The Global System for Mobile Communication:
The Hidden Influence of Standards in Text Messaging and Wireless Communication

by
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3 August 2013

1. Texting: Everywhere, Everyone, All Around

Figure 1. Grandma's first text message. Image courtesy of the Author.

"On June 4 at 2:34 pm, a 73 year old grandmother sent her first text to her granddaughter, 'Hi how are you? This is ny furst tyex byue, miomio [sic]'"

"From June 24-28, 2013, DoSomething.org created a nation-wide digital campaign for the "first ever texting experience with a president." Students from across the United States used a shortcode "PREZ" to text President Obama questions about student loan debt."

"Mobile banking company, Kipochi announced on July 11, 2013, a service that would allow users to purchase Bitcoins or virtual currency through the popular mobile payment service M-Pesa to send or remit micro-payments. A user receives an SMS when their bank account has been credited. The Kipochi mobile wallet will allow users across borders to send and receive Bitcoins through M-Pesa beyond Kenya."

What do a grandmother's first text message, a national student debt campaign involving President Obama, and a Kenyan Bitcoin wallet all have in common? They each rely on mobile phones that can send and receive text messages. Text messages, or the Short Message Service (SMS), are a confluence of standards, infrastructure, and standardization history that has existed for over 20 years. Developed during the standardization and technical realization of second generation mobile networks, SMS is still seen as one of the simplest innovations of mobile telephony (Brown 2007, Goggin 2005, Trosby et al. 2010). Yet it is one of the most popular forms of mobile communication today.

More than 6 billion text messages are sent and received by mobile phones across the world every day (CTIA 2012). The International Telecommunication Union reported this year that there are almost as many active mobile phone subscriptions as there are people in world (6.8 billion), and that by 2014 the number of active mobile handsets will outgrow the global population (7.3 billion) (ITU 2013). The United Nations recently found that there is oftentimes more access to mobile phones and networks in developing countries than there is to running water, even toilets (Wang 2013). All of these facts illustrate striking new realities about our world at the beginning of the twenty-first century: most people interact with mobile phones and wireless networks frequently, if not several times a day, as part of their personal and public lives. We rely on our mobile phones and network coverage to keep in touch with friends and family, to access to the Internet, to coordinate political activism, we even rely on phones as public safety tools during times of crises and in natural disasters. Text messages are leveraged for numerous networking applications as well, such as mobile banking, voting, social networking and public health campaigns through gateways that connect to the Internet.

What makes this mobile teleservice possible? What makes text messaging so common in our lives? And moreover, why is it so ubiquitous and so easy to use? While many social scientists have examined the motivations of why people text—from activism, to flirting and breaking up, to communicating with employers, there is little research that has examined the history and significance of SMS standards protocol to our daily lives (Ito 2005, Katz & Aakhus 2005). In the following essay, I examine the three factors that make SMS possible: consensus frameworks needed for standardization, the modularity of standards introduction, and the innovation of the short message service center to mobile network architecture. Each of these factors speaks to the success of SMS as a wide-reaching teleservice and form of written communication made possible by standards and standardization work. I argue that these factors are possible because a modern, organized standards body made a series of decisions built upon a consensus framework that led to the universal success of text messages in every other iteration of mobile network standards since (that is, in 2.5G, 3G, 4G and LTE networks). The next section covers the landscape of telecommunication standards and mobile communication at the end of the twentieth century. The third section discusses the development of the GSM and significance of its Memorandum of Understanding to standards development and a consensus framework. The final section discusses significant parts of the SMS standard that make it a true innovation to mobile telephony and the history of telecommunication standardization.

2. Wireless Networks and Mobile Communication, Standards

Though many people believe that mobile phones mark the beginning of truly mobile communication, media historians argue that wireless telegraphy figures in as the birth of mobile communication and data transmission at the turn of the early nineteenth century (Wythoff 2013, Carey 1989). Telegraphy infrastructure predates the cellular idea of mobile networks by many decades (Agar 2013), however Wythoff argues (2013) that as early as 1895 hobbyists and telegraph enthusiasts were imagining, pocket wireless transmissions as an early form of mobile communication. Infrastructure is made up of the devices, standards, technical architecture and network elements that make information and communication technologies (ICTs) possible. Distributed mobile communication practices, such as texting or using twitter are built up around infrastructure, and in turn are influenced or "structured" by the infrastructure that enable such practices. Many communication and information scholars have pointed to the fact that new infrastructure is bootstrapped to other infrastructure (Bowker & Star 2000). Often, standards and infrastructure are bootstrapped to other complementing, or earlier forms of infrastructures. Examples of bootstrapped infrastructures might be telephone lines that follow train tracks, or bus stops that are planned near major thoroughfares such as downtown intersections or subway stops.

More recent histories of mobile communication infrastructure focus upon mobility—or the wireless transmission of data while a user or device is moving in a network of coverage (Farman 2012, Mackenzie 2010). Instead of fixed point-to-point communication that the telegraph afforded, mobile networks allow users to receive messages or calls wherever data can be transmitted through network coverage. The text messaging teleservice is made possible by such networked wireless data transmission. When cellular networks were being conceived in the 1960s and first technically created in the 1970s and 1980s, a large portion of the mobile telecommunications industry in Europe and the United States predicted that data transmission, or teleservices, like facsimile and circuit switched data would be the most important mobile applications for end users (second to mobile voice calls). During the initial conception of teleservices in the mid-1980s, SMS was seen as a unique, add-on without much potential for commercial significance (Trosby 2010). While Facsimile and Videotext transmission, as well and other data transmissions formats like Mobitex appeared to be more lucrative for a time (Hillebrand 2010). It was imagined that these other data transmission formats would be bootstrapped into mobile telephony standards and carried over into wireless communication. But within a decade of its introduction, the text message teleservice would soon outpace these other forms of data transmission and be the most popular teleservices used with mobile phones. Originally conceived in the standardization of second generation digital cellular radio, it became a true innovation unique to mobile telephony.

The history and development of SMS standards, network architecture and protocol govern how mobile data is transmitted across networks today. It can also be attributed for the uptake of other services like picture messages (Multimedia Messaging Service), microblogging and social location services with SMS integration (such as bus routes or train timetables). The standardization history of mobile telephony also shapes how users experience infrastructure such as network coverage and other applications, like SMS gateways to the Internet (for example, Twitter or Sina-Wiebo). Though SMS has a variety of applications, personal text messaging between users remains the one of the most popular uses of mobile phones.

Standards and standardization development are cultural practices that influence and shape how our society communicates and creates, from work to play. From public transportation systems, to the ways that books are shelved in libraries, these practices rely on standards and their development over time. They have specific histories with politics, economics, technologies, and ethics. However, as many infrastructure scholars have noted, the power of standards is in their ubiquity and invisibility (Star 1999). Often, the significance of standards and standardization cannot be seen until something breaks down or becomes inoperable. Researchers and historians who examine ICT standards show that these hidden standards structure our experiences, they “shape not only the physical world around us but our social lives and our even our very selves” (Busch 2011, p. 2).

Our experiences of large-scale technical infrastructures ‘structure’ our lives in a variety of ways, in many millions of ways each day, and these are all based on decisions created by standards development (Dourish & Bell 2007). Standards represent consensus, reliability and repeatability over time and place. Wireless communication such as text messaging, just like library cataloging or bus route networks, rely upon groups of organized people (private and public actors) to agree to rules, regulation and modularity (Russell 2006). Often the very important work of consensus building is overlooked and under-examined in histories of standardization in information and communication technologies (ICTs). Standardization of SMS began in February 1985 within the Groupe Spécial Mobile (GSM), it was made possible by consensus generated by the memorandum of understanding (MOU) framework that the GSM later adopted. In this next section I discuss the history and development of the GSM, which was the first standards protocol for digital cellular radio mobile networks and is seen as one of the leading, great successes of mobile telecommunications industry of the 1990s.

3. The Global System for Mobile Communications: Standards and Standardization

In 1982 the European Conference of Postal and Telecommunications Administrations (CEPT) created a working group to address the future of digital cellular mobile radio communications. This working group, called Groupe Spécial Mobile (later named Global System for Mobile Communications) was charged with developing specifications and standards for a pan-European digital mobile radio, and supporting digital equipment (Taylor & Vincent 2005, p. 77). Initially, CEPT used consensus voting to create standards, but could not enforce standards compliance from operators, it could only recommend that manufacturers, telecommunication operators and participating nations make use of them (Eldquist, p.93).

De-regulation in telecommunications in the late 1980s brought a sea change to standards development: European standards development evolved away from national regulators and telecommunication monopolies to regional standards organizations made up of state regulators, telecommunication operators, network service providers and private manufacturers. For the first time, private manufacturers could participate and play influential roles in standards development. This allowed manufacturers to test designs early and work out technical realizations as standards were theorized and developed. These new regional standards bodies pointed to a new regime shift in the "transfer of power" from nationalized telecommunication monopolies to industry organizations made up of different private and public actors (Russell 2006, p. 104). This increased competition and allowed for faster market penetration and interoperability across regions and national boundaries in Europe (David & Steinmueller 1994). In the post-monopoly era of the 1990s, privatized telecommunication providers and manufacturers were able to contribute rapid standardization, with multiple iterations of development, aiming towards a common goal of a pan-European standard for mobile communication while competing in for a new, open market (Dupuis 1995). With this new model of private-public partnership, standards setting bodies such as the GSM could coordinate and create technical and organizational avenues to rapidly innovate, test, or even abandon techniques, and network principles in ways that previously nationalized monopolies backed by governments could not achieve. Andrew Russell has argued that this de-regulation of the telecommunications industry combined with global reforms that enabled competition and made ICT standardization became more *modular* in character (Russell 2005 p. 250).

Such modularity in standards development can be seen in the standardization processes created by the European Telecommunication Standards Institute (ETSI) which took over the GSM from CEPT. The handover from CEPT to ETSI marked an important shift in the ability of the standards body to enforce standards because of a new MOU framework, where all signatories had to use the GSM by certain, binding dates. After the founding of the ETSI, the GSM was absorbed and became a technical committee in 1989. The structure of the working party would be that the GSM developed technical recommendations for approval through ETSI. Within the GSM proposals were written and produced by Special Mobile Groups with working groups called Sub-Technical Committees divided into tasks of oversight ranging theoretical to technical iterations of teleservices, network services, general utilities, and so on. Before approval, development was carried out through general meetings that were held every few years; these meetings were divided into three phases where new phases of standards were introduced to the market.

In 1987, the Memorandum of Understanding was drafted and acted as a binding document to all signatories. The MOU created an open approach to the development of digital cellular standards and set the ball rolling for the effectiveness and the modular character of the GSM. Initially, the MOU was signed by telecom operators and regulators from 13 countries who committed to introduce GSM cellular standards by 1991. Earlier, the GSM had been only composed of network operators and national administrations. In early meetings, equipment manufacturers participated in GSM by invitation only, but in 1988 CEPT members agreed to open membership to any European telecommunications manufacturers who wanted to participate (Edquist 2002). By including a range of private and public actors, the MOU created a consensus framework for standardization development. The MOU eventually enabled transnational mobile station operation and standardized interfaces between equipment. This would pave the way for rapid GSM updates and success, and by 1996, the GSM MOU had 167 operators, from 103 countries with 20 pending applicants including Africa, Asia, Australasia, Middle East as signatories.

In addition to enabling transnational operation, the MOU also required service providers and equipment manufacturers to make all their devices compliant with teleservices standards, and this included SMS capabilities (Hillebrand 2010, p. 132). By 1990 the MOU framework required members to make SMS available for subscribers. Though it was initially rejected by other working parties as an optional add-on service, the fourth meeting of the GSM decided that it would become mandatory (Hillebrand 2010). The binding contract of the MOU framework is a lynchpin for the success and interoperability of SMS because it was available on all early handsets.

The MOU also created phases of protocol introduction. Initially three phases were planned from 1985 through 1996 (Phase 1, Phase 2, and Phase 2+). SMS was introduced during the Phase 2. Standardization development and technical realization of the GSM continued through to 1996 until it was "frozen" in the Phase 2+ rollout. Consensus and modularity are both features of the GSM MOU framework that enabled the introduction of SMS and other teleservices through the three phases. The next section will discuss how SMS as a teleservice is a unique innovation to the GSM standards.

4. SMS as an innovation

Innovations are defined as "new creations of economic significance," they can include new products, but also new processes as well (Edquist 2002, p.2). The SMS standards are a unique innovation because they are made up of both processes and components that represent a new kind of mobile innovation. By 1990, the SMS standard had been defined as a theoretical service, but it was not market ready. While the MOU required service providers to provide services by 1991, they were only built around the reception of text alerts. That is, users could receive text messages, but not send them. These early uses of SMS were usually to provide the user with a voice mail alert for messages waiting to be heard or other notices from their service providers (Hillebrand 2010).

Phase 2 standardization was completed in 1995 with market introduction the following year. In Phase 2, ETSI included more teleservices; these new services involved reworking portions of the earlier GSM standards and introducing new features like user generated SMS. The terminals and network structure of the Phase 2 standards had backwards compatibility with Phase 1 terminals and equipment but would also include a new important network element (Mouly & Pautet 1995). This new network element to the network architecture of the GSM made it possible for users to both send and receive personal text messages by 1994. The Phase 2 rollout of the GSM introduced a new server, called the Short Message Service Center (SMSC) that acted as a store and forward mechanism for data transmission.

At a general level, the basic network architecture of GSM is made up of three interconnected parts. The first component is the user's mobile handset or mobile station (MS). The MS is a terminal that includes the equipment and the subscriber identity module (SIM card) that allows users to make calls or send data through a mobile network, and be billed and located by their service provider. The mobile handset also includes a radio transceiver, the display to the user, and a digital signal processor. When users sent a text message from their phone, their handset transmits the message to a cell tower (or base station) and a base station transceiver handoffs the message to the network's closest SMSC. The SMSC locates the receiver's handset through geolocation registers databases stored by the network provider and send off the message if the receiver's handset was on, or hold it until the message could be delivered to a handset that was on and within range of mobile network coverage.

The new SMSC server allowed users to send and receive messages across a network, instead of point-to-point (as they would with analog or landline phones). GSM network providers were required to introduce SMSCs to their network architecture so that they could route and deliver messages to subscribers in their network or handoff messages to another service provider. The SMSC acts as a checkpoint or way station to send off messages to network operators and handoff confirmation back to users on any network. SMSCs deliver text messages that are a maximum of 140 octet payload, or up to 160 characters. Text messages can also be sent in Unicode, 8 bit and 16 bit encoding, though usually infrequently. The store-and-forward mechanism that the SMSC provided for mobile handsets was an entirely new kind of process for wireless data communication on mobile networks. Moreover, the text messages that were soon being sent and received became an entirely new product or communication format that service providers could bill subscribers for sending and receiving. The SMSC is not just another piece of banal network architecture: it represents a significant introduction to the GSM network architecture that makes SMS transmission possible, and because of the GSM MOU, a mandatory application for mobile handsets. It is the element of store-and-forward transmission process that illustrates the two-fold innovation of SMS as a new product and wireless communication process. With the ability to store, send and receive messages on personal mobile handsets in contrast to early models of voice messages stored on operating servers, mobile subscribers loved text messaging. A "new unique SMS argot" began to appear, and many communication scholars have argued it was an early driver for the mass uptake and catalyst for the success of mobile communication (Vincent 2004, Taylor & Vincent 2005, p. 83).

5. Conclusion

Figure 2. Texting is the most popular form of written communication (Noah, 2012).
Image courtesy of the Author.

The GSM can be seen as an illustrative case for the influence of standards in our lives. Perhaps more importantly, we can see it as a clear example of consensus framework and modularity in action, through the MOU agreement that enforced mandatory services into the introduction of second generation mobile communication in the early 1990s. Policy researchers, such as Pelkmans et al, have identified the European approach of the MOU consensus framework as more successful than the non-cooperative, market driven and competing process that the F.C.C. encouraged in the United States for digital mobile standards development in the late 1980s. Even today, the U.S. has a handful of competing mobile network standards that users can choose from (including GSM) that make it difficult for cost-switching and new contracts. However, Americans from every demographic participate in texting despite the fact that texting had a slower uptake than in Europe because of pricing. Clearly, the harmonized European approach of the MOU framework and the prevalence of competing standards in the U.S. points to the tradeoffs that are present between mandated and market-driven standards development in wireless telecommunications policy (Gandal et al 2003).

For our purposes here, we have examined the historical significance of consensus standardization that the MOU enacted how it influenced the proliferation of the GSM on mobile networks at the end of the twentieth century, and the significance of SMS as an innovation at the process and product levels. While GSM is still one of the most widely used standards suite for mobile communication across the world, SMS is even more prevalent because it was created as a unique teleservice innovation through consensus and modularity. The MOU created a principle of consensus that many other standardizations stories are not tied too, and like many abandoned forms of communication, it's easy to see how SMS might not have survived if the GSM had not required signatories to enable SMS as a mandatory teleservice for second generation mobile telephony.

Text messaging is a writing technology that reaches more people, more times a day than and in a plethora of situations on-the-go than most other networked ICTs combined. This is possible because of standardization, modularity and process innovation. In less than two decades since it was introduced as a teleservice, SMS has become a must-have mobile application, second only to voice calls on mobile phones. In many parts of the world it is seen as the most popular form of writing communication (Noah 2012). As I have argued, it is the consensus and modularity of the GSM MOU standards framework that made SMS proliferation possible, and can be credited for why it is so prevalent, even today. Given this unique history of standards development that enabled text messaging, and its ubiquity as a practice at every level of society—from grandparents, to presidents, to political movements—it becomes all the more important for us to examine the recent history of the hidden, invisible standards and standardization processes that make mobile communication all across the world possible.

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