Chapter 5

Technology options for mobile solutions

Mobile solutions can be constructed in a variety of ways, with diverse choices in terms of networks, channels (e.g. voice channels, signaling channels, data channels) back-end information systems and enterprise architecture, devices and applications. In order to effectively identify and deploy affordable, successful and sustainable mobile solutions, it is critical to have a clear focus on the targeted policy and service delivery goals, and a sound appraisal of available technology options. Technical issues, problems related to security, identity management, broadband connectivity and the integration and interoperability of systems and applications, are all matters that need to be discussed and addressed. Likewise, the development of location-based services, the impact of new trends on the mobile market and of social networking on mobile service delivery, i.e. *"Mobile Web 2.0", will require adequate attention and will be at the core of policy makers' discussions in the upcoming years.*

Introduction

Mobile solutions can be constructed in a variety of ways, with diverse choices in networks, channels, back-end systems, devices and applications. With a focus on clearly defined service goals, understanding technology options is central to effectively identify and deploy affordable, successful and sustainable mobile solutions.

Voice channel

Although there is much focus on texting, mobile applications and the mobile web, voice remains an important function for mobile communications for many reasons: voice works on all telephony networks and all phones; it has greater capacity for information exchange; voice systems do not require literacy; voice is a familiar and trusted communication channel; and voice systems can be developed easily in multiple or local languages not supported on all handsets.

***Voice XML (VXML)* –** Voice applications can be developed and deployed in the same way that HTML is for visual applications through VXML, the W3C's standard format for interactive voice dialogues between a human and a computer. VoiceXML documents are interpreted by a voice browser, which allow people to access the Web using speech synthesis, pre-recorded audio, and speech recognition and can be supplemented by keypads and small displays.[1]

Commercial VoiceXML applications process millions of telephone calls per day to check orders, get driving directions, use voice access for email, refill prescriptions and many other everyday activities. Infrastructure costs can be high for voice channels, and open source solutions for additional modules, such as text-to-speech and speech recognition, are limited.

Signalling channel

SMS – With its relative simplicity and ease of use, SMS continues to grow in popularity, especially with people aged 15 to 25 and for NGOs and grassroots organisations. Bypassing email and Instant Messaging, text messaging has become an integral part of daily lives across the world. Many communication applications have embedded direct-to-SMS functionality. Governments and NGOs actively use SMS for citizen notifications and engagement, news and weather updates, emergency alerts, healthcare and business support services, and to bridge back to websites.

Downsides to SMS are limitations for people with low literacy or language barriers, costs relative to data services such as GPRS, some security vulnerabilities and fake SMS that can be conducted via the Internet.[2]

For many governments, the use of SMS technology to enhance the access to, and delivery of, government services is popular as a complementary channel to existing Internet-based e-government. For example, in Australia, SMS is used for bushfire alerts in Victoria and notification for public transport timetables in Adelaide. In the Philippines in December 2008, 54 national government agencies were providing SMS services to augment traditional public services.[3] Citizens prefer a technology channel that is more familiar, simple and easy to use; supports their native language; uses a readily available device and infrastructure, and is low cost. SMS has crossed network and technology boundaries, and continues to find new applications, and provides inspiration for industry innovation as IP (Internet Protocol)-based messaging builds momentum. Mobile IM/Presence and mobile email are considered as emerging, but nevertheless "core", mobile messaging applications.

Other person-to-person (P2P) mobile messaging channels, such as voice SMS[4] and video, offer a way to create added value and an improved user experience. For instance, Voice SMS is suited for mission critical situations, where proof of delivery is needed, or for those who can't easily read an SMS, such as drivers, the elderly and the visually impaired. Likely applications for Voice SMS include messaging mobile public workers, particularly out of hours or in emergency situations. The same can be said for the network address book and PIM (personal information management).

USSD – Created specifically for standard GSM devices, Unstructured Supplementary Service Data (USSD) messages are transferred directly over network signalling channels. This is unlike MMS messaging, which is transferred via a wireless data connection. USSD is free, simple, logical, inexpensive and accessible, with great potential for mobile banking, accessing news services, submission services, feedback, voting, and directories. With interactive navigation, USSD is fast and allows for mass usage. However, messages cannot be saved or forwarded, the codes may be difficult to remember, and usage is not always reliable due to session-based timeouts.[5]

WAP – WAP (wireless application protocol) is an open, global specification that empowers mobile users with wireless devices to easily and instantly access information and services, and to interact with government. Small mobile devices commonly use a WAP browser, which accesses websites written in or converted to Wireless Markup Language (WML).

Devices that will use WAP include mobile phones, pagers, two-way radios, smartphones and communicators, from low-end to high-end. WAP provides service interoperability even between different device families. WAP is published by the WAP Forum, founded in 1997 by Ericsson, Motorola, Nokia, and Unwired Planet. Forum members now represent over 90% of the global handset market, as well as leading infrastructure providers, software developers and other organisations.[6]

With minimal risk and investment, WAP enables operators to decrease churn (customer attrition or loss), cut costs, and increase revenues by improving existing, value-added services and offering new informational services. To fit into a small wireless terminal, WAP uses a Micro Browser, which is a small piece of software that makes minimal demands on hardware, memory and CPU. Some problems have occurred with WAP related to WML scripts and with gateway, protocol and mobile device security.[7]

The influence of IP and mobile Web technologies, including WAP, on the mobile messaging market is significant. Up to now, mostly tourist information or reminder services can be found on this level. The future success of emerging IP-based mobile messaging mediums will depend largely on how they are interwoven with existing services and standards, and interact with the new channels created by VoIP and social web-based communities; *i.e.* the "in-mail" and "public messaging" mediums of Web 2.0. Industry initiatives have addressed the issue of smooth transition from traditional messaging implementation to all IP messaging architecture. The focus is on improving end-user experiences with new mobile device capability and key network functions, such as location-based and presence information.

Data channel: Mobile messaging categories

There are three predominant categories of mobile messaging:

- A2P (application-to-person) – whereby content is pushed to the mobile phone (popular in both the SMS and MMS domain);
- P2A (person-to-application) – also known as "person-to-content", where the mobile phone user uploads content to the network/Web or sends a message to another application (*e.g.* applications such as voting, uploading photos to social network site, etc.);
- P2P (person-to-person) – the exchange of a message between two mobile phone subscribers.

An emerging mobile messaging category is machine-to-machine[8] (M2M), in applications such as telematics and software diagnostics. The main segments and area of usage are fleet and asset management, tracking and tracing, remote maintenance and control, smart metering, POS/payment, and healthcare security/surveillance.

From a technology perspective, there are three different types of mobile messaging user experiences:

- push – the message is sent out to the mobile device automatically (*i.e.* it is "pushed" from the server to the mobile device);
- pull – the mobile device pulls the remote server to retrieve the message (*i.e.* the mobile device "pulls" the message from the server);
- session – whereby a constant connection is established between the sender and the receiver for the near real-time exchange of messages (employed by IM for example).

There are both types of services: Push and Pull of information. Some Push services are aimed at all citizens, while others cater to individual needs.

MMS – Multimedia Messaging Service is mobile messaging similar to SMS for data transfer, but with additional functionality for rich text, video and audio attachments using Wireless Application Protocol (WAP) to access and display the content.

MMS allows for easy bulk-messaging and, combined with mobile Internet connectivity, can be used to drive an audience to social media or a website. However, MMS is not compatible with basic phones, costs more than SMS, and content is not always well adapted. This messaging platform has had issues with transferring malicious software and has lower read and response rates than SMS.

MMS continues to make headway in the consumer P2P market, but is finding more significant success as an enabler of mobile advertising and thus, ad-funded messaging tariffs.[9] From the perspective of public service delivery, MMS may open a whole range of possibilities, for instance in the medical field.

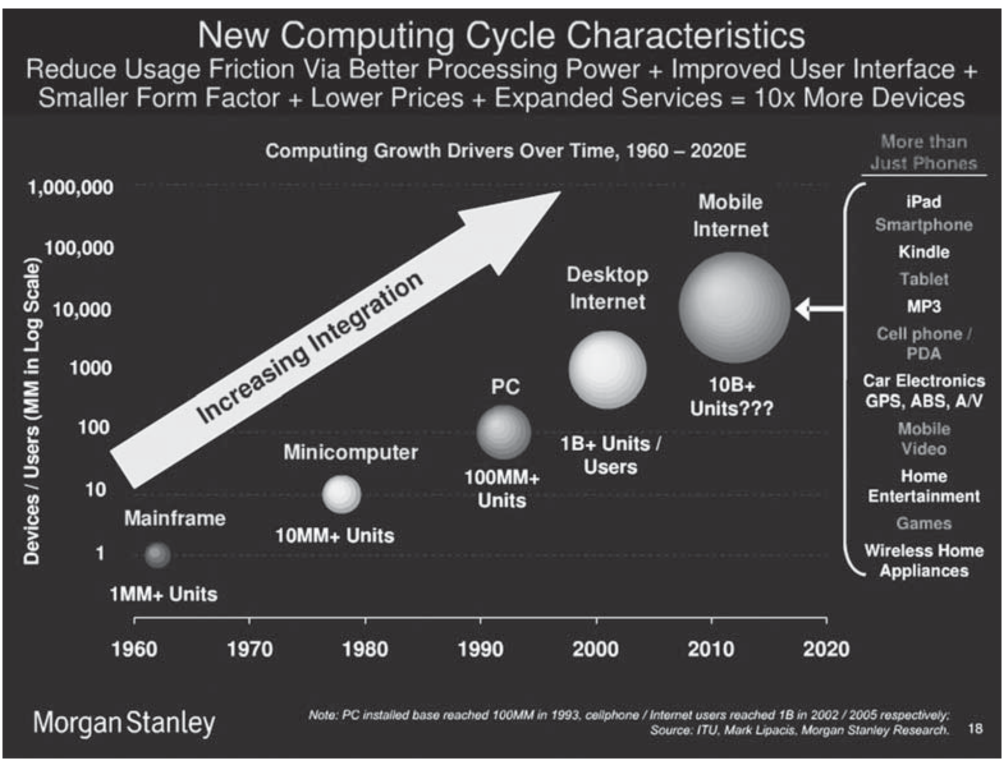
According to Juniper Research, most probably there will be no "big bang" or one "killer app" to catapult the mobile messaging industry to its next phase of development. Rather, the progression will be an evolution of mobile messaging services that play to the strengths and success of current offerings, combined with technology developments that enable mobile network operators (MNOs) to build on existing and stable delivery mechanisms, while gradually introducing IP-based network infrastructure to bridge the mobile/Web divide. The industry consensus is that the economic downturn has yet to negatively impact the mobile messaging market. Indeed, many commentators expect the longer-term impact to be minimal, with overall messaging traffic continuing to grow in many markets worldwide. Messaging, especially SMS, remains an economical method of P2P communication and, therefore, traffic growth is expected to remain strong. Meanwhile, smartphone users, in particular, will continue to drive high usage levels, as more advanced and feature-rich handsets reach the market in the increasingly open mobile Web browsing environment.

Data applications and mobile web – Data service involves the transfer of data to or from the mobile telephone, now enhanced by the power and speed of 3G and 4G technologies.

According to a 2009 Morgan Stanley report,[10] the proliferation of better devices and the availability of better data coverage are two trends driving growth of mobile Internet. Having better services and smaller, cheaper devices has led to a huge explosion in mobile technology that far outpaces the growth of any other computing cycle, as seen in Figure 5.1.

Mobile web opportunities, with richer content and more complex applications, are expanding in both developed and developing countries. Free and improved browsers and applications are becoming available for lower-end

Figure 5.1. **Characteristics of new computing cycles**



Source: Morgan Stanley, The Mobile Internet Report Setup, 2009.

Figure 5.2. **Strengths and weaknesses of mobile channels**

CHANNEL	STRENGTHS	WEAKNESSES
Voice XML	• Portable voice-activated services • Voice- and phone-enabled Internet access • Fast time-to-market • Open standard • Supports natural language • Less expensive than traditional IVR • Ease of integration	• Limited capability and development tools • Web browsing must be specific • Inability to pause, resume, forward and rewind
SMS	• Simple, easy and convenient • Cost effective • Private communications • Fast communications	• Some security vulnerabilities • Fake SMS (spoofing)
USSD	• Simple and logical • Real-time, fast and responsive • Inexpensive • Harmonious with other technologies • Interactive navigation • Can be used for payments, mass usage	• Session-based timeouts • Codes more difficult to remember than Common Short Codes
WAP	• Minimal risk and investment • Independence from carriers • Based on Internet standards • Easier to maintain and iterate user interface/ design • Streamlined reporting • Good for pushing content • One version across platforms, except iPhone	• Small size of mobile screen • Not as popular as SMS or USSD • WML scripts not embedded in WML pages • Cannot update for offline consumption • Must leave WAP site for video or audio • Slow to update • Not great for user-generated content
MMS	• Direct and personal • Messages can be stored and forwarded • WAP push potential • Segmentation • Interactivity through multi-media • Easy bulk messaging	• Not compatible with basic phones • More expensive than SMS • Content adaptation limited by screen size and resolution variations • Read and response rates lower than SMS
Data Applications	• Self-contained experience • Graphics and user-generated content • Automatic updates and read content offline • Leverages device-native capabilities (camera, GPS) • Strong paid model	• Fragmentation, need to build for multiple platforms, with time and costs • Managing multiple releases • Client side changes • Need to submit app to some stores for approval
Mobile Web	• More economical than mobile apps • Mobile phones and smartphones supported • Mobility for content and services • Mobblogging, with videos and photos	• Less functionality, unable to use advanced phone features such as camera, GPS • Small display size • Low text input and low bandwidth

phones. Using a compressed data format, these browsers are able to perform well on a low-bandwidth link, such as GPRS. A summary of the strengths and weaknesses of mobile channels is provided in Figure 5.2.

Back-end information systems and enterprise architecture

Implementing mobile solutions within an organisation can be viewed as extending enterprise applications to mobile devices. This requires understanding what information can be obtained from which applications, and how it can all be integrated and tailored seamlessly for citizens and for the mobile workforce.

The extension process consists of three primary components:

- the enterprise application (*e.g.* CRM, ERP, supply chain management [SCM], work management [WMS] and Business Intelligence [BI]);
- mobile middleware, with emphasis on security, data synchronisation, device management and support for multiple devices;
- the mobile client application (software running on the device), with emphasis on data availability, communication with middleware, local resource utilisation, and local data storage.

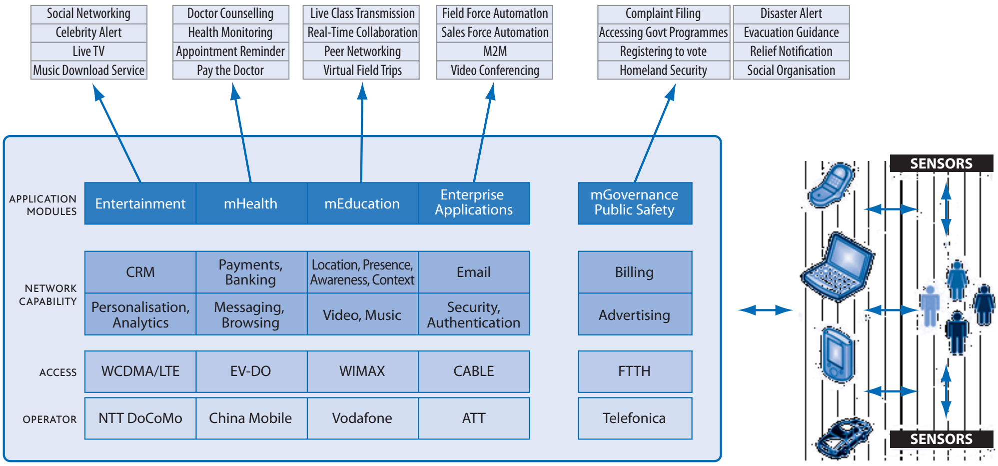
Data exchanges between citizens/mobile workers and enterprise applications may occur in different ways. A good wireless application gateway will operate in all of these modes:

- data is pre-fetched and aggregated on the wireless application gateway;
- data is fetched from enterprise applications on demand;
- data is pushed to the citizen or the mobile worker without a request;
- data exchange takes the form of desktop synchronisation.

Options for device platforms vary, such as online connectivity versus locally installed software and data synchronisation. Because mobile devices cannot display content or interact in the same way as a desktop PC, a user interface should be intuitive and appropriate to the user, job function and mobile device, to promote acceptance.

Decentralised framework **–** In *Mobile Services Evolution 2008-2018*, Chetan Sharma suggests a long-term mobile services platform with a decentralised framework, adding modules on-demand through Software-as-a-Service architecture. This approach, which is shown in Figure 5.3, can minimise complex integration and accelerate deployment.[11]

Figure 5.3. **Integrated m-services framework**



Source: Sharma, Chetan (2008), *Mobile Services Evolution 2008-2018*, Bellagio, Italy, 13 July-1 August.

Technical issues

The effectiveness of m-government depends upon the capacities of technology, which include the features and functionality of mobile technologies (*e.g.* screen sizes, storage space, processor power, input and output devices); supporting physical infrastructure (*e.g.* technology, equipment and networks); software, applications and systems; and related standards and protocols. The availability of multiple channels can raise issues of interoperability, data quality and transparency of delivery across systems. Essential to technology processes are the security, privacy, and policy structures that guide them.[12]

Governments should also ensure that websites (and website content) are accessible from all possible devices, and to all users. As citizens' use of mobile phones to access the Internet will very rapidly exceed the use of PCs to access the Internet, this fact will have consequences for the way websites are developed, as websites and their content will have to be available on different devices, including mobile phones. According to the World Wide Web consortium (W3C),[13] which is responsible for web standards and web accessibility, there is a significant overlap between making a website and making its content accessible for mobile devices and people with disabilities. In The Netherlands, for instance, the W3C guidelines are integrated in the Webguidelines, a quality standard for governmental websites. With the implementation of these guidelines a website and its content are accessible for all users; as a result, the development of a separate website for mobile users is not always necessary.

Experiences across countries also show that because many websites were not originally developed with the idea they would have to be accessible from various devices, more simplified versions of existing website are now often needed because of the amount and heaviness of the content which cannot be easily accessed via a smartphone. For example, the Dutch ministry of Economic Affairs, Agriculture and Innovation made a special mobile website for businesses, which helps businesses to navigate the tremendous amount of relevant information provided by the Dutch government. At a glance, businesses can see which laws, rules/regulations, licences and taxes apply to them. It also indicates which subsidies they may be eligible for. As part of the Ministry of Economic Affairs, Agriculture and Innovation, "Answers for Business" works closely with the entire Dutch public sector, including ministries, municipal authorities, provincial authorities and water boards, and includes links to the websites of these organisations. Because so many entrepreneurs have a smart phone, "Answers for Business" has developed a mobile site. This mobile version (*http://m.antwoordvoorbedrijven.nl/*) contains a simplified version which helps businesses by providing the most important information about rules/regulations etc. If the answer is not there they can contact the contact centre directly by telephone.

Security and identity management

The growth of mobile usage brings with it concerns about security issues. As the extension to mobile devices increases an organisation's security risks, mobile solutions must effectively balance information access and information protection. Security and identity management are strategically important and should include mobile device security policies, asset discovery and inventory, information security, encryption and authentication, secure coding processes for mobile applications, and ongoing risk assessment, security testing and threat monitoring. Most governments integrate mobile security policies, standards and protocols into their existing information technology policies. Many of the same techniques that help secure wired devices can be applied to portable and wireless technology. With the rapid expansion of Internet-connected devices, security is becoming as important a foundational element as energy-efficient performance and connectivity to define computing requirements. Embedding security into chips may provide new options for secure mobile solutions.[14]

By year-end 2013, location or profile information from mobile phones will be used to validate 90% of mobile transactions, according to Gartner, Inc. Gartner indicates that the rapid adoption of smartphones is forcing banks, social networks and other e-commerce providers to implement the kinds of fraud detection capabilities that have become mainstream with fixed-line computing. Such tools for mobile devices are in early development stages and are not expected to work easily across diverse mobile networks until at least 2012.[15]

Almost 40 countries across the world have implemented legislation establishing standards and validity for electronic signatures. A number of these countries provide electronic signature service and eIDs (electronic identification) through mobile applications. For example, Austria's Bürgerkarte, which is a smart card embedded with an electronic signature and a digital certificate, allows citizens to securely access electronic public services and complete administrative procedures electronically. Sweden and Austria also utilise digital signatures and citizen IDs to enable citizens to access public services through their mobile phones. Finland uses mobile SIM IDs that make it possible for citizens to make secure transactions and may even use the handset as proof of identity at a physical point of sale. In Estonia, mobile digital signature and eID-cards are widely used, with over 90% of citizens having the national ID-card with a smart chip. Card owners can communicate with the government by electronic means through the qualified digital signature. The Estonian ID card can be used for electronic voting through Internet. In addition, since the Estonian qualified digital signature is equal to a handwritten digital signature, it can be used over the Internet when establishing new companies and can be extended to be used to certify transactions even with other countries.[16]

M-Government service offerings will need to make security and privacy a top priority, as very strong security will be required for applications or services that contain sensitive information. Some of the reinforced needs to ensure security are related to the increasing use of mobile signatures – there is a need for additional measures to be taken to identify an individual, so that theft or loss of their phones does not allow an impostor to engage in transactions or access private data via that device – or to the fact that SMS messages can be spoofed today, which could potentially lead to credibility issues related to SMS messages used to deliver m-government.

Broadband connectivity

In the early 2000s, 3G networks brought more clarity, faster transfer speed, broadband multimedia applications and seamless global roaming. Fourth generation mobile technologies, beginning in 2006, offer all-IP packet-switched networks for mobile ultra broadband Internet access, multi-carrier access, and significant enhancements for multi-media access. Each generation of mobile communications has been based on a dominant technology, which has significantly improved spectrum capacity.[17]

3G networks – With speeds from 144Kbps to 2.4Mbps, roughly from three times a 56 K dial-up modem to near cable-modem speed, 3G cellular technology brings wireless broadband data services to mobile phones and a web experience similar to a computer broadband connection.

ITU statistics indicate that 3G subscriptions grew almost tenfold in the four years from the start of 2006 to the start of 2010. There were more 3G mobile cellular subscriptions globally by the beginning of 2010 (667 million) than there were total cellular subscriptions globally at the start of the decade (491 million).[18]

Mobile broadband subscriptions are set to exceed 1 billion in 2010, with the largest penetration in Europe (see Figure 5.5).

Box 5.1. **Finnish Mobile Signature**

In an initiative led by the Finnish Population Register (VRK), a department of the Finnish Ministry of the Interior, mobile specialists are helping mobile users in Finland to securely identify themselves and sign for goods and services across a range of public and private sector providers using just their mobile phone.

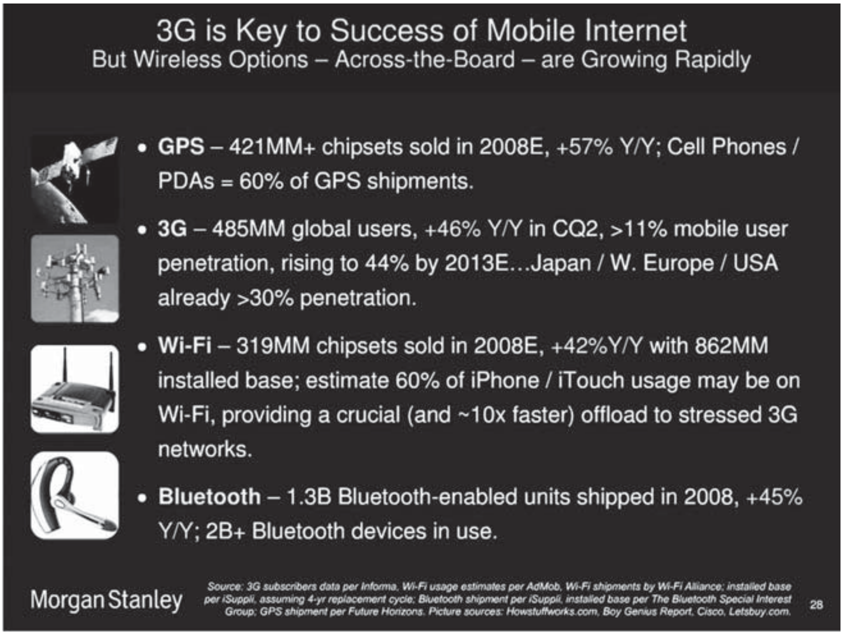
Since 1999, VRK has been responsible for issuing State Citizen Certificates, a national ID card driven by the Finnish Government and seen as an important means of identification within an electronic information society. Now, in the advanced mobile market of Finland, the security functionality contained within these cards (based on the EU Directive for electronic signatures) has been incorporated into the SIM card, turning the mobile phone into a personal trusted device able to remotely authenticate an individual, protect identities and create a legally binding digital "signature". Agreements have been signed with three Finnish operators, including Elisa, who will issue new SIM cards containing the State Certificate to subscribers.

Using the new SIMs in the handset will enable users to access a range of public and private sector services, including electronic banking and government web and mobile services. With their mobile phones, Finns will be able to authenticate themselves when electronically filing tax returns, registering for social security and paying for goods online. Creating a digital signature from the handset may even be used as proof of identity at a physical point of sale.

The mobile phone and SIM card have, by default, become the world's most pervasive smart card/card reader combination. Unlike the existing ID cards (the size of a credit card) that Finns carry around in their wallets, the SIM-based certificates do not require the user to be present when authenticating himself via an independent card reader. In this instance, the handset acts as the card reader, requesting the user to authenticate himself through a PIN code request, and sends an electronic digital signature to the service provider.

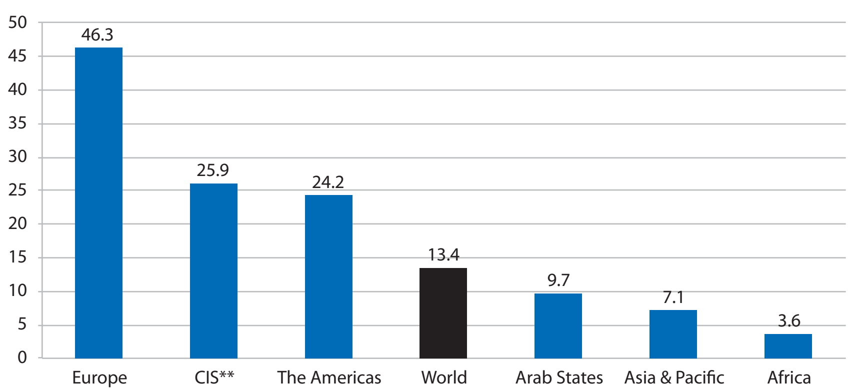
Source: http://digital-lifestyles.info/2005/07/18/smarttrust-provide-sim-based-state-id-to-finland/#ixzz1BgB8tc62.

Figure 5.4. **Growth of mobile Internet**



Source: Morgan Stanley, The Mobile Internet Report Setup, 2009.

Figure 5.5. **Mobile broadband penetration by region, per 100 inhabitants, 2010***



* Estimate

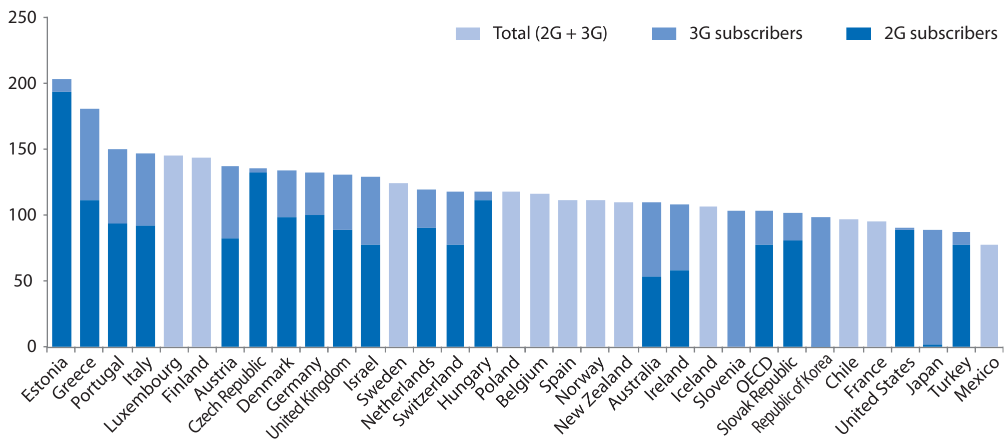
** Commonwealth of Independent States

Note: Regions are based on the ITU BDT Regions; see: *www.itu.int/ITU-D/ict/definitions/regions/index.html*.

Source: ITU World Telecommunication/ICT Indicators database.

According to the OECD, mobile subscription went to 1 billion in 2006 and 1.26 billion in 2009 and grew at a compounded annual growth rate of 4.6% over the previous two years.[19] There were 102.6 mobile subscribers per 100 inhabitants in OECD countries in 2009 (Figure 5.6).

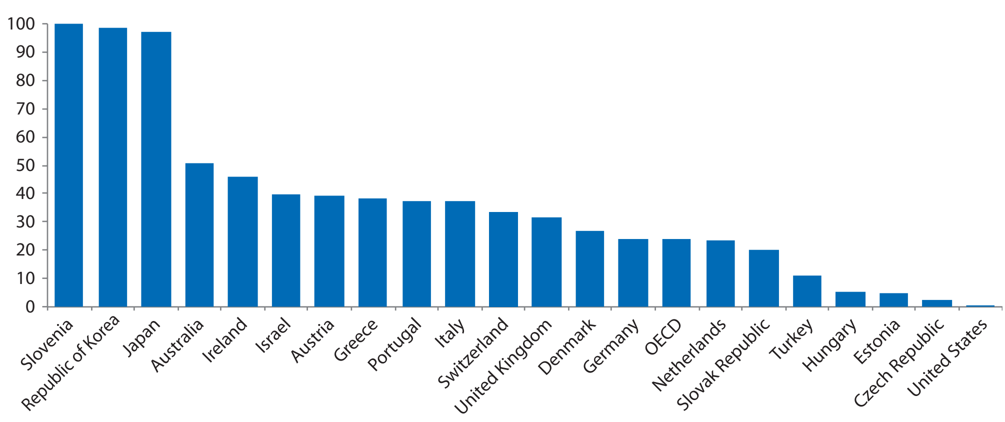
Figure 5.6. **Cellular mobile subscribers per 100 inhabitants, 2009, 2G and 3G**



Note: Portugal's 2G data include both 2G and 3G subscriptions.

Source: OECD Communications Outlook 2011.

Figure 5.7. **3G cellular mobile adoption. 3G subscribers as a percentage of total subscribers**



Source: OECD Communications Outlook 2011.

Moreover, mobile 3G growth is very strong in a number of OECD countries with Slovenia and the Republic of Korea leading with 99% of mobile subscribers with 3G handsets. The main reason explaining the growth appears to be that operators effectively convinced subscribers to upgrade from 2G networks.[20]

LTE – Long Term Evolution is the next step for many already on the GSM technology curve and for others, such as CDMA operators. LTE-Advanced extends the technological principles behind LTE into a further step change for faster mobile broadband and additional innovations. The move from 3G to 4G technology has begun. A number of LTE implementations have been completed and a number are planned. In August 2010, Uzbekistan became the first nation to offer two different LTE networks.[21] Mobile broadband speed influences usage, with faster speeds supporting more widespread take-up.

Integration

M-Government can complement existing e-government applications, or provide new and unique features and functionality to government services. Both efforts require co-ordination and integration at some level.

Primary challenges for integration with existing e-government solutions are how to pull data from a server-side system and how to represent it on the mobile device. This challenge is compounded in older systems. Key considerations include requirements for connectivity, security, data integrity, and devices.

Many governments in developed countries have centralised knowledge bases, CRMs, work management systems, and interfaced enterprise systems to support their customer contact centre operations, web-based services, asset management and performance reporting. As system providers have become less proprietary, governments have moved to open source systems. New mobile application developers are joining the market and mobile web toolkits become readily available, integrating mobile applications technology is becoming less challenging. Developing countries, which lag in their e-government initiatives, may avoid integration barriers and actually have the benefit of up-front planning and co-ordination of their e-government and mobile technology deployment, with the incentive of users who have greater access to mobile devices than to computers.

Because of the prolific usage of mobile telephony, many enterprise systems and many new systems are now including some type of mobile application or, at least, a much greater openness to system interfaces. The popularity and expanding use of Web 2.0 tools and social networking also support mobile telephony as an integral communication tool.

Interoperability[22]

The concept of interoperability has different meanings. The technical definition of interoperability is the ability of software and hardware on different machines from different vendors to share data. A more general definition of interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged. Not only is the ability to share data required, but also the capacity to use the data as relevant information. Both definitions are quite narrow, as they are limited to communication. A broader definition, relevant for m-government and public administration, extends beyond just communication. M-cooperation requires not only technical interoperability (as defined above), but also semantic interoperability: the partners in the co-operation have to give the same meaning to the terms used. In other words, a common framework allowing data to be shared and re-used across applications and institutional and community boundaries is needed, and it must establish syntactic structures for describing data to allow its automated processing. Furthermore, organisational interoperability (the shared information must fit the organisational routines of the participants) and institutional interoperability (the shared information systems must fit into the legal, cultural and professional codes of all participating parties) are also necessary. The requirements of all these kinds of interoperability have to be fulfilled for a successful co-operative deployment of ICT applications.

That is why enhanced interoperability at legal, organisational, semantic and technical levels should progressively lead to the creation of a sustainable ecosystem. This would facilitate the effective and efficient creation of new mobile public services.

At the same time that an exciting landscape for current and future m-government opportunities are being created by the rapid development and diversity of new mobile technologies, the technology itself is outpacing the capacity of governments to respond. Alleviating much of the anxiety for decision making about new technologies, providers and stakeholders in the mobile technology industry are collaborating to develop global standards.

The ITU regulates information and communication technology issues, co-ordinates the shared global use of the radio spectrum and establishes worldwide standards. Since 2007, for example, by co-ordinating the efforts of government, industry and the private sector, IMT-2000 (known as 3G) has more than 1 billion worldwide subscribers. IMT-Advanced systems are mobile systems that include new capabilities of telecommunication services, including high-quality multi-media applications.[23]

Other efforts include the Open Mobile Alliance (OMA), which is also working "to facilitate global user adoption of mobile data services by specifying market driven mobile service enablers that ensure service interoperability across devices, geographies, service providers, operators, and networks, while allowing businesses to compete through innovation and differentiation". OMA is the focal point for the development of mobile service enabler specifications, which support the creation of interoperable end-to-end mobile services.

Also through the Mobile Web Initiative, W3C and mobile industry leaders are working together to develop best practices for creating mobile-friendly content and applications, enabling easy access to device descriptions, setting up test suites for interoperability of mobile browsers, and exploring ways to use the Web on mobile devices to bridge the digital divide.[24]

Accessibility

Around 10% of the world population lives with disability problems and many more have functional impairments which limit their capability to use mobile phones. These situations are particularly frequent among senior citizens. In order to avoid the creation of new forms of digital exclusion, it is therefore indispensable to adopt solutions that ensure that all users have equal access to m-government services. From a legal standpoint, accessibility of information and communication technologies and services is mandated by the Convention on the Rights of Persons with Disabilities (CRPD) which was signed as of July 2011 by 149 countries and ratified by 103. As a result of ratifying the CRPD, governments should strive to launch m-government services that are accessible to persons with disabilities.[25]

Important categories of impairments addressed by solutions that ensure accessibility include: vision, speech, hearing, dexterity and cognitive impairments. Digital illiteracy, while not classified as a disability, is an important factor in many countries which hinders m-government accessibility. This can be tackled with solutions such as text to speech, screen readers, voice recognition and pictures interfaces, which may be applied to vision or cognitive impairments.[26]

Since the percentage of persons with disabilities is often underestimated, it is essential to ensure that proper demographic analysis is conducted in the country[27] before proceeding with the development of any m-government service. When accessible, mobile services are in fact more useful to persons with disabilities than to any other segment of the population: often, persons with disabilities are isolated due to mobility related limitations. In many countries, they also represent a higher proportion of the population in rural areas than in urban areas. Addressing their needs may also benefit all users at large: 57% of all adult users of personal computers benefit from accessibility features.[28]

Strategies to ensure that m-government is accessible to persons with disabilities include making sure that: *(1)* accessible handsets and services are available to all users who live with disabilities, or are digitally illiterate and that; *(2)* developers of m-government services and web application are aware and trained to develop accessible content and interactive services. Key actions include:

- Working with the Telecommunications Regulatory Authority to ensure that guidelines for mobile operators are in place to make handsets and services accessible to persons with disabilities.[29]
- Promoting among mobile service providers the benefits of accessibility and of offering accessible customer services.[30]
- Involving the Universal Service Fund to enlist its support to cover the extra costs that may be associated with accessibility solutions for mobile users living with disabilities, or digitally illiterate persons, as an additional incentive for mobile service providers.
- Training web sites and mobile applications developers to ensure respect of the Worldwide Web Consortium Accessibility Guidelines.[31]

While developing accessible services does not really increase costs if done at inception of a web site or application development, retro-fitting is often extremely costly and sometimes impossible to undertake. It is therefore indispensable to incorporate accessibility at an early stage of development, as stipulated by Article 9.2.h of the CRPD.

Location-based services

Location-based services, leveraging GPS chips, are emerging as a significant aspect of mobile systems. Mobile industry insiders indicate that enhanced location and location-related APIs will become core offerings of major platforms, whether it is iPhone, Android, BlackBerry or the Web. Eventually, all apps will have location-based functionality built in, as location-based ads become mainstream and brands start to use location-based apps to drive sales and marketing.[32] Some exciting initiatives for location-based services[33] are expansion of free downloads and open tools, shared services, crowd-sourcing to help build community maps, and free software and templates made available to NGOs and other groups for targeted services, such healthcare, to leverage data and mapping for social and economic improvements.

Social networking

Social networking sites on mobile devices and mobile broadband-based PCs now account for a large percentage of mobile data traffic. For example, over 200 mobile operators in 60 countries are deploying and promoting Facebook mobile products, with over 100 million active users accessing Facebook through their mobile devices.[34]

The trend described as "Mobile Web 2.0" or simply "Mobile 2.0" – services that integrate the social web with the core aspects of mobility – is a key underlying factor for m-government services. A basic aspect of m-government devices is that they, in principle, do not approach groups, but individuals. Personalisation is, next to location-based services and contextualisation, the core of m-government. Therefore, the mobile phone is central to the Web 2.0 paradigm, because it is carried with the user at most times (presence), is ideally placed to capture information at the point of inspiration (location), and is a key enabler of user-generated content (UGC) and social Web interaction (collaboration).[35]

Together with the ongoing migration to Internet protocol-based messaging, mobile access to Web 2.0 is driving pervasive disruption throughout the mobile industry ecosystem, significant innovation in services and hardware/software and, crucially, rapid subscriber adoption of the mobile Internet. However, these changes also might result in a gradual proliferation of services being offered to mobile users. In the future, the number and diversity of available services might in itself be a burden, since users may be dissuaded from searching for services they require because of the difficulty of identifying those services most appropriate to their needs. A potential solution to this problem is the introduction of facilities that would automatically identify and generate appropriate service bundles that are tailored to the needs of individual mobile users, and adapt the operation of these services as users' needs change. In the m-government context, for example, a citizen passing a government office may be reminded that the car tax is due next week and needs to transfer the required amount. Depending on the service level and the availability of mobile payment solutions, in the future, this might possibly be transacted via mobile phone.

Because of the technical and physical constraints of mobile, Web 2.0 does not translate directly as "Mobile Web 2.0". Mobile Internet evolution lags behind that of online space by at least five years.[36] Nevertheless, due to the ubiquitous role of mobile technology, its presence as an increasingly integral and invisible part of the lives and social relationships of citizens of all ages, and the increasing significance of wireless data transmission, the trend is clearly building up the mobile information society. Bottom-up and user-driven initiatives are going to spread in an increasingly persistent manner. Meanwhile, the task of maintaining and learning new technology skills will be all the more challenging. Still, the spread of Mobile 2.0 services is less driven by the technology. They are more of a signal that the industry is moving into a new era, driven by developments such as smartphones, better data plans, and social web.

Many Web 2.0 mobile services combine multiple application features, including geo-location, social networking, user-generated content (UGC), instant messaging[37] and, in some cases, Voice-over-IP (VoIP).[38] This mash-up of application functions and communications channels sets Web 2.0 on mobile apart from previous offerings, and has given fresh impetus to long-hyped services, such as location-based services and presence, albeit as service enablers as opposed to direct revenue streams.

Widely regarded as a collaborative Web 2.0 service enabler, presence provides the basis for a number of mobile applications, including “chat” (chat rooms and/or mobile IM), enhanced/intelligent network-based address books (NABs), and social web communities combining multiple communications channels, such as mobile IM and mobile VoIP, which are launched OTT (over the top) of the mobile browser or client. On the other hand, the types of applications, programming languages and communications protocols that can be executed in the mobile phone environment are far more limited by the constraints imposed by the phone’s form factor, processing power and battery life.

Over the past few years, there have been significant advances in infrastructure and end user device technology. Virtually all of these have contributed to opening the door for mass market adoption of Mobile 2.0 services and applications in some way. The deployment of high-capacity network infrastructure is well advanced in developed markets, with some 20% of mobile users having access to 3G services in North America and Western Europe. This will have reached over 80% by 2014, with many having access to next generation technology (4G). Although the absence of high bandwidth services does not preclude the development of mobile services, it does influence the pattern and speed of development.

Open source

Mobile applications present unique usability challenges, and developers should follow best practices. Builders of mobile applications selecting from a range of platforms should determine the target audience, required technology power and the future of the platform. As mobile applications become more competitive and fragmented, some developers are turning to cross-platform open source development solutions. Popular open source tools include PhoneGap,[39] QuickConnect, AppceleratorTitanium, as well as Funambol, appMobi, Core

Plot, Ocify, and Tweetero. A number of mobile operating systems are now open source.

The Open Mobile Consortium is a community of mobile technologists and practitioners working to drive open source mobile solutions for more effective and efficient humanitarian relief and global social development. Their goals are to implement joint mobile solutions in the field, maximise interoperability and data-sharing capabilities between technologies and streamline development, deployment, and use of open source mobile technologies. They share code, standards, plans, progress, and lessons learned.[40]

Next trends on the mobile market

It is becoming evident that smartphones and the associated applications are revolutionising the entire mobile market in a number of ways. Linking the hardware device, the smartphone, to a content delivery platform enables a powerful hardware/content combination. This type of initiative can remove one of the main conundrums within the industry: how to generate revenue out of content. A good example is the US government, which launched a selection of applications that allow smartphone users to access its services while on the move. Accessible through a dedicated website (apps.usa.gov), mobile apps offer a variety of useful tools, from finding the nearest post office to figuring out the UV index in a given city. Most are available as mobile websites, but the government has also been building apps for other major smartphone platforms (*i.e.* Android and BlackBerry).

In addition to this, software trends (like the advent of the open source mobile operating systems), hardware trends, and trends related to touch screens, battery, display, operating systems, the user interface, and design will have an important impact on the development of the smartphone market. Successful advances in hardware may spread rapidly to all smartphone manufacturers. For example, battery life is an issue for everyone, but will be a more serious issue in developing countries where there is little to no electricity, for which reason they will need to rely on solar powered battery chargers. Several important developments in particular will be seen over the next five years:

- Smartphones increasingly will be equipped with HD video recording capabilities. Economies of scale will reduce the cost of this component as more OEM handset vendors will adopt HD video.
- High-end smartphone devices will have dual core processors, with most smartphones having dual core processors by the end of 2012. (With a dual core processor, different applications can be split between the processors, saving on battery life and improving processing speed).

- New form factors are expected to emerge, particularly as smartphone devices become smaller, typically to the size of a standard handset.
- 3D technologies for video and still photos are being developed by several handset manufacturers. This is achieved by mounting two cameras on the device to replicate the distance between the eyes.
- Some last generation smartphones (*e.g.* Samsung's pico projector phone, called Beam, launched in 2010) are expected to be the first of several handsets that are equipped with projectors to get over the problem of limited screen "real estate" inherent in the smartphone device.

The smartphone market also has to be seen within the context of the broader communications hardware market. Perhaps the most important trend is the development of new forms of devices, typified by the iPad. Given the described innovation developments, when designing mobile government services, a mid-term perspective and technology trends outlook should be taken into account.

With the market producing more smartphones and inventing new value-added services, the number of mobile phones that support later technologies

Box 5.2. **Generating innovation**

Bob Hitching noted several "awesome, innovative and disruptive things about mobile", including:

- Long after mobile phones become ubiquitous, we will still buy them because of the continual advancement of hardware, battery life and software.
- A lot of mobile software is written to enable high-end smartphone features in lower price-point mobile phones.
- Apple's Push Notification Service, launched in 2009, allows an iPhone to receive short messages from a server controlled by an app developer. The cost to the sender reduces by a factor of 100, from an average of USD 0.10 for an SMS, to a few hundred bytes of mobile data, average cost around USD 0.001.
- The launch of mobile number portability in large markets, including China, India and Indonesia, will also encourage subscribers to switch and telcos to compete on voice and data pricing.
- 60% of the 421 million GPS chips sold in 2009 were put inside a mobile phone.

Source: www.mitchellake.com/news-item-details/nitemId/87/catId/2.

and the number of mobile phone users who know how to use those technologies are increasing. The readiness of a society for m-government services can be assessed on the basis of three aspects:[41] the maturity of technology; the capacity of service providers; and the level of interest among users. So far, the tendency has been that the public sector approaches new technologies and builds on them once the capability and availability of those technologies has reached a mature status in the private sector. This adaptation process can take a leap forward.

Notes

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5. *www.quirk.biz/resources/mobile101/285/1/Mobile-Technologies-SMS-MMS-USSD-and-Bluetooth-Wireless-Infrared.*
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23. *www.itu.int/ITU-R/index.asp?category=information&rlink=imt-advanced&lang=en*.

24. *www.w3.org/Mobile/*.

25. See list of ratifying countries at the United Nations CRPD web site: *www.un.org/disabilities/countries.asp?navid=12&pid=166*.

26. Mainstream mobile accessibility features such as adjustable screen, keyboard and sound settings, peripheral interfaces or picture menus, text to speech and voice recognition can be seen at: *www.e-accessibilitytoolkit.org/toolkit/technology_areas/wireless_phones*.

27. See ITU-G3ict e-accessibility toolkit at: *www.e-accessibilitytoolkit.org/toolkit/who_benefits/changing_views*.

28. See Forrester Research report commissioned by Microsoft at: *www.microsoft.com/enable/research/phase2.aspx*.

29. For samples of regulations see *www.e-accessibilitytoolkit.org/toolkit/technology_areas/wireless_phones%20and%20ICT%20accessibility*, for a list of accessible handsets and accessibility features commonly available, see *www.mobileaccessibility.info/*.

30. See the NTT DoCoMo case study at *http://g3ict.org/download/p/fileId_813/productId_152* or the AT&T case study at: *http://g3ict.org/resource_center/White_Paper_on_Accessibility,_Innovation_and_Sustainability_at_AT&T*.

31. See case study of accessible e-government strategy at: *www.e-accessibility-toolkit.org/toolkit/local_government*, W3C-WAI guidelines, tools and training resources at: *www.w3.org/WAI/* and M-Enabling Summit and training sessions at *www.m-enabling.com*.

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