

Evolution not Revolution in Next-Generation Wireless Telephony

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INTRODUCTION

Traditionally, design for industry transformed consumers' and other product users' everyday lives in one of two ways: "technology-push" or "market-pull". In technology-push, producers took a given technology or a well-specified technological subsystem, applying it into consumers' everyday lives as true to the original as possible. In market-pull, producers took consumer demand as their point of origin, channeling only those new technologies that consumers demanded (Ulrich & Eppinger, 1995). The traditional trade-off was that technology-push isolated design from consumers and other users, and market-pull isolated it from technology. Now, with technological advances, the market-pull side has developed a wholly new kind of sensibility to mold the evolution of technology. This is because of the multitude and diversity of the kinds of technologies that can be offered to consumers. Besides designing products or services by using front-end planning, products or services can also be designed by using feedback from users and customers, who thus become key "co-producers" (Wikström, 1996). This kind of evolution is not, of course, altogether new. This kind of a strategy of "robust design" (i.e., the market introduction of a new product or service and its flexible adaptation to feedback) can be said to trace at least as far back as Edison. In the case of the electric light, Edison introduced the idea of diffusing the science-based benefits of technology to small businesses and consumer households in a way that was earlier reserved for only "high-tech" and large businesses (Hargadon & Douglas, 2001). The design of innovations that have followed this model include the design of automobiles, computers, and mobile telephones, respectively (Ainamo & Pantzar, 2000; Castells, 1996; Castells & Himanen, 2002; Djelic & Ainamo, 2005; Pantzar & Ainamo, 2004). Ford made the automobile accessible, while General Motors played a role in the 1920's in contributing to the spread of the product platform concept as a basis for mass customization (see Pantzar & Ainamo, 2004, for a review).

Apple made personal computers a consumer product. The current "third generation" of mobile telephony is finally bringing on the arrival into consumer homes of what has been called the "information society" (Bell, 1999). Now, there is obviously much interest in, and excitement about, "the next generation" of mobile telephony. Besides researchers who often have held a purely intellectual interest in the issue, many professional or novice engineers have a technological interest. Still other people are financial investors who are interested in the next generation to make money. Consumers and users of phones have an obvious interest in how to "domesticate" third-generation mobile telephony so as to manage their everyday life with a mobile phone and to run and organize their routines. How to approach next-generation mobile telephony? This article provides an overview of how the next-generation of telephony will be more a point in a long chain of evolution than it will be a revolution.

THE REAL REVOLUTION IN WIRELESS TELEPHONY: GOING DIGITAL IN THE 1990s

If there ever was a revolutionary technological discontinuity, it has already occurred and there are few signs of a new one. The revolution occurred in the mid-1990's. The introduction of digital technology into the production, distribution, and reception of the wireless voice signals in the first half of that decade put a new kind of pressure on producers of earlier generations of wireless voice. The passage from analog to digital mobile telephony was a technological change of the most fundamental sort, impacting on such facets of operations as the ramp-up of transmission capability, efficiency of distribution networks, R & D, and the costs bases of all of these. The value and impact of evolution were not only technological. The revolution triggered a process of evolution that had a profound impact on the entire mobile telephony system: from

consumption patterns to technological, to productive structures, and, finally, to business models. The market outlook, the operators' typologies, and the distribution systems changed. The audience behavior and the mobile user's status changed, as well as the nature of the medium and its function.

Digital telephony in the 1990's compressed the radio signal, and was thus conducive of a much larger amount of "traffic". Due to the digital signal compression, the use of electromagnetic spectrum and capacity utilization became more efficient than earlier. These factors, in turn, produced a subsequent increase in the number of channels which could be transmitted, as well as an increase in choice options. Thus, with the same quantity of frequencies as before in an analog wireless channel, a service operator could manage a manifold increase in traffic in the digital wireless channel. The new channel capacity increased in a manner that could be cleverly used in a number of ways, allowing for value-added services such as voice mail and "SMS" (Short Messaging Service) messages, for example. The changes in the nature of the signal in moving from an analog to a digital system are summarized in Table 1.

The digital standards of the early 1990's were the beginning of platform-based and modular strategies in the design, production, marketing, and use of mobile phones, to the point that users can, by the 21st century, create their own personalized program set. Technically, interactivity requires the presence of a return channel in the communication system, going from the user to the source of information. Already, interactive programming was a built-in feature of the new standards.

Essentially, the digital system allowed for two kinds of services: services that are "diffusive numerical" (such as Pay per Use, Mobile Video on Demand), and those

that are "asymmetrical interactive video" (e-banking, e-shopping, interactive games, etc.). Both of these kinds of services are at the rapidly advancing boundary of mobile telephony.

Besides being hot topics in mobile telephony, the new services are also a hot topic in television, which is only now moving from the analog into the digital era. Mobile telephony has recently been making inroads of mobile telephony into video and television. Rather than immediately focusing on the here and now, let us first focus on the past. One of the key platforms from the start in the 1990's has been the "GSM" standard.

DIGITALIZATION AND STANDARDIZATION: THE CASE OF GSM

The term *Global System for Mobile* telephones (GSM) was adopted by European regulators and mobile telephone producers in the late 1980's to specify and form consensus on the then new digital signal processing and transmission. Earlier analog solutions were running out of capacity. Like other digital networks, GSM was, and still is, based on the transmission of a digitized signal which is transformed into a binary numerical sequence, that is, a succession of 0's and 1's. In the 21st century, GSM is a digital mobile telephone system that is still widely used in Europe and other parts of the world.

GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely-used around the world of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). For these and other technical details of the GSM, see Table 2.

GSM receives and compresses data, then sends that data down a channel with two other streams of user data,

Table 1. Moving from analog to digital: Immediate and lagged impacts

- Better voice and multimedia quality
- Smaller size of the wireless terminal device
- Challenges in terms of screen size in the smaller devices
- Integration of web technologies with digital wireless, leading ultimately e.g. the wireless application protocol (WAP) standard in 1997
- Increased programming options leading to the Nokia communicator (1995), Palm Pilot (1996), and the iPhone (2007)
- Security issues – digital encryption for scrambling programming such as e-mail in order to make service inaccessible to «hackers»
- Easy integration with service providers such as games, public services, image banks, and mobile TV broadcasting networks and broadband telecommunication networks (e.g. B-ISDN)
- 3G spectrum auction and the decline of European competitiveness

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