mobile access to services provides an added convenience to citizens. Providing a service through multiple channels has the potential to reduce an agency's administrative burdens and boost efficiency, as online transactions can result in cost savings. With mobile devices reducing the digital divide, smartphones can potentially be used to better serve previously underserved socio-economic groups. The dependence of minority and low-income individuals on smartphones for Internet access indicates the potential value of smartphone use for e-benefits, healthcare, social security, and other services. With their ever-deepening penetration into the market, smartphones could be effective tools for real-time public engagement to inform government policy- and decision-making processes. Crowdsourcing can assist in the gathering of valuable information that would otherwise require expenditure of vast resources to obtain.

As we have shown in this report, many state and local governments are using smartphone apps to provide innovative services. Transit agency apps serve as an alternative to issuing paper tickets to commuters. Likewise, traditional licensing could be supplanted by an app-based approach. Utah launched the Utah Hunting and Fishing app in 2014, which allows citizens to purchase, download, store, and display hunting and fishing licenses on a mobile device. The app has been downloaded by nearly one-third of all licensees in the state. With the arrival of digital wallets such as Apple Pay and Google Wallet, mobile phones are evolving into a personal credential. States including Alabama, Delaware, California, and Iowa are in the early stages of implementing smartphone use for personal identification (Marshall, 2015; Whitney, 2015).

Increased Embedded Approach for Citizen-Oriented Apps

When providing citizen-oriented services via apps, public agencies should take an embedded, contextually aware approach. Typically, citizens do not use government apps to the same extent as their personal apps for social networks and games. But when they do need a government service, they need ready access. In the embedded approach, a public agency embeds its service within, or links its service to, other platforms and apps citizens are already using. The emphasis is on the service, not the organization that provides it. For example, Dallas's DART transit system and Uber have collaborated to provide access to Uber reservations in conjunction with DART's GoPass app.

Possibilities abound for public agencies to collaborate with other private and public organizations to embed their services synergistically. Zillow, for example, offers a popular real estate app for house hunters. While searching for their new homes, however, citizens often look for additional information, such as local school quality, crime rate, demographics, and amenities. Public agencies can embed such data within popular apps in order to deliver value-added information on demand.

Increased Availability of APIs for Third-Party Citizen-Oriented Apps

Because APIs advance the concept of app layering to provide information in context, creating APIs is a crucial step toward fully opening the frontier of mobile app development. As standard protocols for accessing data from an external source, APIs enable apps to dynamically query public agency datasets. To allow such functionality, a public agency must assign a key for the app to access the data. Although public agencies have begun stepping up to provide their own APIs in conjunction with open data initiatives, there is still significant growth potential in this realm. Federal agencies are required to provide access to their data through APIs; state and local agencies would do well to follow a similar mandate. APIs offer an unobtrusive, efficient way for public agencies to provide both data and services.

Among many other benefits, making APIs available for agency data would help leverage citizen co-production of civic apps, a key component in the building of value-added services. Innovation in mobile apps has been heavily driven by the harnessing of creative ideas made possible by citizen co-production. Public agencies have developed citizen-oriented apps through challenge competitions, hackathons, and other crowdsourcing or collaborative mechanisms.

The U.S. Census Bureau's City Software Development Kit (CitySDK) is a good illustration of how APIs provide value-added solutions. The CitySDK Data Solutions Challenge (conducted during the time of this writing, June 6 to August 3, 2015) was an open civic challenge to create an app prototype using the Census Bureau's APIs to improve local city conditions (e.g., economy, environment, housing, education, social justice). CitySDK featured guides for using the data and links to a gallery of datasets in addition to that of the Census Bureau. The Bureau also held a Hack for Diversity and Social Justice hackathon in Baltimore, hosted on Github, an open source platform. Over 20 teams participated to provide creative solutions to local issues. Nonprofit organizations such as Code for America and the Sunlight Foundation have supported similar hackathons that have given rise to apps for government transparency (e.g., following government spending, tracking bills), economic development, environmental issues, and so on.

Mobile App Design Considerations

Three Types of App Design

In developing mobile apps, the type of device (wearable, mobile phone, or tablet) is a primary consideration. App security, a fundamental concern for public agencies, varies with the device used. The matter is further complicated by BYOD arrangements, which allow government employees to use their personal devices for work purposes. Enterprise-level security is required, at least for any enterprise-focused apps installed on such devices. The type of device employed also affects user interactivity. Unlike a smartphone's mobile moments, wearables like watches are characterized by even briefer glanceable moments (Schadler, 2015).

Smaller devices offer greater portability, but have limited screen space for presentation and user interaction. Wearables are appropriate for personalized user-based needs, such as information updates, biometric readings, and location-based activities in real time, all of which can be adapted based on the user's role and goal. Smartphones are used for a range of communications and social networking activities, including location-based services. Both smartphones and tablets have evolved into useful tools for field-based activities (e.g., law and code enforcement). Intermediate devices such as "phablets" merge the functionalities of smartphones and tablets.

Apps must therefore be customized to the specific features of the various devices. Because operating systems vary among mobile devices, different versions of an app need to be developed for each system. Interoperability of apps across different devices and platforms poses a significant challenge. Customization of apps for each device increases development costs; lack of such customization can result in inconsistent user experiences across devices. The problem is allayed to a great extent by responsive web design, by which the same content can be adjusted for display and interaction across different devices. Technologically, such responsiveness is enabled through the use of HTML5 (a version of hypertext markup language), in combination with Cascading Style Sheets (a formatting style for presentation) and JavaScript (executable programs within HTML files for interactivity).

From a software perspective, three types of apps have evolved: native, web, and hybrid (Crowe, 2013; Heitkötter, Hanschke, and Majchrzak, 2013).

- **Native apps** are device-specific; they are downloaded onto the device and thus take maximum advantage of the device's hardware features (e.g., camera). Native apps are hosted on one of the app gateways for download. They are technically complex, because they must be customized for each different mobile operating system. Because these apps reside on the device, many of them can function offline.
- **Web apps** are websites using responsive web design (i.e., HTML5) features, so that the same app can be optimized and accessed from different types of devices (e.g., the user interface will change based on the device). Web apps do not require customization, as they are not specific to an operating system (hence, they are known as "develop once, run many" apps). As a result, web apps can be developed at lower cost than native apps. There is also no need for an app gateway, since web apps are not downloaded and installed onto the device. The primary shortcoming of web apps is that they must be accessed over the Internet, and hence may not be available in the field and may not take full advantage of a device's features.
- **Hybrid apps** combine the features of native and web apps (Barney, 2009). Like native apps, hybrid apps are accessed through app gateways and installed onto a device. However, these apps are developed with cross-mobile device features and so can work across different platforms. Cross-device compatibility is enabled by the web app features of HTML5. APIs allow access to a device's specific features. Because they are obtained through app gateways, hybrid apps are often conflated with native apps.

Which Type of App Should Governments Develop?

As there are no clear guidelines on which type of app to develop, public agencies undergo a learning process as they adapt to the mobile environment. Furthermore, the continuing rapid evolution of mobile devices precludes the use of static guidelines. It would nevertheless be strategic for agencies to consider a few key criteria in the app development process:

- Task complexity
- Frequency of app use
- Security
- Interoperability
- Integration with mobile device's hardware features
- Need for Internet connectivity
- Total cost of ownership

Table 1 summarizes the major elements of these considerations.

Table 1: Criteria for Considering Type of App

	Native app suitable for:	Web app suitable for:	Hybrid app suitable for:
Task complexity	Very complex tasks	Moderately complex tasks	Very complex tasks
Frequency of use	Very frequent use	Occasional use	Very frequent use
Security	Device-level security	Server-level security	Device- and server-level security
Interoperability	Device-specific use	Device-agnostic use	Device-agnostic use
Hardware integration	Full device feature integration	Very little device feature integration	Partial device feature integration
Internet connectivity	Use without Internet connection	Use with Internet connection	Partial use without Internet connection
Total cost of ownership	Lower costs with device specific use	Lower costs across different devices	Lower costs across different devices

Task complexity. Task complexity relates to the time and intensity of human interaction with a device required for completion of a task. Simple tasks (e.g., information updates) require minimal time and device interaction. Moderately complex tasks require more time and device interaction (e.g., providing inputs on forms). Very complex tasks require significant time and sophisticated interaction with the device (e.g., creating or editing a document or multimedia file). Users could switch devices when carrying out more complex tasks. According to Gartner (2014), when conducting online activities, “smartphone [use is] first as a device that is carried when mobile, followed by the tablet that is used for longer sessions, with the PC increasingly reserved for more complex tasks.” Simple information updates (e.g., status of an IRS filing or license application) could be sent as a message on a wearable or mobile phone. Enterprise-focused apps have a moderate-to-high level of task complexity, are often native or hybrid apps, and are ideally used with tablets. Customer apps for moderate-to-simple tasks could be implemented as web apps (e.g., forms).

Frequency of app use. Users are typically constrained by a device's available memory for downloading and storing apps. A user is unlikely to download apps that are not frequently used. If not useful or helpful, an app is eventually deleted (Purcell, Entner, and Henderson, 2010). Native and hybrid designs, which require downloading and consume storage space, are appropriate for frequently used apps. Enterprise-focused apps used by employees on a regular basis for fulfilling specific tasks lend themselves native or hybrid design as well. Web apps, which do not require downloading, are ideal for an infrequent user of the service.

Security. The ability to control security features differs among apps. Because native and hybrid apps are installed on the device, app security is device-centric and security updates depend on the device user. Native enterprise-focused apps, however, require enterprise-level security. Hence, a public agency needs enterprise-level security protocols that are enforced through a mobile application management process. Since web apps are accessed online and not installed on the device, their security can be implemented at the enterprise level (i.e., a web server).

Interoperability. Citizens seeking public services use a range of different mobile devices to access them, including desktop and laptop computers. Customer service apps must therefore be interoperable across a range of devices. By the very nature of their design, web apps provide a great deal of interoperability. Since public agencies that have BYOD schemes cannot control employees' devices, their enterprise-focused apps would need to function across various devices. Enterprise-focused apps requiring such flexibility should be developed as web or hybrid apps. However, specialized enterprise-focused apps requiring high levels of security must be designed for specific platforms; employees should only use agency-issued devices to accomplish the indicated tasks.

Integration with the mobile's hardware features. Mobile devices are equipped with a range of hardware features, such as the camera, GPS, and accelerometer (to sense movement and tilt of the device). Smartphones take advantage of voice commands and functions. Devices are also increasingly equipped with Near Field Communication (NFC), which is used for contactless transactions (e.g., mobile payments) and access control. Native apps developed for specific devices can take advantage of these hardware features for value-added functionality. Web apps do not have the same capacity to use hardware features. Hybrid apps provide a middle ground, allowing some use of device-specific features while maintaining flexibility.

Need for Internet connection. Because native apps are installed onto a device, they do not need Internet connectivity to function. Enterprise-focused apps lend themselves to native app design, since they must perform in the field where Internet access is spotty or nonexistent. Hybrid apps and web apps typically require an Internet connection to function, although HTML5 has given hybrids a greater degree of offline capacity.

Total Cost of Ownership. Total cost of ownership refers to all costs associated with apps over their lifetime of use, including production costs, operational costs (e.g., security, maintenance, and updates), software and hardware (e.g. servers) costs, and user training and support costs. Production and operational costs are generally higher for native apps than for web apps, especially since the former need to be customized for different devices. The higher costs of native apps may be justified for enterprise-focused apps if such apps are associated with complex tasks and the organization can control the devices used. Web apps are often appropriate for citizen-oriented apps, since citizens will use a variety of different devices. Similar tasks tend to have comparable software and hardware requirements to support the associated apps; hence, these costs may not vary much across native, web, and hybrid apps. User training and support costs are particularly high for enterprise-focused apps in the initial stages of deployment; citizen-oriented apps generally do not require the same level of user support.

Federal, state, and local government agencies have developed all three types of apps. As mobile technology diversifies, however, apps need to be responsive to ever-changing devices, providing specific on-demand services that are suited to individual users. In such a context, public sector agencies need to adopt mobile apps in a strategic way. Broadly, from an organizational perspective, apps must make it possible to fulfill the organization's mission more effectively and efficiently. From a user perspective, apps need to be contextually relevant and helpful in completing a task. Government agencies are typically the only source for key citizen services such as licenses, voting registration, and social security and other benefits. Citizens benefit when services are provided through multiple channels. Online transactions benefit agencies through costs savings, improved speed in delivery, and greater accuracy.

The Road Ahead for Mobile App Design

In the future, organizations should consider the impact of the Internet of Things in general, and the mobile sphere in particular, as key components of organizational transformation. The rapid growth of sensors and machine-to-machine connections will reshape organizational routines. Just as electronic government initiatives streamlined routine jobs, continued app development and deployment will streamline field processes. At the base level, mobile will replace paper-based processes in the field. At a more advanced level, mobile will further blur the distinction between back-office operations and front-line field activities.

Federal agencies are already poised for mobile optimization through adoption of responsive design features, because recent federal policies require all new online offerings to be mobile optimized. Recent organizational initiatives within GSA (such as 18F and Digital Government) provide support structures to federal agencies in the process of adopting mobile-centric features. State and local government agencies are also on an evolutionary path toward adopting the mobile environment. For example, the state of Utah, which provides an exemplary model for state governments, has explicitly adopted a "mobile first" strategy and made responsive web design the default.

Recommendations for Government Mobile Apps

Recommendation One: Optimize Online Services for Mobile Devices

Government agencies at the federal, state, and local levels should strategically assess their existing online offerings and engage the public in identifying those that would be most valued on various mobile devices. Smartphones are ubiquitous; tablet penetration is also increasing; and wearables like the Apple watch and Google Glass are the next frontier. Each of these devices has its strengths and limitations. People spend a great deal of time on their smartphones, but in a series of brief “mobile moments.” Each mobile moment is critical to shape consumer decisions and preferences instantaneously (Forrester Research, 2015). Smartphones are used for social networking, communications (e-mail, text, video, chat), online searches, and periodic news tracking (Smith and Page, 2015). Wearables are used for even briefer glanceable moments. Tablets lend themselves to more complex tasks requiring longer engagement. Public agency online offerings need to be sympathetic to the use and capability of various devices. Furthermore, with smartphones reducing the digital divide, it is all the more imperative that public agencies use smartphones in particular to offer appropriate services to meet the needs of different population groups. In adopting a mobile-first approach, organizations should optimize their existing online content offerings, interactions, and transactions for mobile devices.

Mobile optimization implies that agencies employ responsive web design to make their online offerings mobile friendly. Responsive design allows for the same content and services to be offered in varying formats suitable to the different modes of human interaction with a device. Reading content or watching video on a computer and on a smartphone are distinct experiences. With the frequent use of smartphones to access the Internet, it is imperative for public agencies to respond. Google⁷ and the W3 consortium⁸ provide methods to verify the mobile friendliness of a site. Wearables offer yet another distinct realm of experience, and lend themselves to short messages that require instantaneous action in a specific geographic location.

Recommendation Two: Provide Open Data Based on Common Standards

The core value of a public agency is to be found in its data. Public agencies are typically treasure troves of data collected in order to fulfill their missions. At the same time, government data is public data that should be in the public domain. The open data movement has gathered tremendous momentum in the United States across federal, state and local agencies. Federal policy requires that all federal agency data be open by default and provided in machine-readable format. State and local governments make their data available through their web portals. Proactive open data policies are highly useful to citizens, because open data does not have to be obtained through requests under the Freedom of Information Act (FOIA). More importantly, making government data available publicly has broader social benefits. Data can be the foundation of socially useful apps. As of mid-2015, the federally sponsored data.gov portal catalogued over 158,500 datasets from federal, state, and local government agencies.

7. <https://www.google.com/webmasters/tools/mobile-friendly/>

8. <http://validator.w3.org/mobile/>

While the open data movement is commendable in itself, public agencies must now move into the next phase of providing data in useful formats based on common standards. Government adoption of standards-based approaches would ensure that data is of high quality and can be used reliably for analysis. The quality of data can be partly ascertained from metadata. Metadata includes information about elements that describe the data (e.g., title, abstract, author, and keywords), the structure of the data, and administrative aspects of the data (e.g., version, rights, preservation). From a technical perspective, standardization facilitates interoperability of data across different platforms. Standardization is therefore useful for further development of mobile apps, since external users can access data through APIs. While there are numerous data formats, JSON has become a popular format for publishing data; XML and CSV formats are also used frequently. These machine-readable formats are more valuable than data made available in other forms (such as .pdf files) that are not amenable to reliable machine reading.

Recommendation Three: Assess Feasibility of Standard Data Structures Across and Within Agencies

While technical standardization is important for interoperability, the more fundamental issue is to create a standardized structure of data. For example, government budgeting and financing is an important aspect of government transparency. Budgeting and finance data would be far more useful for analysis if data were available in a standardized structure across different jurisdictions and over time. The eXtensible Business Report Language (XBRL) provides a standardized structure by which business and financial information is reported by public agencies. The Federal Bureau of Investigation's Uniform Crime Reporting and the North American Industrial Classification System (NAICS) are other examples of standardized data structures, for crime and industrial data, respectively. Making data available in structured formats enables its use in apps across agencies. Crime mapping apps across jurisdictions are typically based on FBI UCR standards. Similarly, economic development apps analyzing industrial trends use NAICS standards.

Reviewing whether it is appropriate to standardize data structures across different agencies is arguably the next big step for government data. Even though the federal government has established standards in the aforementioned areas within agencies, there is a great need to standardize data structures across agencies. For example, the U.S. Census Bureau (2013) acknowledges, "Lack of Census Bureau-wide standardized data creates challenges for comparing and integrating domain data across different surveys and censuses, impedes streamlining the survey line and producing new data products." The Census Bureau is the principal source of demographic and economic data for the country. Several mobile apps use census data, and making this data available in a standardized structure would jumpstart a range of apps providing historical and comparative analyses.

Two examples, one each at the state and local government levels, help to further illustrate the significance of standardization of data structures across levels and units of government. At the state government level, the emergence of the Local Inspector Value-Entry Specification (LIVES) is significant for apps to provide value-added services. LIVES was the result of a collaborative effort of Yelp and the cities of San Francisco and New York to include the health inspection ratings of restaurants on the Yelp app. LIVES describes a standardized data structure for states and municipalities to follow when publishing restaurant inspection information.⁹ LIVES helped add value to the Yelp restaurant locator service, because users can now view a restaurant's health inspection grade along with its menu, customer reviews, etc. As more states adopted the standard, LIVES spurred additional apps for food safety, such as the HDScores and What the Health apps (Shueh, 2015).

9. See <http://www.yelp.com/healthscores> for the specification

At the local government level, the General Transit Feed Specification (GTFS) has become an important standard for transit agency data feeds. The GTFS was an outcome of the partnership between Google and Portland's TriMet in 2005 to standardize transit data (McHugh, 2013). The GTFS provides a standard CSV format for public transportation schedules and associated geographic information (stops, timing, etc.).¹⁰ Over 900 transit agencies have since adopted the standard, spurring the development of a variety of exemplary transit apps. Similar standardization of data across other public agencies would jump start the development of value-added apps for services both existing and not yet imagined.

10. See <https://developers.google.com/transit/gtfs/?hl=en> for the standard

References

- Altringer, B. (2013). A New Model for Innovation in Big Companies. *Harvard Business Review*. Retrieved from <https://hbr.org/2013/11/a-new-model-for-innovation-in-big-companies/>
- Army CIO/ G6. (2012, March 23). *Army launches apps marketplace prototype*. Retrieved from http://www.army.mil/article/75966/Army_launches_apps_marketplace_prototype/
- Bailey, K. D. (1994). *Typologies and Taxonomies: An Introduction to Classification Techniques*. Thousand Oaks: Sage.
- Barney, L. S. (2009). *Developing Hybrid Applications for the iPhone: Using HTML, CSS, and JavaScript to Build Dynamic Apps for the iPhone*. Upper Saddle River, NJ: Addison-Wesley Professional.
- Barr, A. (2015). Google Quietly Distributes New Version of Glass Aimed at Workplaces. *Wall Street Journal Tech Blog*. Retrieved from <http://www.wsj.com/articles/google-quietly-distrib-utes-new-version-of-glass-aimed-at-workplaces-1438283319>
- Blumberg, S. J. and J. V. Luke. (2015). *Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July–December 2014*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. Retrieved from <http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201506.pdf>
- Botsman, R. and R. Rogers. (2010). *What's Mine Is Yours: The Rise of Collaborative Consumption*. HarperCollins: New York.
- Boyd, A. (2015, February 26). CIA to launch private app store next month. *Federal Times*. Retrieved from <http://www.federaltimes.com/story/government/it/cloud/2015/02/26/cia-private-app-store/24064285/>
- Cheeseman, K. and S. Trujillo. (2014). *Developing FDA's Field Investigator Tool with Mapping (FIT-Map) Prototype*. ESRI User Conference Proceedings, San Diego. Retrieved from http://pro-ceedings.esri.com/library/userconf/proc14/papers/181_17.pdf
- Cisco. (2015). *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2014–2019*. CISCO White Paper. Retrieved from http://www.cisco.com/c/en/us/solutions/col-lateral/service-provider/visual-networking-index-vni/white_paper_c11-520862.html
- Clarke, R. Y. (2013). *Smart Cities and the Internet of Everything: The Foundation for Delivering Next-Generation Citizen Services*. IDC Government Insights #GI243955 (White Paper). Sponsored by Cisco. Retrieved from http://www.cisco.com/web/strategy/docs/scc/ioe_citizen_svcs_white_paper_idc_2013.pdf
- Columbus, L. (2015, February 22). Why Enterprise Mobile Apps Are Most Lucrative To Build In 2015. *Forbes*. Retrieved from <http://www.forbes.com/sites/louiscolombus/2015/02/22/why-enterprise-mobile-apps-are-most-lucrative-to-build-in-2015/>
- comScore. (2014). *The U.S. Mobile App Report*. Retrieved from <https://www.comscore.com/Insights/Presentations-and-Whitepapers/2014/The-US-Mobile-App-Report>
- comScore. (2015). *U.S. Digital Future in Focus*. Retrieved from <http://www.comscore.com/Insights/Presentations-and-Whitepapers/2015/2015-US-Digital-Future-in-Focus>.
- Crowe, G. (2013). *Hybrid Apps: The Future of Mobile Development?* Retrieved from <http://gcn.com/Articles/2013/02/12/Hybrid-apps-future-mobile-development.aspx>.

- Crump, J. (2011). What Are the Police Doing on Twitter? Social Media, the Police and the Public. *Policy & Internet*, 3, 1–27. doi: 10.2202/1944-2866.1130.
- Customs and Border Patrol. (2015, February 26). *Mobile Passport Control App Expands to Miami International Airport*. Retrieved from <http://www.cbp.gov/newsroom/national-media-release/2015-02-26-000000/mobile-passport-control-app-expands-miami>.
- Dischler, J. (2015, May 5). *Building for the next moment*. Retrieved from <http://adwords.blogspot.com/2015/05/building-for-next-moment.html>
- Doty, D. H. and W. H. Glick. (1994). Typologies as a Unique Form of Theory Building: Toward Improved Understanding and Modeling. *The Academy of Management Review*, 19(2), 230-251
- Fedscoop. (2014). *Digital Government Study, 2014: Digital government outlook for federal government*. Retrieved from <http://www.xerox.com/downloads/services/white-paper/digital-gov-ernment-study-2014.pdf>
- Fiorenza, P. (2013). Making mobile matter: Implementing your mobile enterprise strategy. *Govloop Guide*. Retrieved from <https://www.govloop.com/resources/new-govloop-guide-making-mobile-matter/>
- Forrester Research, Inc. (2015). *Moments That Matter: Intent-Rich Moments Are Critical to Winning Today's Consumer Journey*. Retrieved from <https://storage.googleapis.com/think/docs/forrester-moments-that-matter-research-study.pdf>
- Fowler, G. A. (2015, May). There's an Uber for Everything Now. *The Wall Street Journal*. <http://www.wsj.com/articles/theres-an-uber-for-everything-now-1430845789>.
- Fretwell, L. (2015, March 21). The 4 most popular .gov websites aren't mobile friendly. *Govfresh*. Retrieved from <http://www.govfresh.com/2015/03/the-4-most-popular-gov-websites-arent-mobile-friendly/>
- Ganapati, S. and C. G. Reddick. (2013). Modeling IT Evolution in E-government: Theories and a Proposed Model. In J.R. Gil-García. (Eds.), *E-Government Success Factors and Measures: Concepts, Theories, Concepts, and Methodologies* (pp. 24-36). Hershey, PA: IGI Global.
- Gansky, L. (2010). *The Mesh: Why the Future of Business is Sharing*. Portfolio Penguin: New York.
- Gartner. (2014, December 8). *Gartner Says By 2018, More Than 50 Percent of Users Will Use a Tablet or Smartphone First for All Online Activities* (Press Release). Retrieved from <http://www.gartner.com/newsroom/id/2939217>
- Georgia Department of Natural Resources. (2014). *Camp Lawton Augmented Reality*. NASCIO 2015 State IT Recognition Awards. Retrieved from <http://www.nascio.org/awards/nominations2015/2015/2015GA3-NASCIO-Submission, Georgia Department of Natural Resources, Camp Lawton Augmented Reality.pdf>
- Goodchild, M. F. (2007). Citizens as Sensors: The World of Volunteered Geography. *GeoJournal*, 69(4), 211-221.
- Google. (2015). *Mobile App Marketing Insights: How Consumers Really Find and Use Your Apps*. Retrieved from <https://think.storage.googleapis.com/docs/mobile-app-marketing-insights.pdf>
- Gordon-McKeon, S. (2013, October 10). *Hacking the hackathon*. Blog. Retrieved from <http://www.shanagm.net/blog/2013/10/hacking-the-hackathon/>
- Government Accountability Office. (2012). *Mobile Device Location Data: Additional Federal Actions Could Help Protect Consumer Privacy*. GAO-12-903. Retrieved from <http://www.gao.gov/assets/650/648044.pdf>

- Government Accountability Office. (2014). *In-Car Location-Based Services: Companies Are Taking Steps to Protect Privacy, but Some Risks May Not Be Clear to Consumers*. GAO-14-81. Retrieved from <http://www.gao.gov/products/GAO-14-81>
- Government Business Council. (2014). Digital Government 2014: The Two-Year Progress Report. *Government Executive Media Group*. Retrieved from <http://www.govexec.com/gbc/reports/digital-government-2014-two-year-progress-report/90644/>
- Government Business Council. (2015). Delivering on Digital Government. *Government Executive Media Group*. Retrieved from http://cdn.govexec.com/media/gbc/docs/gbc_accenture_digital_ir_april.pdf
- Grimmelikhuijsen, S. G. and A. J. Meijer (2015). Does Twitter Increase Perceived Police Legitimacy? *Public Administration Review*, 75, 598–607. doi: 10.1111/puar.12378.
- Heitkötter, H., S. Hanschke, and T. A. Majchrzak. (2013). Evaluating Cross-Platform Development Approaches for Mobile Applications. In J. Cordeiro and K. H. Krempels (Eds.), *Web Information Systems and Technologies: Lecture Notes in Business Information Processing*, Volume 140 (pp. 120-138). Heidelberg: Springer.
- Hickey, K. (2015, March 2). Cities tap Yelp to improve health inspection process. *GCN*. Retrieved from <http://gcn.com/articles/2015/03/02/yelp-city-restaurant-inspections.aspx>
- Jokela, T., J. Ojala, and T. Olsson. (2015). *A Diary Study on Combining Multiple Information Devices in Everyday Activities and Tasks*. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI 15) (pp. 3903-3912). New York: ACM.
- Kerschberg, B. (2015, January 15). Four Critical Reasons to Build Enterprise Apps. *Forbes*. Retrieved from <http://www.forbes.com/sites/benkerschberg/2015/01/15/four-critical-reasons-to-build-enterprise-apps/>
- Khalaf, S. (2015). Seven Years Into The Mobile Revolution: Content is King... Again. Retrieved from <http://yahoodevelopers.tumblr.com/post/127636051988/seven-years-into-the-mobile-revolution-content-is>
- Kleweno, D. and P. Hird. (2012). *New Solutions, Challenges, and Opportunities: CAPI the NASS Way*. United Nations Economic Commission for Europe Conference Of European Statisticians, Geneva, Switzerland, 31 October-2 November. Retrieved from http://www.nass.usda.gov/Research_and_Science/Technology/CAPI%20the%20NASS%20Way_New%20Solutions%20Challenges%20and%20Opportunities.pdf
- Kyte, A., D. Norton, and N. Wilson. (2014). *Ten Things the CIO Needs to Know About Agile Development*. Gartner. <http://www.gartner.com/doc/2939622>
- Lane, K. (2014). Looking at 77 Federal Government API Developer Portals and 190 APIs. *API 100K View Blog*. Retrieved from <http://apievangelist.com/2014/07/10/looking-at-77-federal-government-api-developer-portals-and-190-apis/>
- Lella, A. (2015). comScore Reports February 2015 U.S. Smartphone Subscriber Market Share. *comScore Insights*. Retrieved from <http://www.comscore.com/Insights/Market-Rankings/comScore-Reports-February-2015-US-Smartphone-Subscriber-Market-Share>
- Lopez, M. H., A. Gonzalez-Barrera, and E. Patten. (2013). *Closing the Digital Divide: Latinos and Technology Adoption*. Pew Hispanic Research Center. Retrieved from <http://www.pewhispanic.org/2013/03/07/closing-the-digital-divide-latinos-and-technology-adoption/>
- Lorenzi, D., J. Vaidya, S. Chun, B. Shafiq, and V. Atluri. (2014). Enhancing the government service experience through QR codes on mobile platforms. *Government Information Quarterly*, 31(1), 6-16.

- Makino, T., C. Jung, and D. Phan. (2015). Finding more mobile-friendly search results. *Google Webmaster Central Blog*. Retrieved from <http://googlewebmastercentral.blogspot.com/2015/02/finding-more-mobile-friendly-search.html>
- Marshall, P. (2015, February 24). Using smartphones for ID authentication. *GCN*. Retrieved from <http://gcn.com/blogs/emerging-tech/2015/02/mobileid-authentication.aspx>
- McHugh, B. (2013). Pioneering Open Data Standards: The GTFS Story. In B. Goldstein and L. Dyson (Eds.), *Beyond Transparency: Open Data and the Future of Civic Innovation* (pp. 125-136). San Francisco: Code for America Press.
- NASCIO. (2012, October). *Advancing the C⁴ Agenda: Balancing Legacy and Innovation. The 2012 State CIO Survey*. Retrieved from <http://www.nascio.org/publications/documents/NASCIO-2012StateCIOSurvey.pdf>
- National Academy of Public Administration and ICF International. (2015). *Federal Leaders: Digital Insight Study*. Retrieved from <http://www.napawash.org/reports-publications/1703-federal-leaders-digital-insight-study.html>
- Nielsen (2014, October). Tech-Or-Treat: Consumers Are Sweet on Mobile Apps. *Nielsen Newswire*. Retrieved from <http://www.nielsen.com/us/en/insights/news/2014/tech-or-treat-consumers-are-sweet-on-mobile-apps.html>
- Nielsen (2015). *So Many Apps, So Much More Time for Entertainment*. Retrieved from <http://www.nielsen.com/us/en/insights/news/2015/so-many-apps-so-much-more-time-for-entertainment.html>
- Otto, G. (2014). 3 innovative ways agencies are leveraging mobile apps. *Fedscoop*. Retrieved from <http://fedscoop.com/great-government-mobile-apps/>
- Pew Research Center. (2015). *Device Ownership*. Retrieved from <http://www.pewresearch.org/data-trend/media-and-technology/device-ownership/>
- Purcell, K., R. Entner, and N. Henderson. (2010). *The Rise of Apps Culture. Pew Research Center's Internet & American Life Project*. Retrieved from <http://pewinternet.org/Reports/2010/The-Rise-of-Apps-Culture.aspx>
- Rich, S. (2013, October 10). Dallas Transit Agencies Launch Mobile Ticketing App. *Government Technology*. Retrieved from <http://www.govtech.com/local/Dallas-Transit-Agencies-Launch-Mobile-Ticketing-App.html>
- Sampson, H. (2015, March 3). Embracing tech, MIA seeks to improve passenger experience. *Miami Herald*. Retrieved from <http://www.miamiherald.com/news/business/article12323765.html>
- Schadler, T., J. Bernoff, and J. Ask. (2014). *The Mobile Mind Shift: Engineer Your Business to Win in the Mobile Moment*. Cambridge: Groundswell Press.
- Schadler, T. (2015). Apple Watch—Bliss or Bling? Glanceable Moments Will Decide. *Ted Schadler's Blog, Forrester*. Retrieved from http://blogs.forrester.com/ted_schadler/15-04-24-apple_watch_bliss_or_bling_glanceable_moments_will_decide
- Schrier, B. (2013, July 2). Apps Contests are Stupid. *the Chief Seattle Geek blog*. Retrieved from <https://schrier.wordpress.com/2013/07/02/apps-contests-are-stupid/>
- Shen, S. and B. Blau. (2013). *Forecast: Mobile App Stores, Worldwide, 2013 Update*. Gartner. Retrieved from <https://www.gartner.com/doc/2584918>
- Shueh, J. (2015, July 22). Can Food Inspection Data Standards Stop an Epidemic? *Government Technology*. Retrieved from <http://www.govtech.com/data/Can-Food-Inspection-Data-Standards-Stop-an-Epidemic.html>

- Smith, A. (2015). *U.S. Smartphone Use in 2015*. Pew Research Center. Retrieved from <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>
- Statista.com. (2015). *Number of apps available in leading app stores as of July 2015*. Retrieved from <http://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/>
- Townsend, A. (2013). *Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia*. W.W. Norton.
- U.S. Census Bureau. (2013). U.S. Census Bureau: Strategic Plan FY 2013 – 2017, Version 1.0. Retrieved from <http://www.census.gov/content/dam/Census/about/about-the-bureau/PlansAndBudget/strategicplan.pdf>
- United States Government Accountability Office. (2015). *Telecommunications: Agencies Need Better Controls to Achieve Significant Savings on Mobile Devices and Services*. GAO-15-431. Retrieved from <http://www.gao.gov/assets/680/670333.pdf>
- Vision Internet. (2015). *What's Next in digital communications for Local Government?* Retrieved from <http://www.visioninternet.com/Home/ShowDocument?id=38>
- Whitney, L. (2015, March, 21). The driver's license of the future is coming to your smartphone. *CNET*. Retrieved from <http://www.cnet.com/news/your-future-drivers-license-could-go-digital/>
- Williams, J. (2015, May 14). *Arkansas Launches First State Government Apple Watch App*. Retrieved from <http://statescoop.com/arkansas-launches-first-state-government-apple-watch-app/>
- Wilonsky, R. (2015, April 14). Dallas Area Rapid Transit, Uber partner in an effort to fill in riders' 'first mile-last mile' gap. *The Dallas Morning News (Transportation Blog)*. Retrieved from <http://transportationblog.dallasnews.com/2015/04/dallas-area-rapid-transit-uber-partner-in-an-effort-to-fill-in-riders-first-mile-last-mile-gap.html/>
- Ziadeh, A. (2014). Mobile apps drive fleet management. *GCN*. Retrieved from <http://gcn.com/articles/2015/07/06/fleet-management-apps.aspx>
- Ziadeh, A. (2015, May 6). Are state websites up to the mobile challenge? *GCN*. Retrieved from <http://gcn.com/Articles/2015/05/06/Mobile-friendly-state-sites.aspx>
- Zickuhr, K. and L. Rainie. (2014). *E-Reading Rises as Device Ownership Jumps*. Pew Research Center. Retrieved from <http://www.pewinternet.org/2014/01/16/e-reading-rises-as-device-ownership-jumps/>

ABOUT VIDERITY

VIDERITY provides clients with business process and industry expertise, a deep understanding of technology solutions that address specific industry issues, and the ability to design, build, and run those solutions in a way that delivers bottom-line value.

To learn more visit: [Viderity.com](https://www.viderity.com)

VIDERITY
STRATEGIC, CREATIVE, TECHNICAL

www.viderity.com