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Anri Kivimäki

Evolution in Telecommunication Standardisation Practices: The Case of 3rd Generation Wireless Communications

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Anri Kivimäki

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Tutkielma

Standardoinnin merkitys kasvaa tietotekniikassa ja erityisen merkittäväksi standardit ovat muodostuneet teleliikenteessä, mikä on voimakkaimmin kasvava teollisuudenala maailmassa. Teleliikenneteollisuuden kulutus ei ole vain riippuvainen teknologiasta, vaan yhä enemmän se on riippuvainen hyväksytyistä ja käyttöönotetuista standardeista. Standardit mahdollistavat tuotteiden ja verkkojen yhteensopivuuden ja luovat positiivisia ulkoisia etuja käyttäjille (network externalities).

Tässä tutkimuksessa tutkimme menestystekijöitä, jotka johtivat eurooppalaisen GSM-järjestelmän leviämisen maailmanlaajuiseksi standardiksi. GSM:n menestys johti myös seuraavan sukupolven systeemin kehittämiseen, jota kutsutaan UMTS:ksi.

Tämänhetkinen UMTS standardointi mahdollistaa informaatioteknologian laajemman investoinnin teleliikenneinfrastruktuuriin. Seuraavassa sukupolvessa tulee olemaan (virtuaalisesti) mahdotonta eritellä informaatioteknologia, media- ja teleliikennetoiminnot liikkuvassa verkossa.

Tässä kvalitatiivisessa tutkimuksessa esittelemme yleisen standardointi mallin, joka koostuu ympäristöstä, "portinvartijasta" (gatekeeper), insitutionaalisesta funtiosta ja teknologia/tieto ja markkina/politiikka (toimintaperiaate) sykleistä. Malli yhdistää standardoijat: operaattorit, tuottajat, regulaattorit (lainsäätäjät) ja organisaatiot saman "sateenvarjon" alle keskustelemaan kansallisista, alueellisista ja kansainvälisestä standardoinnista. Siirtyminen toisesta sukupolvesta kolmannen sukupolven maailmanlaajuiseen standardointiin, on merkittävä muutos standardointiin. Muuttuvia tekijoitä ovat: aika, standardoinnin ominaisuudet, standardointiin osallistuvien määrän kasvu ja muutokset standardointiin osallistuvien organisaatioiden toiminnassa.

AVAINSANAT: standardointi, prosessi, 3. sukupolvi, teleliikenne, GSM, UMTS, IT

ABSTRACT

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The importance of standardisation is growing in the IT (Information Technology) sector and especially in telecommunications, which is the fastest growing industry sector in the world. Telecommunication industry is not only dependent on technology advances, but increasingly on commonly accepted and adopted standards. These enable compatibility of products and networks and create network externalities for users.

In this paper we identify the key factors that lead European based GSM (Global System Mobile for Communications) specification to become a global standard. The success of GSM paved a way to the concept of the next generation global system - UMTS (Universal Mobile Telecommunication System). Current UMTS standardisation enables a rapid migration of information technology into the telecommunication infrastructure. In the next generation it will be (virtually) impossible to distinguish between information technology, media and telecommunication features in a mobile network.

This qualitative study outlines a general -standardisation model, which consists of environment, "gatekeeper" and institutional function and a technology/knowledge and a market/policy creation cycles. The model connects different players i.e. operators, manufacturers, organisations and regulators under a technology push-pull model to that enables investigation of national, regional and global standardisation practises. The migration of 2nd generation standardisation towards 3rd generation global standardisation is characterised by a number of novel issues such a timing, standardisation properties, the growth of standardisation stakeholders, and changes in the organisational forms of standardisation.

Keywords: Standardisation, process, generation, telecommunication, IT, UMTS, GSM

INDEX

1.	INTRODUCTION	1
	1.1. Motivation and Goals of the Research	
	1.2. Research Problem	
	1.3. Standardisation: Theoretical Preliminaries	
	1.4. Organisation of Thesis	
2.	EVOLUTION OF MOBILE WIRELESS TELECOMMUNICATION SYSTEMS	
	2.1. Background Information	
	2.2. Definitions of Standardised Technologies	
	2.2.1. Features in Wireless Telecommunication Technology	11
	2.2.2. Globalisation of standards.	
	2.3. GSM	
	2.4. UMTS	
	2.5. Summary	
3	RESEARCH APPROACH	
٥.	3.1. Types of Research Methods	
	3.2. Research Setting.	
	3.3. Interviews	
	3.4. Literature Survey	
1	STANDARDISATION	
4.	4.1. Standardisation Preliminaries and Need for It	
	4.2. Standards and Standardisation	
	4.2. Standards and Standardsauton 4.3. Types of Standards	
	4.4. Main Players in Standardisation Process	
	4.4.1. The Role of Standardisation Organisations	32
	4.4.3. Formal Standardisation Organisations	
	4.4.5. Forums	
	4.4.7. "3 rd Part Developers"	
	4.4.8. Regulators	
_	4.5. Summary	
Э.	A MODEL OF A TELECOMMUNICATION STANDARDISATION PROCESS	
	5.1. The need for General Model	
	5.2. Environment	
	5.3. "Gatekeeper" Function	
	5.4. Technology/Knowledge Creation Cycle	
	5.5. Market/Policy Creation Cycle	
	5.6. Institutional Function	
	5.7. Relations	
_	5.8. Summary COMMONALITIES AND DIFFERENCES IN THE 2 ND AND 3 RD GENERATION	66
Si	TANDARDISATION	
	6.1. General Characteristics	
	6.2. Why Timing Is Important?	
	6.2.1. Critical Issues of Timing Related to Standardisation Process Model	
	6.3. The Role of IPR Issues	
_	6.4. Summary	
7.	DISCUSSION	81

7.1. Standardisation Process Model	81 84
7.3. Recommendations for Standardisation Process	85
7.4. Conclusion	88
REFERENCES	91
APPENDIX 1	99
APPENDIX 2	100
APPENDIX 3	102
APPENDIX 4	104
APPENDIX 5	106
APPENDIX 6	107

1. INTRODUCTION

Telecommunications is the fastest growing industry sector in the world. In this study we identify key factors that lead European based GSM¹ specification to become a (really) global standard. The success of GSM broadened later to the idea of a next generation global system – called Universal Mobile Telecommunication Systems (UMTS). Through UMTS standardisation a migration of information technology - especially Internet technologies (TCP/IP²- HTML³) - into a wireless telecommunication infrastructure will become commonplace. In the next generation it will be (virtually) impossible to distinguish between information technology (IT) services and telecommunication services in a mobile telecommunications network.

In order to achieve this in a global scale multiple players - operators, manufacturers and operators - need to negotiate with a amount of regional standardisation bodies. A global standardisation strategy is needed to adhere the required compatibility standards.

To understand this phenomenon we present a standardisation model, which consists of an environment, "the gatekeeper" and institutional functions. The model involves two main processes: a technology/knowledge creation and a market/policy creation cycle. We use the model to analyse 2nd and 3rd generation standardisation processes. Our analysis shows that the migration from the 2nd generation to 3rd generation wireless services is characterised by the following issues: criticality of timing and increased of speed, novel standardisation properties, the increased number of standardisation stakeholders, and flexible changes in organisational forms.

¹ Global System Mobile for Communications, formerly: Groupe de travail Speciále puor les services Mobile

Mobile
2 Transmission Control Protocol/Internet Protocol

³ HyperText Markup Language

The goal of the research is to understand the nature of the third generation mobile standardisation process as a significant information integration and discovery process and to identify key factors/inhibitors that shape this process. We also examine the role of institutions, organisations and the impact of technical change in the standardisation process. Furthermore, we want to investigate the technological and business reasons why GSM based standards expanded into a global third generation UMTS standard. The importance of this expansion will be studied through our analysis of the development of global wireless infrastructure, integration of IT technologies in to the wireless infrastructure. The new global mobile telecommunication standardisation process will play a key role in the development of common wireless communication infrastructure within the US, Far East and Europe. This evolution will strongly affect the telecommunication industry, communication culture, business models. Moreover it will require massive investments.

This research area interests multiple players: telecommunication industry, operators and various user organisations. The importance of standardisation research has grown significantly due to rapid technology development, an increase in the number of players and a wide recognition of its value and importance.

1.1. Motivation and Goals of the Research

A rapid evolution in telecommunications has increased the importance of standards and the standardisation processes (Cargill, 1989;Cowan and Foray, 1997; Nielsen, 1996; Foray, 1998; Krechmer, 1996). This is due to drastic changes in technology, economies of scale, the increased need of both national and global administration, and the rapid service development that has resulted from decreased regulation. The next generation wireless telecommunication systems in Europe are expected to: "encourage innovation, liberalisation and competition in the provision of telecommunication and information technology service, leading to a larger market for mobile communication with lower

equipment prices and tariffs, and the ability to support a wide range of user requirements" (UMTS Task Force Report, 1996, p. 12).

The main motivation of this study is to examine the equalities and differences of adopting standardisation processes, such as timing and speed issues, the process features, and varying organisations' role in the 3rd generation standardisation. The push behind this evolution is digital technology and for pull from emerging global markets and user expectations and requirements. The telecommunication is the fastest growing field in the IT sector currently and thus requiring from operators and industry players vast investments. At the same time the expectations of revenues are significant. In order to understand these issues a standardisation process model is suggested which consists of five components: the environment, the market/policy cycle, the technology/knowledge cycle, the "gatekeeper" role and the institutional function. The nature of relations in the model is analysed in the context of 2nd and 3rd generation wireless standardisation. When analysing the future of wireless services we assume that world economy will continue to remain stable, but regional differences may grow. We also expect that new technology will meet the service requirements, which are set by users, operators and regulators. Because mobile telephony is a relatively young industry with many uncertain elements, all critical issues for service uptake such as health risks are not researched.

1.2. Research Problem

We expect that the third generation broad-band mobile telecommunication systems UMTS/IMT-2000⁴ (previously FPLMTS⁵) will be introduced in the early years of the 21st century. The third generation standardisation process was created in the aftermath of the success of European GSM system. The motivation for this initiative is the rapid

⁴ International Mobile Telecommunication

⁵ FPLMTS, Future Public Land Mobile Telecommunication Systems

growth of base technologies (semiconductors, batteries, signalling technologies, radio frequency technologies, and data mart technologies), rapidly increasing number of subscribers (overall the number of subscribers is expected to grow over billion by 2005), globalisation of the services, and the demand for new types of services. Timing aspects are also becoming critical in the standardisation process. Therefore we will investigate the key factors/inhibitors in the creation of global standards and how standard making is affected by perceptions concerning customer needs, market growth and speed, and changes in the institutional standardisation regimes.

We want to investigate in consequence what are the main factors that affect the needs, if any, for expanding GSM based standards globally, and what institutional, organisational and technical issues have changed from the development of European based GSM standards. Additionally, we need to find out what is the emerging "learning-by-doing" process, which creates 3rd generation standards, and which forces and players, if any, have an impact on it.

No doubt the coming global standardisation regime for wireless communications will create new forms of technology regulation, new standardisation organisations and new forms of market creation. In this thesis we investigate what new features can be recognised in the global standardisation processes. The evolution of mobile telecommunications will have a significant role in the emerging global information infrastructure (GII). In this context we research how standards can govern the mobile telecommunication technology in the future. This research primarily concentrates on the development of global mobile telecommunication standards from the view point of European participants.

1.3. Standardisation: Theoretical Preliminaries

Standardisation has played a prominent role in all spheres of information technology. In particular its importance has been decisive in the emergence of wireless telecommunications, as the success of NMT⁶ and GSM technologies demonstrates. In wireless telecommunications standards enable users to deploy a mobile terminal anywhere and anytime thus creating a novel mechanism for global social interaction (Hollan and Stornetta, 1992). Standards and technologies are social artefacts. Therefore participants in the standardisation process must create social networks for using and shaping the technology. Thus social networks play an important role in the standardisation process as they are critical in creating compatibility between different technological components and regimes that span across different nations and regions. Farrel and Saloner, (1985, p. 70) point out that: "Consumers (Users) benefit about compatibility in (telecommunications) a number of ways. There may be a direct "network externality" in the sense of that one consumer's value for a good increases when another consumer has a compatible good, as in the case of telephones or personal computer software"

A term network externalities was suggested by Kantz and Shapiro (1985) when they developed the oligopoly model in which a consumer values a product more highly when it is "compatible" with other products. Later they have made a distinction between direct and indirect network externalities. Indirect externalities are divided into two types: technology and pecuniary externalities. An example of technology externality is pollution. The pecuniary effects are external effects that work through the price system (Liebowitz and Margolis, 1994). Network externalities, such as compatible standards in certain markets or community, increase the value of each instance. For example, the value of a phone increases with the size of the network, value added products and when services increase. The stable market, such as telephone services, stabilises the competition and thus reduces the manufacturing costs. Stable markets can be enhanced

⁶ Nordic Mobile Telephone

by compatibility standards where manufacturers do not have to put effort to develop competing standards. Network externalities are investigated extensively in (Farrel and Saloner, 1985, 1987; Katz and Shapiro, 1985, 1986, 1994; Economides, 1994). Also David and Greenstein (1990) give a thorough review of the economics of the standardisation.

The compatibility of products brings benefits for several players of standardisation in the form of network externalities. These players comprise of users, manufacturers, operators and regulators. The capabilities create demand-side economies of scale: there are benefits to do what the others do. Two main sources of these benefits here are 1) interchangeability of complementary products and 2) cost savings (Farrel and Saloner, 1986).

There are several classical examples of interchangebility of complementary products such as computer software, VCR⁷ tapes, CD⁸s, and camera lenses. We have also failures in the history of compatibility of products: Beta vs. VHS⁹, and QWERTY replacement (Arthur, 1990; David, 1985). Standardisation, especially interchangeability of parts, facilitates mass production. During the standardisation process cost savings begin from the knowledge creation. Thus fewer alternatives need to be examined and the specification is developed in a shorter time. This has effects on the market side, and thus benefits the final user.

The literature offers several definitions of compatibility and interoperability. Bailey et al. (1995), define compatibility as the ability of two components to work within one system line e.g. mobile phones. In contrast, incompatible products can not instead achieve this e.g. Macintosh and UNIX operating systems. Yet, the current technology developments can make these systems interoperable through "gateways" when using open network applications e.g. TCP/IP, or WWW¹⁰. These systems can mask the incompatibilities from the user and allow unencumbered data exchange (Bailey et al., 1995) through "gateways" or "adopters". Normally the compatible market creates a few

⁷ Video Cassette Recorder

⁸ Compact Disk

⁹ Video Home System

dominant players that operate globally. Accordingly, compatibility leads to a "lock-in effect": i.e. users buy products, which are compatible with their original, purchases (Bailey et al., 1995; Beggs and Klemperer, 1992). Thus the compatibility is achieved by software, which provides the compatibility between different technologies/interfaces. The market requirement is also that new products must also be backwards compatible ensuring efficient usability in e.g. software version updates. To differentiate products companies channel them in to conventional dimensions, such as services, prices and product features e.g. colours, user interface. Thereby telecommunication standardisation seeks to achieve compatibility between products and thereafter yield "increasing returns" (Arthur, 1990) and interoperable systems that achieve these effects. For example a Bluetooth¹¹ provides compatible, flexible, and high data rate links between any types of system components thus creating huge lock-in effects and "increasing relations".

Interoperability is defined as follows: information and services can be accessed by a user of one system while the services may reside on other systems. Interoperability is found within a heterogeneous communications environment e.g. Internet. Non-interoperable products operate only within the limits of their own system. For example, satellite mobile phones like IRIDIUM may interoperate only within their specific system.

1.4. Organisation of Thesis

The organisation of the thesis is as follows. In chapter 2 we focus on the standardisation of wireless telecommunication systems by studying GSM and UMTS systems and their new components. Chapter 3 presents the research approach including general research

¹⁰ World Wide Web

¹¹ Bluetooth is a global specification for wireless technology. It is designed for short-range wireless connectivity within three areas: data and choice access points, cable replacement and ad hoc networking.

methods, research setting, description of the interviews and a literature survey of the study. In chapter 4 we present standardisation targets, and define key issues that must be overcome during the standardisation process. We shall discuss the increased number of players of the 3rd generation standardisation and the new organisations and forums that seek to adhere this. Chapter 5 presents a standardisation process model which entails essential features of standardisation processes. We highlight the fundamental components of the model in subsequent sections. Chapter 6 will focus on illustrating equalities and differences in the 2nd and 3rd generation standardisation process. We shall also discuss why timing and speed has become important in the next millennium standardisation process. The role of IPR¹² issues in the standardisation process are also discussed. In chapter 7 we summarise results and make some recommendations for future studies.

The Bluetooth specifications defines a system solution comprising hardware, software and interoperability requirements. More information is in www.bluetooth.com ¹² Intellectual Property Rights

2. EVOLUTION OF MOBILE WIRELESS

TELECOMMUNICATION SYSTEMS

2.1. Background Information

In this chapter we definite firstly radio spectrum and frequency, systems and components. Then we look at GSM and UMTS technologies. The basic features of both systems are shown in Table 1. and described in subsections.

Covered issue	GSM	UMTS
Main Standardisation body	ETSI ¹³	Originally ETSI, later 3GPP ¹⁴
Phases	Originally 3	2
Originally developed for	European market	Global market
Standardisation finalised	1992	In Europe 1999
In commercial use	1991/92	2002 in Europe
Frequencies	GSM: 890-915, 935-960 MHz	1900-1980, 2010-2025,
	DCS1800: 1710-1785,	2110-2170 MHz
	1805-1880 MHz	
Services	Voice, data	Voice, data, video
Standard type	Open, de jure	Open, de facto

Table 1. Basic features of GSM and UMTS systems.

The term technology has various definitions based on what the term before "technology" is: information technology, telecommunication technology, signalling technology etc. The difference between information technology and information systems equals with telecommunication technology and telecommunication systems: technology is the means, and systems are the ends (Briffault and Spitz, 1995).

 ¹³ European Telecommunication Standard Institute
 ¹⁴ 3rd Generation Partnership Project

Radio technology can be divided into two types of technologies: analogue and digital. Analogue technology relies on audio signals that transmit information. Controversially digital telephony uses a set of binary codes to transmit the information. The line transmits a series of "on" or "off" pulses to the receiving terminal, which reconfigures the information for the receiver. The significant difference is that digital uses the same binary codes that prevail in the computer industry and therefore it makes the integration of telephone and computer feasible (ETSI, 1995).

Each radio application has its own frequency band within the radio spectrum, e.g. global positioning systems, mobile phones, dog watchers, baby alarms etc. A radio wave, which is an electromagnetic wave propagating between a transmitting and a receiving antenna. Radio waves are characterised by their frequency, and by tuning a radio receiver to a specific frequency one can pick up a specific signal. Basically the allocation and amount of used radio spectrum may vary from one country to another. Regulatory authority, in Finland Telehallintokeskus, decides who is able to use what frequency band for what purpose. However, the goal is to harmonise frequencies at the global level to have bigger advantages of the developed systems. This enables international use of products and services. The harmonisation is carried by Regulatory bodies that issue licenses and organise auctions (CEC, 1998b). Frequency bands define specific locations of services in the radio spectrum such as GSM spectrum GSM900, or GSM1800. Radio spectrum is a scarce resource and the increased number of users and players may lead to reallocation of frequencies at some stage around the year 2005.

Telecommunication products consist of available components, the switching transmission and power components. Various products together form a telecommunication system. In defining the term component we follow Economides (1989) who defines components as complements. A personal computer can be divided to two components, i.e. monitor and central unit. The personal computers can be sold as systems like the original Macintosh by Apple. Personal computers are made of a number of compatible components such as disk-drive controllers, input/output card, etc..

2.2. Definitions of Standardised Technologies

In this context we mean by technology a telecommunication technology. The term telecommunication covers a number of human activities concerning the transportation of data (telephone, TV). Thus, it is important to achieve a clear definition of what is telecommunication and what it is not. Generally accepted definition is written by ITU in 1947 with minor changes is still valid (Bekkers and Smits, 1999, p. 2).

"Any transmission, emission or reception of signs, signals, writing, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems."

We must also recognise the difference between telecommunications and telecommunication. Telecommunications is the art of, or subject relating to, communicating over distances. Telecommunication is the act of so doing, or an adjective qualifying, for example, a network or a terminal.

2.2.1. Features in Wireless Telecommunication Technology

Mobile communications or wireless communications usually refer to telecommunications, where a user/customer has an access, to the first communication link, in this case wireless and uses radio transmission, by using the user mobile or more mobile compared to a situation in which the user is attached to a fixed network by wire. When mobile radio refers to a private network for radio communication, whereas mobile telephony refers to radio voice communications using a network that is connected to the public switched telephone network (PSTN). Cellular telephony refers to a case of mobile telephony, where the area of coverage is divided into a cell-like structure with different cells using different frequencies (Lindmark and Granstrand, 1995).

We have terms mobile communications and landmobile communications, meaning nearly the same. The difference is that landmobile refers to those communication stations without the restricted location that were established on land (Bekkers and Smith, 1999). For mobile communications Bekkers and Smits (1999, p. 5) propose the following definition:

"Mobile communications is a form of communications in which a radio connection exists between a communications station whose location is not restricted and a fixed communications station in which the communications stations may be transmission, reception and transmission/reception stations."

It is also important to define what is a personal communication service, because it is part of the mobile telecommunication. A widely accepted definition of personal communication service is "the ability for a user to originate and receive calls or messages at any time, anywhere and in several roles using a pocket terminal".

2.2.2. Globalisation of standards

The term globalisation is widely used in various contexts. On industrial globalisation new balances must be sought between competition and co-operation, also in standardisation.

One description of globalisation is given by Martin Bangemann (ETSI, 1995, p. 11):

"This globalisation of the Information society and the management of the transition to this Society, taking into account the needs of all interest of society at large, constitutes one of the most important tasks to be undertaken in the remaining part of the last decade of the 20th century. To succeed, and to respond in the available timewindow, authorities, governments and states should encourage private initiatives and investments and should develop a dynamic and adaptive regulatory regime. The globalisation will likewise rely on establishing a favourable international environment by having close co-operation between international organisations, such as the ITU, ISO and WTO¹⁵."

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¹⁵ World Trade Organisation

More specific definition is given by Castillo, the chairman of ETSI GA¹⁶. He states that telecommunication globalisation "proves that users of standards require global solutions in order to benefit from new sources of strategic advantage in markets that are no longer bound by geographic frontiers.... It has become synonymous with liberties such as the freedom of speech and the right to knowledge" (ETSI, 1995, p. 13).

Globalisation can be seen as the impersonal forces of global competition may now, in other words, replace conscious antitrust policy at the national level, particularly if such policy is seen to disadvantage the largest and most efficient USA firms in the international arena (Snow, 1995, p. 219). From the US perspective this provides an even larger and more open market for non-USA suppliers of telecommunications equipment and services. Equally we can state that USA or Far -East suppliers have similar possibilities for markets in Europe. Globalisation requires companies to attempt to internationalise their outputs through mergers, acquisitions and joint ventures, driven by a combination of escalating costs of the new communications technologies and an explosion of demand for new communication services (Dyson and Humphreys, 1990, p. 1).

The term generation is taken to use in telecommunications to differentiate the different stages in the development of technologies. We can recognise currently the 1st, 2nd, and 3rd generations. These generations are divided according to their technology development: analogue and digital, and more precisely voice and data services. All these generations have different life cycles, in the meaning of time and economies of scale.

¹⁶ General Assembly

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2.3. **GSM**

GSM offers digital high quality telephony, short messaging, fax and slow data services. GSM development was started by the establishment Groupe Special Mobile in 1982 within CEPT¹⁷. The first step towards GSM was taken already in 1978, when European politicians reserved a common frequency band twice 25 MHz around 900 MHz for mobile communications in Europe. GSM development moved to ETSI when it was established in 1988. At that time GSM became a subgroup of ETSI TC SMG major working item. In 1989 GSM 900 MHz specifications were frozen. At the same time ETSI decided to develop a high frequency version of GSM at 1800 MHz (previous DCS1800¹⁸). Standardisation work was completed in 1991 and an official launch was at 1992 (Mouly and Pautet, 1992). The GSM standardisation was divided into three phases (originally to two: phase 1 and phase 2), because standardisation process could not be completed for all aspects before a service launch (Mouly and Pautet, 1992; Ojanpera and, Prasad; 1998, ETSI). The reasons for the changes were the complexity of the Specifications and the continuous technology development. The time between successive technical generations is shorter than the lifetime of a system, the latter being constrained by financial issues: the infrastructure cannot be replaced before the system is paid off (Moyly and Pautet, 1992). The GSM standardisation program Phase 2+ lead GSM from the 2nd generation system half way towards the 3rd generation. This will boost GSM global market position as well as GSM operators' and manufacturer's position. One reason for the flexible migration is that in phase 2+ each work item has its own working plan. Overall phase 2+ has over 100 working items (SMG Basis, 1998). Currently GSM offers roaming between 130 countries including USA and Canada (DCS1800). Interstandard roaming GSM/PDC¹⁹ provides a bridge to/from Japan. GSM is an open standard. Success of GSM services has resulted in equipment with a high market volume having attractive prices.

¹⁷ European Conference of Postal and Telecommunications Administrations

¹⁸ Digital Communication System

2.4. **UMTS**

UMTS can deliver video, graphics and high volume data services on top of GSM based services. This enables expansion to a broadband multi-media services that will lead to the integration of wired (Internet) and wireless (GSM) services and technology platforms. UMTS Task Force Report states that new UMTS architectures may emerge or will be derived from several telecommunication technologies, and/or information technologies. During UMTS system development and standardisation the rapid migration of information technology (especially internet) into the telecommunication infrastructure will become reality. Therefore in the next century it will be (virtually) impossible to distinguish between information technology and telecommunications in a mobile network. This will create the need for standards that accommodate developments in both telecommunication technologies and internet which will reflect the convergence.

UMTS system was originally standardised in ETSI. It focused on a subset of fixed wide band services supplemented with mobile specific services. UMTS will enhance global personal and terminal mobility by supporting multimedia and virtual home environment (VHE). Its speech quality is comparable to many current fixed networks. UMTS supports services up to 144 kbit/s, 384 kbit/s, or 2 Mbit/s according to service environment. The core band for UMTS in terrestrial part will be (155 MHz) 1900-1980 MHz, also 2010-2025 MHz, and 2110-2170 MHz, and a satellite part. UMTS spectrum capacity is expected to be fully exploitable around year 2005, depending on the market demand. Some extra spectrum is required after that.

The evolution of mobile wireless telecommunication systems is taking place. The UMTS is designed to advance the use of mobile communication in higher bit rates, thus enabling data and video connection, when compared to the current single slot data

¹⁹ Personal Digital Cordless

connections in GSM. Higher bit rate connections are HSCSD²⁰ (ETSI, 1997) and GPRS²¹ (ETSI, 1997), which are applicable in GSM in the near future. The "bridge" between UMTS and GSM network evolution is EDGE²², which is an enhanced version of the previous network technologies.

Current wireless data services, have not yet made a take-off due to their low data speed. However, these services are expected to have a more significant role in the future. These efficient data services are standardised in ETSI SMG - namely HSCSD and GPRS - to meet market needs before the introduction a 3rd generation platform EDGE. We can question the need for two advanced data services on GSM. Anyhow they both will provide valuable enhancements to operators' services. Even though we are discussing generally compatible products we are not dealing with an integrated high speed data offering. This means that we can not "commute" between HSCSD and GPRS. Each of them requires a specialised radio. The critical points in both systems are whether the users will pay extra for the extra bandwidth as we will discuss below the context of a market cycle. The GPRS is packet data and thus reduces time-spent setting up and using connections. The limitation is not the number of connections, but in the amount of data being transmitted. When we need higher data transmission rates, a higher signal quality is required. This sets requirements for both developers and the institutional function. HSCSD is useful for applications with high-speed data requirements, such as mobile video communications. It is commercially available 1999. Conversely, GPRS provides a suitable medium for Internet access and it will be commercially available in the year 2000. The EDGE will take full advantages of GPRS such as fast set up and that many users can share the same channel. This will result in a highly improved utilisation of the network, especially for bursty²³ applications (Pereira, 1998).

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²⁰ High Speed circuit switched data

²¹ General Packet Radio Service

²² Enhanced Data rate for GSM Evolution

²³ Burst is a basic concept for example of the GSM transmission on the radio path where the unit of transmission is a series of about a hundred modulated bits. (Moyly and Pautet, 1992)

UMTS is planned also to be member of IMT2000²⁴ family, which is being standardised by ITU²⁵, particularly within TG²⁶ 8/1 (IEEE, 1997). The family concept makes an option that systems can have a certain level of commonality, but that does not require commonality between every single part of the systems.

2.5. Summary

Originally GSM was developed for the European market, but UMTS is developed for the global market, hence making the standardisation more complex. All players need to agree on the standard or a set of standards if there has to be a globally accepted standard. This creates a situation where the *de jure* standard, e.g. GSM, versus nominated approach, e.g. CDMA, are discussed as solutions that will lead to a new configuration of UMTS/IMT2000. According to an industry interviewee the players seem to forget that telecommunications is changing continuously and the markets are not any more in a virgin state like when GSM was entering the market (Interview p.42). The new generation will not throw away 2nd generation technology, e.g. CDMA, or IS²⁷-95. It will provide users solutions, which allow for migration and ensure users' and operators' investments.

Interestingly, in all interviews it became clear that GSM technology development will not end. In fact, more sophisticated products will be produced for markets and this will be improve the services quicker than it would be otherwise. When GSM came into the market, all manufacturers were focused on the same issue. Now the standardisation system allows that they can develop different types of systems to address the same issue. In UMTS there will be various degrees of freedom and competitive technologies.

²⁴ International Mobile Telecommunication

²⁵ International Telecommunication Union

²⁶ Technical Group

²⁷ Qualcomm-CDMA, narrowband CDMA system

Abernathy and Utterback (1978) observe that once a dominant design comes into existence, radical product innovation slows down, and product improvements become incremental (Nelson, 1994). This was common when there were substantial improvements in technology. We can speculate that the situation does not exist the telecommunication technology, where new product innovations have appeared incrementally and lead to competition in the IPR issues. The development leads rather to the "dropping out competition" where companies that produce an alternative product will drop out of the industry, or into small niche markets. This "shakes out" industry and its structure becomes more concentrated, where the surviving companies tend to be relatively large (Nelson, 1994). The final alternative is that companies - with other participants – can stabilize the situation by agreeing to make their products compatible.

3. RESEARCH APPROACH

The focus of this study is fairly broad, as the main goal of research is to describe and give a detailed account of a complex standardisation process and its main components. More specifically we will investigate commonalities and differences in GSM and UMTS standardisation. Some of these have taken place few years ago while some of these are ongoing activities. Therefore the research will have to follow a flexible and qualitative research strategy that combines fact finding, model building and model validation.

3.1. Types of Research Methods

We can categorize research approaches according to the type of research followed. One way is to divide research into empirical and conceptual study. An empirical study can be classified into case study, and into quantitative or qualitative approaches. In any research study we can use several methods according to the type of research requested. Moreover, each research strategy has its advantages and disadvantages, and we must select the strategy according to our research purposes. In this research we will use variable qualitative methods to analyse interviews and archival data. Thereby we follow mostly case research strategy.

We have chosen a case driven research strategy, because it is appropriate "when research and theory are at their early, formative stages" (Roethlisberger, 1977). We can also observe that "sticky, practise-based problems where the experiences of the actors are important and the context of action is critical" (Bonoma, 1983) have to be studied using qualitative method. The research area, wireless telecommunication

technology, sets also requirements for the research. The area is characterised by constant technological change, innovations, speed, diversity and complexity. According (Benbasat et al., 1987, p. 370) there are three reasons to use case study strategy. First, the researcher can study phenomena which study in a natural setting, learn about the state of the art, and generate theories from the practice. Second, The case method allows the researcher to answer "how" and "why" questions, that is, to understand the nature and complexity of the process taking place. Third, case approach is an appropriate way to research an area in which few previous studies have been carried out. These three reasons are appropriate for this research, because:

- in this research we study systems in a natural setting by meeting experts in their own
 offices and collecting material informal by our research questions to gather
 knowledge about the process.
- 2) To gather knowledge about complex and multilevel standardisation process we have to ask "why and how" questions to understand the process (Appendices 3,4).
- 3) Standardisation is of interest to many researchers. However, empirical IT standards' and especially telecommunication standardisation process have not yet been widely examined by researchers.

3.2. Research Setting

In this thesis the research methodology is qualitative. Interviews were carried out to obtain a real "touch", and learn about experiences and expectations concerning the third generation mobile standardisation process globally, and in Europe.

This study is part of Stamina research group research, which started in spring 1998 (Lyytinen and King, 1997). The study is based on archival research interviews and a literature survey. The framework, the standardisation process model, helped us focus on prominent aspects of the standard domain and develop questions to each interviewee.

We used semistructured questionnaire thus enabling flexible data gathering strategy with an intention to figure out an impartial set of data and characteristics of standardisation process (Benbasat, et al., 1987). Part of the questionnaire dealt with background information of the interviewee and the organisation, and a part the standardisation process such as relations, changes, timing and trends. We were also interested in how the standardisation process had changed and what will be its future.

3.3. Interviews

The interviews were carried out during the autumn 1998. The goal was to get a rich set of data surrounding the standard process model (Figure 4) and gather the latest knowledge in the area. 17 experts were interviewed from different bodies involved in the 3rd generation telecommunication standardisation. Initially, we sent more than 40 requests of interviews via email, but due to hectic business and timetables we managed to organise 18 interviews. The interview pool included four representatives from manufacturers, three from operators, seven from standardisation organisations and three from regulators. Critical matter is that all representatives form manufacturer side are from the same company. However, the company is one of leading ones in telecommunications at the global level. These parties were chosen, because they play the most prominent role in the telecommunication standardisation. Experts and organisation were chosen in light of their capability to give answers in relation to the process model (Appendix 1). They were chosen based on their expertise within organisations that had extensive experience with wireless standardisation. Both experts involved in standard making and senior managers from these organisations were interviewed. Thus interviewees' questionnaires (Appendices 2, 3) varied to some extent according to the background of expertise.

The interviews were scheduled to last approximately two hours to cover the topic thoroughly. The interviews were carried out mainly in each party's offices and we used

an open set of questions. The questionnaire was sent to interviewees beforehand to allow them sufficient time to look at the questions and prepare answers. The questions focused on the process model and related areas such as Internet. If during the interview, an interesting new issues appeared, those were covered promptly. As the interview process matured, we started also to have a *priori* knowledge of the topic, and ask more specific questions. During the interview process some "hot" issues arose such as IPR issues. Those were discussed more thoroughly on site.

The interviews were tape recorded and transcribed. A hundred page interview document was produced which formed the basis for further data analysis. Other documents were requested during the interviews. These materials were valuable due to a lack of published material about the research topic and they were also used in the subsequent data analysis.

All transcripts and notes were analysed to get a rich understanding of differences in the standardisation process and its outcomes: structures, changes in the organisation and environment, and the drivers which affect the standardisation process and its relations. We analysed the data according to our process model (Figure 4.) and thus based our analysis on the structure of the model and categorised the issues following the model. By analysing this way, we could promptly find out main "issues" in each of the five components: technology/knowledge and market/policy cycles, "Gatekeeper", and institutional functions, and environment. The developed standardisation process model differs from other similar models in various ways. The model presents the components and the relations between them and it recognise the integration between IT, media and telecommunication and states the importance of standardisation organisations as a gatekeeper in the process.

All interviews and interviewees are treated here anonymously due to the confidentiality of the material. Therefore when we refer to interviews, we state only the Interview and a page number in the interview document.

3.4. Literature Survey

The background data for this research was gathered from standardisation documents, journal articles, memos, books, and other scientific publications. These publications are mainly from the 90s. Standardisation organisations provide updated standardisation documents and memos. They are available from internet via organisations' www-pages.

The topic of the research, telecommunication standardisation research is at its early stages. We have been able to obtain several journal publications in the field (Goodman, 1998; Samukic, 1998; da Silva et al.; 1999, Ojanpera, 1998; Rapeli, 1995 a, b).

There are not many academic articles or papers available on the process of telecommunication standardisation. The IT standardisation process has raised interest among several researchers (Libicki, 1995; Cargill, 1989; Farrel and Saloner, 1985, 1986, 1987; Aden and Harris, 1993; Fitzgerald, 1990; Lehr, 1992; MacPerson, 1990; Reilly, 1994; Nielsen, 1996). Empirical standardisation research has been conducted by Lehr (1992) and Weiss and Sirbu (1990). We have also studied and collected materials on issues which are closely related to the field, such as network externality theory, innovation research, and studies covering relationships between regulators, technology, manufacturers, and operators. In order to understand the current situation we have also studied a wider environment of standardisation. Even though we concentrate on the 3rd generation telecommunication standardisation, we have examined literature on earlier telecommunication generations or classical standardisation cases such as QWERTY-case, to understand standards' role (David, 1985).

The standardisation process forms a forum of technology push, so we have studied general features of the telecommunication technology. We concentrated an TDMA²⁸

²⁸ Time Division Multiple Access

(Glicic and, Leppanen 1997), CDMA²⁹ (Glicic and Leppanen 1995, 1997), and WCDMA³⁰ (Ojanperä and, Prasad, 1998; Lee et al., 1998) technologies, because TDMA is used in GSM (Mouly and Pautet, 1992; Rappaport, 1996; Steele, 1992), and CDMA, or WCDMA will be used in the 3rd generation systems. The other technologies related to 3rd generation telecommunication were examined to the extent needed for understanding the standardisation process.

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²⁹ Code Division Multiple Access

³⁰ Wideband CDMA

4. STANDARDISATION

Standards are not only used with complex technologies. In fact, we use standards every day, such as languages, A4 or A3 papers. These standards are so commonly used, that they have become invisible. Another practical example is when we wake up in the morning. We usually have the same scrutinised way to wake up, take a shower, make coffee and read the paper, and usually in this order. Technical standards are based on the same idea, i.e. commonly accepted rules on how to act in specific technology issues. In addition, standards have to be available for everyone, have commonly known acceptance policy, and be combinable. Standardisation is a process in which standards are created within a formal, or informal standardisation organisation. In the following we define the concepts of standard and standardisation more thoroughly, and present the main players in the standardisation process.

4.1. Standardisation Preliminaries and Need for It

The entire standardisation process can be seen to consist of negotiations concerning scope and depth of the standard, testing, different technological regimes, and recognising final user needs and an implementation of new processes. All these are shaped by continuing changes in a complex social system (Hanseth and Monteiro, 1997). The negotiations can be take place between standardisation bodies, or manufacturers. Testing is a crucial part of standardisation to ensure that the developed technology is functioning and standards are appropriate. New standardisation processes are needed so that standardisation follows technology development and improve organisations' and manufacturers' position in the technology system. We can present various criteria for the standard development process (Oksala et al., 1996).

The 3rd generation global telecommunication standardisation process requires decision making in an open climate. Open climate means that anyone who wishes to participate, collaborate or contribute to the global standardisation must be allowed to join. To become recognised as a global standard means also, that it has an agreement from all players (Interview p. 42). The diverse background of players, must be managed in a global standardisation process. The players can not easily create new standards, if one player attempts to dominate it.

The 3rd generation mobile terminals should be available and take an advantage of more than one standard in order to be a global service. 3rd generation wireless terminals can be dual-, or multiband according to users' requirements. That is because of the differences between US, Japan and European frequency policies. This would enhance the user mobility with one terminal around the world and create network externalities.

To implement a standard after the standardisation process the process must end with a detailed standard. After the specification a number of other elements need to be investigated and finalised before commercial deployment such as spectrum wide enough can be acquired, applications developed and market analysed (Ojanperä and Prasad, 1998).

4.2. Standards and Standardisation

We have various types of standards: basic, terminology, products, testing, safety, service, engineering or planning, and organisation or social standards. These all have a specific meaning. This research focus on telecommunication standards. However, we want to give a more general definition of standards. Various organisations have also created their own definitions of standards. The following definition given by ISO³¹ and

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³¹ International Organisation for Standardisation

UNECE³² is widely accepted within official national standards institutions (Nicolas, 1994):

"Technical specification or other document available to the public, drawn up with the co-operation and consensus or general approval of all interests affected by it, based on the consolidated results of science, technology and experience, aimed at the promotion of optimum community benefits and approved by a body recognised on the national, regional or international level."

According to Lathia (1995) the "depth" of standardisation will very much depend on a case-by-case analysis. Simply put, they should be detailed enough to allow interconnection and interoperation in a multi-vendor environment; open and "modular" (platforms) with a view to a "phased" approach for service offering; usable in different network configurations (for example wireline or wireless), and rapidly updated as technology advances.

Cargill (1989, p. 41) differentiates standards according to the behavioural definition of participants in the IT standardisation process and the motivation of the participant (provider or user). One of the interviews shared the attitudes and behaviours of the participants in the standardisation process:

Standardisation is the product of a personally held belief that the market has the ability to understand and chart a valid future direction through the use of collective wisdom, to understand the impact of change on itself, and to adjust itself to that change. The specific change agents utilised in this process are collective technical descriptions of how things ought to be and function, called standards.

To understand the motivation of the participant, further attributes and definitions can be developed (Cargill, 1989 p. 41):

A standard, of any form or type, represents a statement by its authors, who believe that their work will be understood, accepted, and implemented by the market. This belief is tempered by the understanding that the market will act in its own best interests, even if these do not coincide with the standard. A standard is also one of the agents used by the standardisation process to bring about market change.

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³² United Nations Economic Commission for Europe

We can assume that a manufacturer will accept and use standards only if it believes that it cannot control the market directly, and by standards it can do better. Acceptance of the market as externally controlled and understanding of the tools available to influence the market determine when the manufacturer is interested in using standards. On the other hand, the users, individuals, separately or collectively accept and use standards only if they believe that standards offer a benefit (Cargill, 1989). User behaviour is difficult to predict and also the benefit which user gains from the standard is not necessarily distinct or quantifiable - it is a trade-off of less desirable and more desirable factors (Cargill, 1989).

The prime objectives of standardisation from the point of view of economic and social life are 1) promotion of quality products, processes and services by defining the characteristics which determine their capacity to meet given needs, i.e. their fitness for use, 2) promotion of economy in human effort, materials and energy in the production and exchange of products and 3) promotion of industrial efficiency through control variety (Nicolas, 1994). These facilitate mass production and interchangeability of components and products.

As we can recognise there is no one "right" definition for standard and standardisation due to their abstract and intangible nature. We suggest a telecommunication standard definition as an agreement, which is created in a consensus between interested participants by usually agreed working procedures in order to improve/enable wireless compatibility and the quality of networks and products.

4.3. Types of Standards

We have various types of standards. Each of them is formed according to requirements of participants, technology, product and environment. Among standards we distinguish between *de facto*, *de jure*, formal, sponsored, unsponsored and open standards. *De facto* standardisation is characterised by its reliance on market forces. There are no regulating,

institutional arrangements influencing the process. De facto standards e.g. NMT are often developed by industrial consortia or vendors. Unsponsored and sponsored standards are often outcomes of market forces. Unsponsored standards are sets of specifications, on which an originator holding a proprietary interest can not be identified. These specifications highlight the technical features of a product or network externalities in consumption. On the contrary, sponsored standards have one or more sponsoring entities holding a direct or indirect proprietary interest, which another firm can adopt from the particular sets of technical specifications. Unsponsored and sponsored standards are widely discussed in (David and Greenstein, 1990). We can refer for example WAP³³, Bluetooth or Symbian specifications, which change the current market technology. Sponsored standards are referred also as de jure standardisation. This denotes to a situation where a standard is approved and given a law-like status by an institution authorised for this e.g. GSM in ETSI, ITU or ANSI³⁴. Formal standards are mandated standards, which are specified by governmental agencies that have some regulatory authority. For example military standards have often a law backing them. Open standards are generally defined and cited as follows:

An open standard is a publicly available specification that is developed and maintained by an open, public consensus process and that is consistent with international standards, where relevant. Additionally, an "Open System" is one built to conform to one or more open standards.

Key principles of open standards are according to Bird (1998): any standard must be available to be implemented in a product without royalties or other charges, and a standard must be developed through a known and predictable process. The process should be open for inputs and all interested parties have a possibility to influence the process. This kind of standardisation process is achieved in the Internet standardisation in IETF³⁵ organisation.

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³³ WAP (Wireless Application Protocol) is an open global specification that empowers global with wireless devices to easily access and interact with information and services instantly. WAP Forum is a industry association comprising 90 members. They have created a *de facto* standard for wireless information and telephony services on digital mobile phones and other wireless terminal. More information is available in (www.wapforum.com)

³⁴ American National Standard Institute

³⁵ Internet Engineering Task Force

Another way to classify standards is proposed by Krechmer (1996). He classifies standards into four groups which are related to each other. The first group is unit standards measurable by physical qualities. The second involves similarity standards that define the variation permitted within a set of standards. Compatibility standards are the third group, which defines the interface between two or more connecting components that are compatible rather than similar. The fourth group is etiquette standards, which presents the initial negotiation between independent communicating processes for the purpose of establishing communications e.g. to say "hello!".

After defining various kinds of standards we must distinguish telecommunication standards from device standards. Telecommunication standards differ from device standards in that they define compatibility, not sameness (Krechmer, 19996). However, in this research we shall restrict our analysis to *de facto*, *de jure* and formal standards.

4.4. Main Players in Standardisation Process

There are many players in global telecommunication standardisation field: regulators, manufacturers and organisations. They all have their own interest and role in the standardisation process and involve different participant groups.

Standardisation organisations are e.g. ARIB³⁶, ETSI, ITU, ANSI and TTC³⁷. GSM Association, previously GSM MoU Association, and UMTS Forum are examples of standardisation organisations, ERO³⁸, CEPT³⁹ are examples of regulatory bodies. 3GPP is regarded as a global consortium. These all are explained in Appendix 4. Various national regulatory bodies and manufacturers are important players in the standardisation field, but they are not presented separately in this thesis. In addition, there are many important global standardisation bodies such as ISO or ATM Forum, but

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³⁶ Association of Radio Industries and Business

³⁷ Telecommunication Technology Committee

³⁸ European Radio Office

in spite of their importance they are not discussed in this thesis. The relations between the regional players are illustrated in a simplified form in Figure 1. From this figure we can recognise the players' relations, uni or bidirectional, to each other. We must state that the players presented in figure are central players from the European perspective. As a comparison a more complex figure from the Japanese perspective is given of players in Appendix 5.

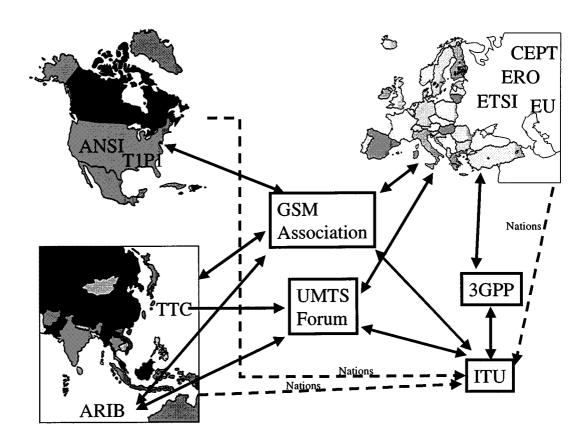


Figure 1. Relation between different regions.

³⁹ Conference of European Posts and Telecommunication

4.4.1. The Role of Standardisation Organisations

As mentioned earlier global telecommunication standardisation involves many players: regulators, manufacturers and organisations. They all have their own interest. GSM Association forms an interest group of GSM operators world-wide (due to a change in the recent regulation - also manufacturers and regulators can be members). They look after their commercial aspects. ETSI is a European standardisation organisation. Its members can be regulators, manufacturers and operators. UMTS Forum concentrates on markets, research, regulatory aspects and spectrum, and its members are mainly manufacturers, and operators, but also regulators. All these organisation are in a close co-operation by having co-operation agreements, sharing chairmen or members (Nielsen, 1996). For example a chairman of a subgroup of ETSI SMG⁴⁰ and a vice chairman of UMTS Forum, submit liaison statements, or send documents to corresponding meetings (Interview p.83).

The organisation process is becoming more complex. During the 2nd generation standardisation the chairman of an ETSI subcommittee could handle all issues in his/her subgroup (Interview p. 20). This situation does not hold anymore. The number of working items has increased, and as a result many of them require specialised knowledge and necessitates the establishment of ad hoc groups and working committees. At the same time the chairman's work has not decreased. Their work requires efficient distribution of issues to experts. Interestingly, the work load and complexity have increased and this is the situation even though the 3nd generation standardisation does not start from scratch in contrast to the beginning of the 2nd generation standardisation. This is due to squeezed time schedules and the global environment.

⁴⁰ Special Mobile Group

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The main integrations in this process are manufacturers and operators who can participate in all standardisation organisations. They have a significant role to play and change information from one organisation to another. Thus, they act as information brokers. As an example when ETSI TC⁴¹ SMG sends a liaison statement to GSM Association and gets an answer, the liaison statement can concern for example market requirements, which is not the main topic in ETSI TC SMG. In this way they reduce duplicate work and ensure information flows between organisations, regulators and manufacturers. Other important global telecommunication standardisation bodies are ANSI from the USA, US T1P1⁴² from the USA, Japanese ARIB and Korean TTC from the point of view 3GPP.

ETSI has done pioneering work by distributing knowledge of standardisation processes. The Chinese standardisation institution was invited to technical talks after hearing of Chinese plans to start production of an independent GSM specification, which would have meant incompatibility, the lost of the roaming capability and a growth of development costs outside Chinese industry. After negotiations they accepted one standard - GSM standard. This was very important in maintaining GSM specifications at the global level (Interview, p.84). Roaming enables to use different networks when moving from one place to another and even the use of the same terminal. Roaming also requires "play" rules, standards between countries, operators and manufacturers on how to operate within the network.

During the 3rd generation standardisation moved to develop standards for global markets. This requires an establishment of a new global consortium (3GPP) due to the timing requirements and complex unsettled technical matters (e.g. radio access level standards). At the same time the hectic standardisation process involves more experts. ETSI technical committee meetings, where GSM and UMTS are being standardised, have 150-200 participants, while in the earlier days they had 40-50 participants. On the positive side, the more participants are involved, the more ideas and more creativity, the more sensitive issues there are to deal with, and the more public environment. In

⁴¹ Technical Committee

⁴² subcommittee of TIA, Telecom Industry Association

contrast the more choices we have, the greater the design freedom, and in principle, the greater our ability to optimise. Also, the growth number of participants has improved the document handling process. In the 1st generation there was no co-ordinated document handling procedure. The documents could be even hand written papers. At the beginning of the 2nd generation standardisation documents distribution were organised by posting a heavy bunch of papers to participants. In the end of 2nd generation standardisation document handling was moved to Internet and CDs, which enabled equal on-line service to all participants. On the negative side more choices - especially choices that are not mutually exclusive - mean more uncertainty about finding the appropriate strategy (Calhoun, 1988). All this requires that the process has to be transparent (Interview p. 39, 47, 51, 95).

The evolution of institutions relevant to standardisation has also become very complex, involving not only action from private companies, but also from semiformal organisation bodies, government agencies etc.. The "new institutional economics" suggests a broad theoretical attitude to examine institutional aspects. Institutions change in most cases slowly (if perhaps with a lag) in response to changes in economic circumstances that called for those changes. According to interviews depending on the organisation, we can recognise both positive and negative sides in the institutional change: as fastening and less bureaucratic process are regarded as positive issues while the growth of technical aspects was regarded as a negative issue (Interview p. 41, 51, 62, 70, 88).

Perez (1983) and Freeman (1991) suggested the concept of a "techno-economic paradigm" to understand the interplay between standards and institutions. They follow Schumpeter here: different eras are dominated by different fundamental technologies. To be effective with these technologies demand that a set of institutions compatible with and supportive of them is established (Nelson, 1994). If institutions are not compatible, even having interest groups, the standardisation will without global roaming be in a flux. This situation applies especially to the 3rd generation telecommunication

standardisation. In the 3rd generation standardisation this means that we cannot have a global standardisation regime.

4.4.2. Characteristics of Regions

In telecommunication standardisation we can three dominating regions: Europe, Japan and the USA. All these regions have their own characteristics in the standardisation. In earlier generations their differences have been more pronounced, but the globalisation has decreased the gaps. From the global perspective organisations like ITU, RAST⁴³ form a group of organisations where regional standardisation organisations exchange views and discuss radio standardisation, including 3rd generation systems.

In the 60s and 70s each region and nation had their own national regulation policies and standards. The first generation analogue systems provided voice services in a limited area, without compatibility and interoperability. The exception was Scandinavia, where NMT was originally developed as a Pan Nordic system with the goal of achieving compatibility and interoperability. The standard was created by Scandinavian PTTs⁴⁴. It was the first system that offered roaming and interoperability. Moreover NMT standard was open and was offered free to other operators and manufacturers. In contrast, in the USA telecommunication equipment manufacturers introduced a specification for a cellular concept called AMPS⁴⁵. This was an analogue system, but offered no roaming across networks thus limiting services to a specific region.

In the USA the standard setting process has been market driven and dominated by private industry interests. This enables players to react faster, but at the same time leads to a larger number of standards. In the USA two main standardisation bodies for mobile

 ⁴³ Radio Standardisation Meeting
 ⁴⁴ Ministry or Department of Post, Telephone and Telegraph
 ⁴⁵ Advanced Mobile Phone System

radio systems are TIA⁴⁶ and T1. TIA and T1 can set ANSI accredited standards. In the USA the FCC⁴⁷ manages spectrum issues. The allocated spectrum for 3rd generation telecommunication is used currently by PCS⁴⁸ system. The USA is developing spectrum positions for the 3rd generation by recognising new frequency bands (Ojanpera and Prasad, 1998). An extensive view on US standard development can be found in (Reilly, 1994; Garcia, 1992).

Japan has been exceptionally lead by one dominant player, NTT⁴⁹. Other players are DDI and IDO, (wireless operators), ARIB, and TTC. The manufacturers and operators have moved as a unified entity. This has created a closed standard setting and it has been difficult for international companies to participate in the standard setting process. Other difficulties have been language barriers and differences in the business culture. But globalisation has landed also in Japan. For the 3rd generation standard documentation the chosen language has been English (Interview p. 15; Ojanpera and Prasad, 1998). In Japan the Ministry of Post and Telecommunication (MPT) is responsible for the spectrum regulation. In the 3rd generation spectrum regulation Japan follows the ITU recommendation for IMT-2000.

Europe follows ITU recommendations for spectrum issues, and European wide spectrum harmonisation is carried out by CEPT. European Commission has also issued directives that create a harmonised frequency allocation policy (CEC, 1998). More extensive view of the European standardisation policy is presented in "Bangemann Report" (1994). European Commission has also promoted European and international standards in public acquisitions related to information technology in (CEC, 1986).

⁴⁶ Telecomm Industry Association

⁴⁷ Federal Communication Commission

⁴⁸ Personal Communication Systems

⁴⁹ Nippon Telegraph and Telephone corporation

4.4.3. Formal Standardisation Organisations

Formal standardisation bodies have to follow predefined procedures and rules that regulate the status, organisation and process of developing standards. In recognition of the limits of both market forces and hierarchical control, formal standardisation is a key strategy for developing an information infrastructure (OECD, 1991 in Hanseth and Monteiro, 1997).

Figure 2 describes a formal standardisation process: manufacturers and operators acting in their own cycles and a gatekeeper in between them. The formal standardisation takes longer time to create, due to a longer and formal acceptance policy. However, the formal standardisation bodies are trying to improve their standing, e.g. by opening up the process to specifications generated by some external entity or forming liaisons with other specification-producing organisations such as participating in 3GPP work (Jakobs et al. 1998).

For example ITU is a global formal standardisation body is and its members are also members of UN⁵⁰. Thus the membership is wider than for example in ETSI. It acts as a gatekeeper between the telecom industry and the service market cycle. It can select technologies under an "umbrella" from the technology cycle by recognising trends and market requirements. This enables co-operation with regional and national regulators. In its gatekeeper role ITU shapes the "gateway" along several critical dimensions: timing, IPR, players' role, intensity and the role of artefacts. Artefacts can be in this case terminals, components and standardised interfaces, which enable compatibility.

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⁵⁰ United Nations

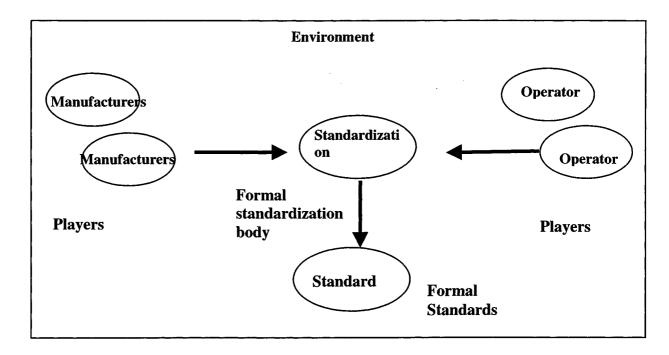


Figure 2. Formal standardisation

4.4.4. Informal Standardisation Organisations

The informal or voluntary standardisation organisations do not have a law like status such as ITU has. They are ad hoc type organisations, created for certain purpose such as WAP Forum, Bluetooth or Symbian. The use of voluntary standards is therefore optional. The number of informal standardisation organisations has grown when we have been moving towards the 3rd generation. Their work is expected to be more open, faster and flexible, but at the same time to be economical for the developers.

Figure 3 describes an informal standardisation process. When compared with formal standardisation the connection between the coalition of organisations and standards is different: there are no formal organisations. Manufacturers and operators can create a coalition to create standards. The pull effect to create an informal standard can come for example from research and development (R&D) innovations. Informal standards often

effective integrations between engineering push and market pull, due to the need for taking an advantage of technology development for the market use.

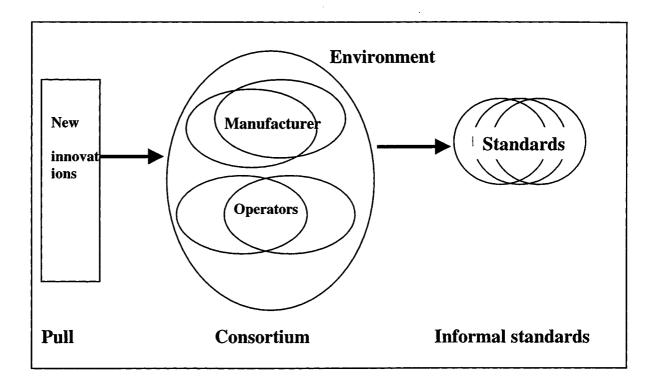


Figure 3. Informal standardisation.

4.4.5. Forums

The number of participating organisations and discussion arenas has increased and a new form is standardisation forums. Forums like WAP Forum, UMTS Forum, do not prepare standards, but play an informing and knowledge creation role. Forums are collections of people and companies - most of manufacturers and operators - who attempt to create favourable conditions for different technologies like UMTS to be adapted. They look at technical issues and attempt to create a vision of a technological environment of what is required from the technology point of view to move ahead. They focus on what type of technical research needs to be done. If there is a gap in the knowledge, which needs to be filled, the forum attempts to identify that. After

identifying the gap, it contacts a standardisation body, e.g. ETSI and presents the requirements and gets formal acceptance for their standards by agreeing on a cooperation agreement with a formal standardisation organisation. In liaison statements they can contact IT community and present the needs of the work to be done. Forums are catalysts for action, identifying action plan and ensuring where it should take place. Forums seek to avoid also overlaps (Interview p. 49). In the future telecommunication organisations need to live closer with the IT industry and engage with appropriate associations and this will increase role of forums.

The UMTS Forum was established in 1996. It is a non-profit organisation under the Swiss law. It has currently 160 member organisations around the world. The establishment of UMTS Forum was recommended by the UMTS Task Force in 1996. The UMTS Forum is an international and independent body. It focuses on creating an environment for the successful commercial realisation of UMTS/IMT-2000 services. The Forum is engaged in a wide range of activities to increase awareness and understanding of third generation opportunities and issues. The UMTS Forum works as a catalyst with specialist organisations to examine standards, spectrum and other issues (UMTS FORUM).

According to a UMTS Forum participant a question - "What makes forum that is quite unique?" - (Interview p.52) we answered that the forum manufacturers, when compared with the GSM Association, discuss future services with cellular operators, fixed operators, and regulators together. For example ETSI is a standardisation body. Therefore it does not discuss market issues. In a forum, members attempt to find a consensus on issues, which can be submitted forward to standardisation bodies on the European level. Within the varying forum groups formulate agreement, and then bring the result to a forum an attempt to find a consensus is made.

The Forum is committed to building the industry consensus and successful introduction and development of UMTS that can satisfy future market demands in low cost, high quality and mobile communications. UMTS Forum has created connections with other

established organisations, including standard creation bodies, and recognised operators and industry communities. They give advice and recommendations when requested to such institutions as European Commission, ERC⁵¹, and national administration bodies. For example, the spectrum issue is extremely important and forum has been working very closely with CEPT in Europe, and particularly European Radio Communication Office, and its CEPT group, which is concerned with the preparation of WRC2000⁵². Another group, which is important, is GSM Association, which consists of operators and regulators. There is a co-operation agreement between the GSM Association 3rd generation interest group and UMTS Forum. UMTS Forum expects that these relationships will continue and develop as 3rd generation develops.

UMTS Forum is open to any legally established corporation and individual firm, partnership, governmental body or international organisation that supports the promotion and further development of mobile and personal communications in the form of UMTS. There are no geographical restrictions where the candidate member is located. UMTS Forum has two levels of membership: Full and Associate. The UMTS Forum work is divided to various working groups such as WG1⁵³ Regulatory, WG2 Spectrum and WG3 Market Aspects.

4.4.6. The New Consortiums: 3GPP and 3G.IP

Two new consortiums have been established to enable and foster global co-operation. The 3rd generation partnership project (3GPP) has been established for the preparation and maintenance of Technical Specifications, and it is a non-profit association. Technical specifications for the 3rd generation Mobile Systems base have evolved forum the GSM core network and the radio access technology studies in ETSI as UTRA⁵⁴ and

51 European Radio Communication Office

⁵² World (Administration) Radio Conference

⁵³ Work Group

⁵⁴ UMTS Terrestrial Radio Access

in ARIB as W-CDMA (both FDD⁵⁵ and TDD⁵⁶ modes). They are meant to work on a global level as a one group and have several subgroups (ETSI, e, 1998). The project should provide a flexible working method for global standardisation. There are different kinds of members: a partner, an organisation partner and a market representation partner and an individual member. Membership is open to all standard organisation bodies irrespective of the geographical location. The goal is that all work together. The amount of members will grow, when all work is in the same "site". In the earlier generation standardisation processes, organisations did their own specifications. After that they changed information and attempted to co-ordinate the work. Currently the organisations co-ordinate and distribute their work and projects concurrently. Much of this has been made possible by network technologies and especially Internet that allows real time exchange of documents and collaboration. 3G.IP was established in June 1999. It is a group of operators and vendors who together have formed a focus group towards developing standards for the implementation of wireless IP networks (Total Telecom, 1999). We do not have much information about the 3G.IP, because it is such a recent establishment.

3GPP focuses on novel forms of co-operation, because it has to face the question of a wider organisational base and large diversity in standardisation practices. It contains players with different commercial interests. For example an operator can operate a GSM network in Europe, and in Asia a CDMA network (Interview p. 30). This makes a decision process more complex. The situation also creates challenges for standardisation organisations, which have to co-operate in a competitive environment and engage in different types of processes. In this context we must recognise that personal networks across these networks play an invisible, but important role in the complex negotiation processes. Making of such "weak ties" are currently amplified by the availability of email, faxes and other communication technologies.

⁵⁵ Frequency Division Duplex⁵⁶ Time Division Duplex

4.4.7. "3rd Part Developers"

By 3rd part developers we mean standardisation IT sector, and media and entertainment business. Their entrance to the standardisation arena is expected, because future terminals are expected to provide internet connections and media services. However, despite new entrants have been invited to participate into standardisation work especially from the IT sector they have not shown a great interest (Interview p. 43, 82). This is surprising as, the success of UMTS does not depend only on base technology, but also the active role of content providers - the 3rd party developers and associated service delivery platforms. Users do not buy standards or 2 Mbit/s bandwidth, they buy services - the content (Interview p.53).

4.4.8. Regulators

The historical origins of regulation as an institutional function were located to national monopolistic PTTs. During the 2nd generation the institutional function has adopted a new role. This has been caused by changes in the environment, privatisation, initiatives and the liberalisation of markets. In the mid -1980s in Europe ten national regulatory authorities moved from national governments to the European Commission in Brussels. This, and the initiation of CEPT increased the institutional function's role in Europe, while it at the same time decreased in USA due to the fact that FCC conspicuously applied its new toward requiring compatibility to AM stereo broadcasting (FCC, 1982 in Goodman, 1998). In Europe the institutional goal was to gain advantage for, telecommunication manufacturing, industry and operators. In the US the regulatory environment is different. The FCC, in particular, wanted to ensure that only a minimum set of technical requirements be mandated, so that new technologies and innovations are free to come to market (da Silva et al., 1999). An example is PCS auctions, which the FCC favoured to increase market competition and to determine what technologies will

prevail. This is in contrast to situation in the other regions, and US seem to want the 3rd generation standardisation to be as flexible as possible. However, the situation of the multiplicity of standards for mobile communication systems does not make it easy because most of the US standards are not mandatory.

Regulators work both at the national and the regional level. An important factor for 3rd generation development was WARC'92⁵⁷ (Reinhart et al., 1992) and W(A)RC'95 conferences which made recommendations concerning the 3rd generation development and spectrum reservation. It cleared 1900-1980 MHz, 2010-2025 MHz and 2110-2170 MHz frequencies for further use. The regulators also manage satellite frequencies and licenses. As a consequence each nation has to take care of its own nation frequency clearance. In the next millennium it is expected that the clearance of frequencies is necessary due to extra spectrum requirements and growth of users (Interview p. 37, 41, 76). In previous generations this kind of reservation did not exist to such an extent on the global level.

At the current stage the operators may have difficulties to create a clear understanding of what UMTS is, and what they want due to the licensing policies. In the USA the situation is still open concerning 3rd generation frequencies. Therefore a national operator in Europe, nationally, does not know if it will get licences from the auction, or not, if such are organised (like in the UK). Currently only Finland has granted licenses for the 3rd generation networks. The auctions are organised by national regulators. Such auctions are justified by goals of promoting fair competition position for all operators and also to stabilise the end user position in the service market. This may slow both standardisation and service development, due to uncertainties in the frequency allocation. The operators may also create a coalition to apply licences from another country to get an entrance to a new market (like Telia in Finland).

EU has a significant role when it comes to supporting 2nd generation systems in the context of research and in setting directives, which will harmonise frequency allocation for GSM, DECT and forthcoming UMTS technologies (CEC, 1998). In Europe two

⁵⁷ World (Administration) Radio Conference

extensive research programs have been carried out concerning UMTS: RACE⁵⁸ (da Silva et al., 1996 a, b; CEC, 1994a), and its successor ACTS⁵⁹ (CEC, 1994b). The EU projects' common factor is that they contain a strong and clearly focused thread of user activity on innovative technology.

4.5. Summary

Accepting a standard reduces pre-competition. Noticeable is that it does not eliminate the competition altogether. In fact it is becoming more important in ensuring manufacturers' products will work with other manufacturers' solutions (Bluetooth) and in created markets. For example, Bluetooth technology will integrate short-range radiobased technology into varying devices. It is also an open standard. Bluetooth and WAP Forum present the "hottest technology" in telecommunication standardisation, and hence are the "first generation standards" of this kind of technology (Appendix 6). As we have indicated, inside the technology arena there are different evolutions and generations of standardisation taking place on multiple layers. This leads to a situation where all is not standardised in a formal way. Comparing to the 3rd generation standardisation to 2nd in this context the 3rd generation is more technology development focused then 2nd generation which concentrate more on standardisation. And if we look further back, the 1st generation standardisation was also focused more to technology development, because developers' have to design the whole system.

We can note differences between the 2nd to 3rd generation. In the early days of GSM, the markets were national, and technology was seen as a rich boy's toy. Moreover, it was not of great interest to politicians. Researchers, technology experts and "pull" organisations had a lot of freedom to carry out their work. Now, in the 3rd generation players must think UMTS market globally and recognise the growing number of

⁵⁸ Research in Advanced Communications in Europe
 ⁵⁹ Advanced Communication Technologies and Services

subscribers and economic stakes. Globalisation requires from the technology point of view to address the problem of how several technologies will become standardised in different bodies including Japan with (ARIB), USA with (ANSI) and Korea with (TTC).

Standardisation bodies have take the pride in being open, but the openness can currently mean that the process may slow down and lead to endless discussions, "democratic" consensus seeking including endless process or voting cycles (Interview p. 39, 51, 53, 61 94). This is due to the growth of the number of participating members. The semi "closed" groups such as WAP Forum, or Symbian, show that when the forums show results - other market players will join (Strandberg, 1998). The semi "closed" means in this context that the preparatory work will be done behind curtains and released when the work has progressed to a stage where openness can be applied. This was the case in Bluetooth, or WAP. Accordingly, the gatekeeper has a role when designing the compatibility of a standard whether it is comprehensive like a GSM standard, or narrower like a UMTS standard. By the narrower UMTS standard we that in UMTS standardisation we do not standardise everything, but for example service platforms or interfaces. Thus the relations between different gatekeeper functions can become very time and technology dependent. Technology push necessitates that different players have to communicate via the gateway when wanting to influence the final standard.

After defining the principle terms of standardisation we can summarise that standardisation integrates multiple participants together from different backgrounds. In the following chapter we will present a model of telecommunication standardisation process that helps understand the dynamics of the interplay of different participants.

5. A MODEL OF A TELECOMMUNICATION STANDARDISATION PROCESS

"A common threat among the standardisation processes is that they all consist of procedural steps that mix the science of technology with the art of dealing with human behaviour" Nielsen (1996). This requires us analyse multiple and complex standardisation processes using a model based approach. In this chapter we suggest such a model. The model outlines relations between the components of standardisation process, leading to the integration (mix) of technology institutions (science technology) and market-regulatory organisations (i.e. art of human behaviour).

5.1. The need for General Model

We can find various IT standardisation process models, but very few of them describe the telecommunication standardisation process as an interplay between various stakeholders and this helps analyse the social dynamics of the standardisation. The standardisation process model we suggest is enough simple but at the same time, presents all necessary components and relations involved in the process. Thus, to meet the need that all participants in the standardisation process can more thoroughly understand their role in the process and recognise important relations between the components. By understanding the telecommunication standardisation process as social variable institutional change we will gain deeper understanding of such issues as the correct timing, the role of R&D, technology and market strategies, the importance of network externalities, and define more clearly the type and the depth of specifications and standards. We are also recognised the role of user requirements in shaping different stages of the process.

Understanding standardisation processes has become important, because new technologies, new forms of business organisations, trade issues and new institutions are emerging. In addition, standards are under a constant change. We have *de facto*, *de jure* and formal standards, but also sponsored and unsponsored standards. These all imply different standardisation processes. However all these processes must be integrated into a generic standardisation approach. For example in an unsponsored standardisation process the institutions do not have a significant role, but are an essential component in a sponsored standardisation process. Standards also form mechanisms for the diffusion process, enabling the evolution of multidimensional and complex telecommunication system. As Nelson (1994) notes standardisation and technology move forward. Things are not simply getting bigger or smaller, they are changing level.

The suggested standardisation process model (Figure 4.) describes steps in the telecommunication service development. A telecommunication standardisation process includes the following components: market/policy creation cycle, technology/knowledge creation cycle, "gatekeeper" function, institutional function, and an environment. The core content of each component we show briefly in Table 2.

Technology/knowledge cycle relates to the technology push and market/policy creation cycle to the market "pull". These two processes can be understood by supply-push and demand-pull theories (King et al., 1994a, 1994b). But as the model clarifies none of these theories alone is sufficient to explain technology diffusion. Push factors are created by the internal evolution of technology and research. Pull factors are created by the identification of users needs, changes in service growth, changes in users' service requirements and learning. Most of this is normal business activity and creates often a "destructive" change in the market. Market pull is often created by a user that stresses his/her individual behaviour such as differentiation of production, and novel attitudes towards technologies and services. We will investigate all components separately below in relation to the 3rd generation telecommunication standardisation. Overall components consist of objects, which are a target of action by different actors within the

environment. These include such as market specific technologies, or industry. Specific objects can inherit from the generic attributes of the component they belong to.

Component	Description of Basic Function	Push/Pull effect
Environment	A standardisation environment includes various stakeholders and diverse environments. The standardisation environment can change along with the general technology and business change.	Global change in business demographics Values and policy guidelines
Technology/ Knowledge creation cycle	Technology cycle develops technology platforms and solution. It has sub-cycles of movement and invention. Knowledge creation cycle implements continuous changes in technology.	Engineering culture and community Scientific active
Market/Policy creation cycle	Market creation cycle provides visibility for the users. Discovers the users' expectations. Technology Diffusion Dynamics. Coverage of user requirements.	Market/legal culture Business active
Gatekeeper Function	In the standardisation process a gatekeeper acts as a standardisation body or a trade association. The gatekeeper is a role to act according to the classification of the standard guidelines. Gatekeepers can act as evaluators of the standards. The getekeeper function between cycles and institutional function form a piazza, where standardisation stakeholders can move from one "arena" to another "arena".	Legitimacy and Jurisdiction scope Mode of standardisation type and level Membership criteria
Institutional Function	Institutional function ensures an appropriate balancing of commercial and public interest. The institutional function has a crucial role in promoting a region's economy and competitive capability.	Institutional legitimacy Social welfare National interest

Table 2. Core functions in Standardisation Process.

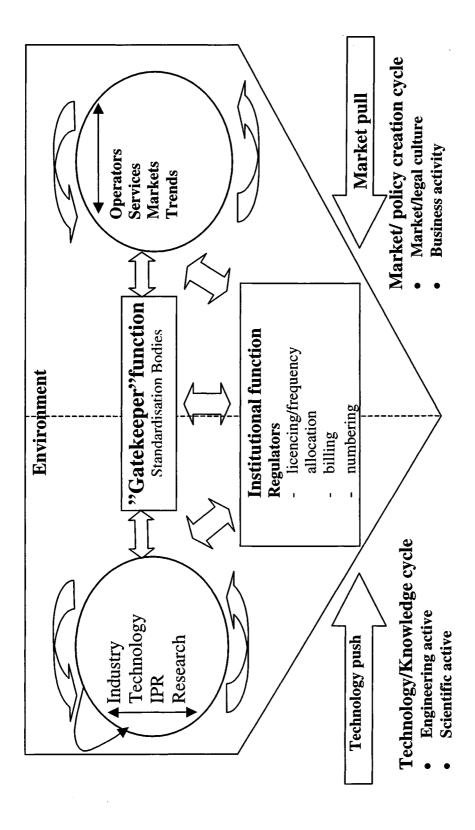


Figure 4. Standardisation process model.

5.2. Environment

A standardisation environment includes varying stakeholders and diverse environments that are origins/arenas for these stakeholders. Such environments include global business protection environments, research policies and political regulation of consumer and service provisioning. It changes when the technologies change. The 1st generation wireless standardisation environment was limited to the area inside a nation, except in Scandinavia where the standardisation covered the whole Scandinavia. During the 2nd generation standardisation the arena extended globally to three regions: Europe, Japan and USA. At the beginning of the 2nd generation many nations had a duopolistic market situation and after the market liberalisation in the 90's many countries have moved to an oligopolistic market situation due to limited frequencies and the nature of investments(CEC, 1994a). The next generation standardisation environment will be global. Thus it requires a compatible global telecommunication standard, which enables users to communicate anywhere, and anytime.

Stakeholders in the environment include users, administration bodies, manufacturers, service and network operators, organisation bodies and regulators. The stakeholders' positions have changed over time. The number of users has grown due to functional and regional expansion, and due to technology development. Technologies have become user friendly and equipment prices have come down. In addition, the manufacturers have to produce a wider range of products and develop brand names to meet users' requirements. Similarly, as part of service development network operators need efficient equipment and must increase network utilisation by providing competitive services. Also, the stark competition has lead both manufacturers and operators to joint ventures. Mergers and acquisitions between companies have become common.

Most stakeholders' primary business is not the standards. They know the value and importance of standards in their primary business, if the standard meets their immediate needs (Strandberg, 1998). From this follows that standards have a role to create markets

and speed up technology cycles, when other environmental conditions are favourable. They can speed up considerably the cycle if they can create large enough expectations, which implies fast growth, high investments, high returns and rapid growth (Evans et al., 1998). Controversially, if the expectations are low and pessimistic, standards can slow down the process.

The standardisation environment varies between different nations. For example technology penetration varies between countries. This affects readiness with which new companies want to enter the market and finance technology investments and open markets to the new entrants. Equally the diversity of users, a variety preferences concerning services, equipment etc. intervene the process. Moreover, different regions form their own market environments according to user requirements. For example in Japan users favour light terminals with voice services.

The market environment of fixed line and the 1st generation telecommunication was a homogeneous voice communication system. From the 2nd generation it has become heterogeneous, in that involves services between variable systems and software, e.g. voice and data and increasingly Internet services. Stakeholders during the 1st or at the beginning of 2nd generation did not have many possibilities to intervene the service platform. Later they have started to gain benefits from the network externalities in the form of extended network services.

5.3. "Gatekeeper" Function

The centre of the standardisation cycle is formed by a gatekeeper function. A gatekeeper is normally a standardisation body or a trade association, such as ETSI, ITU, WTO, WAP or 3GPP. The gatekeeper is a role with a specific right and authority. It can specify questions or problems in the standardisation field from the view point of alternative standardisation and technology solutions (Hanseth and Monteiro, 1997).

According to Latour (1987) when we have reached consensus concerning the standards – i.e. interests are aligned - we have had a race between different actors trying to manoeuvre themselves into key positions as "gatekeepers" or "obligatory passage points". The gatekeeper function between the two cycles and institutional function forms a *piazza*, a "space", where all participants of the process are able to meet. From the *piazza* participants can request a gateway "address" to trace them down in order to voice their issues. For the players *piazza* is an important place to collect information and knowledge and distribute it to its own organisation (Interview p.17).

The gatekeepers' role can vary according to the classifications of the standards. It can be open (*de facto*), mandatory (formal), or proprietary (*de jure*). The major companies from both cycles can generally benefit from the ownership of proprietary standards, while small companies are interested in open standards (Goodman, 1998). Proprietary standards are for example Microsoft operating system platforms. Zaninotto (1998) remarks an interesting problem about proprietary standards. He rises a question of joint effects of private proprietary and networks. For example Microsoft has covered the markets giving it some kind of monopoly power. However, we can question how stable is monopoly power arising from *de facto* standardisation?

Gatekeepers act also as evaluators of standards. In general one can evaluate standards as *intrinsic* and *extrinsic*. Intrinsic standards embody the compatibility specification and the extrinsic standards describe a relationship how well the technology embodied in the standard meets the needs of its users (Goodman, 1998). Extrinsic standards require that gatekeeper and participants in both cycles to form a relation, in which industry, technology, and market actors establish a "gateway" where the standards are defined. Extrinsic standards include e.g. SIM⁶⁰- card or data services development. Correct timing plays a significant role in extrinsic standards, as we have recognised from the GSM standardisation. The GSM was released in the right time and the system met the users' needs. An example of intrinsic standards are recently developed Bluetooth or WAP specifications. Libicki (1995) argues that for intrinsic standards the quality is important and good outcomes are more quickly achieved in the standardisation process

⁶⁰ Subscriber Identity Module

when the technology "matures" before hitting the market. After all what counts is the extension and adaptability of the standard. Standard adoption cannot be a single-side adoption. Instead, adoption requires all players' acceptance especially that of industry and users.

Acting as a "gatekeeper" can take place by coincidence. For example the site was given for CEPT due to its initial role as a co-ordination point between European PTT's. At that time no other applicable organisation existed. Currently it acts in a significant role in frequency policy within the institutional function.

During the recent years the number of participants has increased in standardisation and the environment has become more conscious about the importance of standards due to market pull. Whilst the number of participants has grown this has brought new entrants to the environment, "3rd part developers". These players come mainly from the Internet community and entertainment-industry. They are expected to have a significant role in the future telecommunication concepts.

Participants of the standardisation process have also different roles in standardisation organisations according to a company's strategy as presented in Figure 5. The participant can act as a viewer, commentator, supporter, or reporter of a document. The diversity of appearances in formal organisations may be caused by the lack of resources, different focus in core issues, or desire for visibility. According to an interview (p. 26) we can estimate that approximately 20-30% of individual members are members in various other standardisation organisations. Due to cross-participation the information flow has less barriers. For example, one chairman of a certain group can become a vice-chairman of an another subgroup. Acting in many organisations ensures that everybody works in a similar way (Interview p.83).

A new interesting situation is emerging in global organisation bodies when, for example, 3GPP acts as a gatekeeper (Figure 5). UMTS Forum or GSM Association act in the market cycle. Technology creation cycle is presented by WAP Forum or Bluetooth. That all together create a big mass and a conglomerate gatekeeper function,

which can wield power globally. This arrangement offers great flexibility, but we must recognise the increased complexity of the process, because different players can act in various roles in the process. For example, UMTS Forum and WAP Forum, both have either manufacturer or operator members acting in roles, while 3GPP creates a large *piazza* where all actors/participants can meet and provide equal possibilities for players to act.

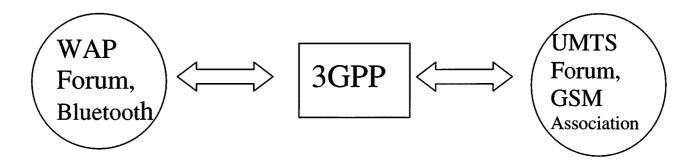


Figure 5. Informal standardisation would create a big mass.

The "gatekeeper function" forms a *piazza* in the sense that participnts can move from one culture to another culture. Manufacturers can and must act fluently in both cycles: in the technology cycle as members of manufacturer networks, and in market/policy cycle as an market object and as a representative of telecommunication products.

5.4. Technology/Knowledge Creation Cycle

Technology creation cycle involves industry core function, technology - IPR issues, research arrangements, and funding. Industry covers manufacturers, technology components and leading edge technology companies in the telecommunication field. The difference between manufacturers and leading edge technology companies is that the latter ones are more specialised in specific leading technologies like Internet, software or signalling technologies. Technology consists of technologies and techniques

used in the telecommunication sector. By industry we mean an organised ensemble of organisation for the purpose of manufacturing products, which the available techniques enable. IPRs are related to technology and research products, because current technologies embed, and patents which research produces. These must be always recognised before the commercialisation of the product. Research is regarded as a catalyst of the cycle. Without continuous research, new products will not enter markets. Research produces innovations, and these lead to products. Innovations can be characterised as a process of movement through three overlapping stages: invention, innovation and diffusion (King et al., 1994; Enos 1962; Mansfield 1968; Dosi, 1988). Invention is a new idea or product, which may or may not have economic value. Innovation forms a process whereby inventions move into usable form. Here standard making is an example of such an innovation. Furthermore, King et al. state that diffusion is the spread of the capacity to produce and/or use an innovation, and its use in practise. This part relates to market/policy cycle. For example several inventions will be required before the 3rd generation system is functioning to the extent it is designed. Telecommunication standard related innovations cannot be regarded as single innovations, but as collections of innovations, or parts of a larger "ensemble" of technological change. This is because systems are complex, large and are composed of components from other technologies. As Strandberg (1999) states standards are not stakeholders' primary answer, and a standard itself does not mandate innovation. Standards provide incentives to exact and use innovations that conform to the standard, or produce new innovations that meet the standard more efficiently.

R&D process develops and invents "prototype" products- innovation. In this sense technology cycle is related to standards more than the market cycle, because there is a need for global compatibility that must be met across research committing (Gabel, 1991; Goodman, 1998). Compatibility can also be achieved by "gateways" (Goodman, 1998), i.e. products that are capable of following more than one standard. The important issue is how to catch the idea/knowledge, tacit or codified, into the process of conversing knowledge into messages which can then processed as information i.e. standards (Cowan and Foray, 1997). The codification process, in principle, reduces the cost of knowledge. There are some claims that the distribution of knowledge between

tacit and codified has not changed (Dasgupta, and David, 1994). Cowan and Foray (1997) point out that the stability in the knowledge environment is not universal. Thus it is often the case that the knowledge environment involves subtle changes.

Knowledge creation cycle is embedded in the engineering and scientific culture. Innovation and technical excellence are main driving forces for the whole process rather than a response to market pull. Telecom industry has traditionally followed push, because the whole industry is dependent on the continuity of technical development, research and innovation within the knowledge creation cycle. Having said that, technology cycle is inartistically related to on the market cycle where operators adopt technology to produce services. Technical development however "guides" gatekeepers until new developed/invented technologies are developed to meet compatibility and interchangeability requirements. Therefore standardisation processes must start as soon as possible.

The complexity of acting as a gatekeeper has increased, because simultaneously the quality of both the process and the standards is becoming critical. This requires more resources within both cycles. During the 1st generation standardisation traditional institutions played a more significant role in this process, but due to the increased complexity and resource demands, they have left standard setting to the "market forces".

The 3rd generation technology deals with digital system components. The main digital technologies are GSM, TDMA, CDMA, IS⁶¹-95 (US CDMA), (Ross and Gilhousen 1996), or W-CDMA. We can find inside the technology cycle sub-cycles, which inherit attributes from previous technologies. Technology is also required to conform to IPR issues, which are outputs of the research process. Technology cycle process can "proceed" with its own speed regardless of the whole cycle.

We can look at the SIM card as an example. This is a small electronic card inside the GSM terminal, which enables international roaming and carries the telephone number,

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⁶¹ Interim Standard

and other information e.g. billing and services (ETSI, 1997 a, b). The open GSM standard created opportunities for industry to manufacture such components. To make SIM card function, it requires a relationship to the gatekeeper and institutional function that co-operate according to the administration requirements e.g. numbering and standardisation of products. At the same time when technology development is taking place one needs to recognise expectations of operators passed via the "gatekeeper" function, that forms a technology-access gateway. By the technology access-gateway we mean that the participants interested in discussing technology can meet. We can assume that the "Gatekeeper" function can have various parallel gateway-access processes going on simultaneously an research or regulatory issues. The SIM functionality facilitates international roaming, enables handling of environmental issues such as regional services, and tariffing policies to be taken into account. This requires an administrative gateway between the market cycle and the institutional function.

Technical advances can be seen as an evolutionary "random" quote process, which leads technological variants to compete with each other at some point (Nelson, 1994). The classic case is VHS and Beta standard rivalry. Here, the market environment has a significant impact on the compatible products. The benefit to have a standardised technology becomes so tempting, which will sooner or later dissipate other potential opportunities. We can note that the benefit for the winner is attractive, while the competition may not be. This may lead for example to competition which delays market growth by encouraging users to wait to see what the standard will be, that is, what other users will do (Besen and Farrell, 1994) - so called "heard effect". Nelson (1994) notes that when new technology comes into existence, there is considerable uncertainty regarding which of a variety of possible variants will succeed. This may be the case in the 3rd generation telecommunications too, because it has a lot of uncertainties from the market (cycle) point of view. The situation where competing technologies are cumulative, an early adopter can get advantage over the others. This can be a matter of right timing, or a matter of chance that may lead the race to end shortly (Farrell and Saloner, 1986).

In the 3rd generation the early adopter will be Japanese industry. It will commercialise a compatible system one year earlier than Europe (Interview p.34). When one technology gains an advantage over the competitors there are strong incentives for resources to be drawn away from the technology rival, because major advances may be needed to increase product competition. This may lead to a situation where competing designs are left behind, and the only economic way is to proceed with the leading technology. We can hypothesise that this situation was with GSM, and it will be the case with UMTS.

Within the technology/knowledge creation cycle we must observe how extensively the future telecommunication environment will grow due to the integration of media and information technology. The technology, more precisely network technology consists of Internet technology, components from a variety of suppliers, which are integrated into a range of different devices using various levels of interface definitions and a family of standards. ATM⁶² switches and IP routers are examples of standard-based equipment from a variety of suppliers that interconnect and interoperate facilitating substitution without vendor-switching costs (Bailey et al., 1995). The critical connection is open interfaces and standards, which are created among volunteer industry members without the approval of a formal standardisation body e.g. ETSI. The life cycle of an organisation can be tied to the needs of informal "open" standards, without the formal standardisation body continuity.

Thus, we can state that standards have a fundamental role in the future technology, which involves conversion of media, telecommunications and computing (Interview p. 53, 67, 85). However, this also requires the development of new technologies such as MEXE⁶³. Network protocols such as TCP/IP and an application suite are critical in achieving interoperability between the underlying transport and switching facilities (Bailey et al.,1995). Different standards such as MPEG⁶⁴ (Soares and Pereira, 1998) and protocols are also critical in the future equipment. These different standards/protocols enable moving pictures and banking services can be delivered via wireless communications using a variety of delivery channels such as WWW. The technology

⁶² Asynchronous Transfer Mode

⁶³ Mobile Station Execution Environment

⁶⁴ Moving Pictures Experts Group

representatives have formed voluntary forums (e.g. WAP Forum), which create *de facto* standards. This is based on existing Internet standards such as XML⁶⁵, and IP⁶⁶ protocols for a wireless network.

Technology creation cycle dominance will stay, but the gatekeeper role as a *piazza* to integrate various participants will remain and grow in importance. In the case of multiplicity of standards it is important to update them in one central place. Otherwise after years of unstructured use we may face the situation of unorganised and loosely maintained standard specifications.

Research and development activities are a seed of technological and economic growth. Traditionally firms have benefited from their own R&D activities, thus developing proprietary products and networks. This has created technological opportunity, productivity of R&D, and the ability for appropriate returns from a new developments, making the R&D profitable. This means high intensity from R&D, such as from the semiconductor development, because new ones are created with a comparable speed (Klevorick et al., 1995). The intensity differs from the 1st generation and varies among industries such as wood industry. Along the technological development, compatibility and interoperable requirements have been voiced. Therefore it is efficient to arrange inter-organisational arrangements such as joint ventures or consortia, technology licensing, IPR, sub-contracting with universities or private laboratories. The high technology companies cannot live anymore as "lonely wolfs". They co-operate, or are forced to, in terms of standardisation, do joint research projects and IPR contracting. R&D can act as a bridge between technology development and commercialisation. In different environments the R&D objects can vary due to political, cultural and economical effects.

65 Extensive Markup Language

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⁶⁶ Internet Phone

5.5. Market/Policy Creation Cycle

A market creation cycle involves operators, services, trends, and markets. Operators consist of services which are provided by various network and service operators. Industry provides network technologies to operators' use and enables frequency usage. Market includes services, telecommunication equipment, and markets. Trends include the current main waves in telecommunication field such as globalisation or user behaviour. This cycle has a market/legal culture and consists of business activity, which pulls the cycle forward. By market culture we mean the liberalisation of the markets and changes in users' lifestyle along the development. Market creation cycle provides visibility for the end users. The users get knowledge about products and services mainly via the market and thus it provides user visibility. Users participation for standardisation process is a complicated matter (Jakobs et al., 1998; Peterson and Dvodak, 1994). In contrast of the technology/knowledge cycle provides visibility for the experts. By legal culture we mean auctions in nations to apply licences to operate UMTS services. Business activity includes the growth of markets, development of services and globalisation.

Previous GSM MoU⁶⁷ played an important role at the introduction of GSM. Now operators' commitment is needed for the acceptance of UMTS (Samukic, 1998). The critical point in the market creation cycle is users' adaptability to the service concept. In contrast to the 2nd generation low-speed wireless data, 3rd generation high-speed data transmission will be successful if the cost to the average user is competitive with the wire-line alternative (Lee et al., 1998). Currently we cannot forecast exactly these numbers due to the amount of uncertainties in the system. An extensive overview of scenarios is given in (UMTS MFS, 1997; da Silva, 1999). This leads to the other critical aspects of 3rd generation market including coverage, tariffing, lifestyle changes and terminal offerings (Ojanpera, 1998).

Services standardisation provides users with a minimum service platform. UMTS services are not specified at such a deep level as in GSM. They are mainly defined at the level of service capabilities. The market now needs a service platform based on a set of minimum service requirements so that operators can differentiate their services according to the competition in the market. The 3rd generation service requirements are specified on top of a service platform, and they will rely on a core set of standardised services. According to an operator interview, if operators were to standardise services that would take too long a time and competitors would take the benefit. The operators' services are not standardised, but protected to gain better competition position such as banking services and in a wide range of public transportable timetable systems (Interview p. 22). These services are end-user oriented, which can be provided for Europe and global markets. The problem is how to recognise the users' functional requirements, the weight of the terminal, "gimmicks" and price. This requires extensive co-operation between knowledge creation and market cycles. When developing services a critical point is that the final user does not know his/her needs (Interview p.13, 58, 67, 91). The technological development cycle needs to have a vision of user needs from the market cycle. The vision can draw on user questionnaires or stakeholder negations between technology and market cycles.

Earlier generation service providers were national PTTs. Users depended on equipment manufacturers, which were developed in the technology creation cycle. The 1st generation service providers delivered the network equipment for a monopoly operator. During the 2nd generation the market changed. The market came more distributed by having several national operators, and later also international operators. The user could choose from manufacturers' equipment for voice communications and network components from several service providers. Currently operators obtain equipment from several manufacturers, but also determine the service segments of the equipment: voice, data, or internet communication.

In the market creation cycle specific trends prevail like the expansion of the market. According to one manufacturer the telecom sector market does not develop quickly.

⁶⁷ Memorandum of Understanding

Market and users' service expectations seem to match to generations' in years rather than in months (Interview p. 48). This prolongs the market creation cycle. The market creation cycle creates market pull by establishing expectations and leading to the growth of the user population. This implies that the user must have a choice to use new services governed only by his/her own needs without being pushed to a change for the sake of technology, or regulation (Samukic, 1998). Longer market pull requires time. This is determined by users who need to understand what they can do with the equipment, and the service providers have to develop services around them. A fax machine is an old concept - about 30 years olds - but in business terms it's new - 10 years old. It was first seen as an electronic post-box, and an alternative to mailing a letter. Today e-mail is replacing faxes. E-mail systems were created originally in the 60's in the USA.

5.6. Institutional Function

Institutional function seeks an appropriate balance between commercial and public interests, secures radio spectrum availability, and thereby provides an efficient use of radio frequencies. The regulators form their own group, nationally and regionally, such as ERO. They set regulations for frequency and give licences, identify spectrums, allocate spectrums for specific purpose, and clear a spectrum when needed. Radio spectrum is the backbone of wireless telecommunications as well as a wide range of other services. It is thus an increasingly scarce resource.

Tight interrelations between the regulator, the market and technology have substantial effects on globalisation and commercialisation. In previous standardisation processes regulators were most often monopolistic operators wielding a significant power. With the technology development and environmental change the regulators' role has changed. PTTs have been divided into two organisations: regulators and operators. The new situation has reduced the operator's power. Regulators set the frames for the industry,

markets and standards in the form of licences, spectrum allocations and service regulations (e.g. billing, numbering schemes, portability (etc.)).

The institutional function has a crucial role in each region to promote the region's economy and competitive business. The governments fund research via their own institutions and thus the relation to policy and knowledge creation cycle is becoming tight. One example of government funding is ARPANET in the USA which during the 1960s and the 1980s lead Internet to grow (Cerf, 1995). Governments also recognise technology development by making laws and thus responding to public opinions e.g. to the changing role of PTTs. In Europe the European Commission has had a decision-maker role while formulating telecommunication liberalisation directives (CEC, 1994).

Noticeable is the importance of operators' and regulators' co-operation. Especially in the 3rd generation standardisation process markets are dependent on regulators' decisions concerning the frequency allocation. How these frequencies are allocated varies from auctions to "beauty contests". The uncertainty of the availability of licenses among operators has created uncertainty and caused investments to slow down. The 1st and 2nd generation systems frequencies were auctioned in the USA leading to different frequencies between USA and the rest of the world. In the 80s USA adopted an opposite policy. They allowed different standards to enter the market in different areas and frequencies. This was due to the US government policy: it organised auctions to sell frequencies. According to UMTS Task Force Report in 1996 (p. 39) it is essential for the legal and regulatory environment to reduce the risks and uncertainties and thereby stimulate the mobile industry to make the required investment in research and technology development and standards. In contrast Hemenway (1975) argues that the National Bureau of Standards declined to write interface standards for the computer industry because it feared that such standards would retard innovation.

5.7. Relations

Finally we illustrate the relations between model components. Between the "Gatekeeper" and technology/knowledge cycle we can state three relations: technology, knowledge and information. Technology relation means that technology/knowledge cycle provides technology concept for "gatekeeper" as a base of standards. This follows knowledge relations, which enable exchange and gathering of knowledge from standardisation bodies. As we recognised the gatekeeper function acts as a *piazza*, where the technology/knowledge cycle collect information to their actors' use. Relationships between institutional function and technology/knowledge cycle is technological, i.e. institutions get technology knowledge from technology/knowledge cycle for their decision making. The bridge between technology/knowledge and market/policy cycle is formed by business and engineering activity, which can be cooperation, e.g. between industry and operators in a form of common interests networks.

Relations between market/policy cycle and gatekeeper are technology, knowledge, information, trends and markets. Technology relation gathers technology information for of operators. Also, market/policy cycle collects information from *piazza* for their organisations' use. Operators can act as "information traders", because they can act in multiple roles in standardisation organisations. For the "gatekeeper" it is important to get information from the market/policy cycle about markets, e.g. what is the penetration or the expected amount of subscribers, because formal standardisation organisations are not commercially oriented. The last, but not least, relation is trends. It is important for "gatekeeper" to know what are changing user requirements, though they might be difficulties to take into account in the actual standardisation process. The relation between market/policy cycle and institutional function involves an administration relation. This means that operators are dependent on regulators' decisions concerning legal issues, licensing etc.

The relation between "Gatekeeper" and institutional function consists of information relation and administration relations. Information relation means that institutional

function gets information from the "piazza" again, for their function's use.

Administration relation means that standardisation bodies must work in co-operation with regulators when dealing with such issues as frequency reservation or clearance.

5.8. Summary

To summarize, we can state that standards can be seen as a "gateway" between market pull and technology push. They can have an enormous impact on business performance and technological development. The term "gateway" denotes a transparent process, as it can be seen as a virtual connection, which channels simultaneously activities between a market and a technology cycle. The gatekeeper means a role which enables this connection to be established, and leads to a possible standardisation process.

Nelson (1994) argues that effective use of the latent potential in a new technology can require significant institutional accommodation. Therefore this might take a long time before there is much effect on productivity. Mansfield (1968) denotes an another view. He states that we must understand how rapidly new technology can replace an old one causing intrafirm diffusion. Intrafirm diffusion denotes the change rate inside the company. In this case to make process complete the new technology must take in use in both cycles, technology/knowledge and market/policy cycles, and institutional accommodation to enable diffusion happen. In this context a "gatekeeper" role is needed to integrate these cycles in to a standardisation process. The institutional function enable to recognise regulatory issues.

Possible effects of the telecommunication standardisation within the 2nd to 3rd generations we will discuss in the following chapter.

6. COMMONALITIES AND DIFFERENCES IN THE 2^{ND} AND 3^{RD} GENERATION STANDARDISATION

6.1. General Characteristics

In this chapter we apply the model of the standardisation process to understand telecommunication standardisation processes during the 2nd and 3rd generation standardisation.

During the 2nd generation standardisation the crucial factors were the following two issues: the regulators helped focus the work and there was a sufficient critical mass. During the 3rd generation standardisation the process is dependent on the mobilisation of several stakeholders, and is influenced by the multiplicity of forces. It has to become more flexible. These various forces are a novel market and business issues, the new role of IPR's, economies of scale and new technology integration issues.

Using the model we will examine some key issues that have driven the global standardisation processes. These key issues are presented in Table 3. The table shows all model components which characterise 2nd and 3rd generation standardisation processes, based our interview data. The number of organisations has increased and new entrants have entered (or expected to enter) standardisation work. This issue has an impact for all process components of the model. These new entrants are coming from the new technology environments such as Internet, entertainment business, or consultant services. The remaining players are regulators, manufacturers, operators and expected "3rd parts developers". We call them Expected "3rd party developers", because such groups do not play an active role in standardisation (Interviews p. 22, 82). The role of

regulators is decreasing. Yet, they have the monopoly in allocating spectrums and granting licences. At the same time the standardisation work has become complex thus requiring more participants to be active in the standardisation meetings.

In the "gatekeeper" function the number of active participants has increased in ETSI TC SMG plenaries. This is interesting, because system standardisation between the technology cycle and the "gatekeeper" role did not start from scratch like with GSM. Instead the new system is based on the 2nd generation system. Standardisation environment has expanded from national or regional to global operations thus enabling the compatibility of terminals and providing economies of scale. Powerful organisations are not acting only as regulators, more specifically national PTTs, but manufacturers and PTTs together are dominant coalition. The key players in the 3rd generation standardisation are regulators, manufacturers, "3rd party developers", i.e. media, IT, and regional blocks, such as EU, USA and Japan. The nature of standardisation process has shifted in that it deals with both technology and service concepts. This requires closer co-operation between cycles. The role of IPRs has increased in the technology/policy cycle along with the rapid technology development, the growth of the number of participants, and massive "economies of scale" related to markets. As we can recognise all these changes have multiple effects on the standardisation process. None of the model components affect the change separately.

The evolution from the 2nd to the 3rd generation has impacted several aspects of standardisation issues. Firstly, we cannot underestimate the critical role the institutional function has played in Europe, specifically within EU and its national regulators. One reason for GSM success was a political vision and a will among decision-makers - PTT's and regulators' - to create a single standard in Europe (Interview p. 42, 49, 57, Robin, 1994). That vision was laid down in the early 80s, when there were about seven analogue systems in Europe, and therefore, no compatibility (e.g. NMT in Scandinavia

and TACS⁶⁸ in the UK). The political vision was pushed from the regulator's side. National regulators organised licensing, dealt with commercial competition, and allocated the spectrum. They do not have such role any more, because the pan-regional institutions, like EU, and globally WTO, have taken the role.

Covered component in process model	Aspect	2 nd Generation Standardisation (GSM)	3 rd Generation Standardisation (UMTS)
All components	No. of organisations	Few organisations	New forums, more organisations, manufacturers, operators
	Main affecting components: What are the Key Players	Regulators, manufacturers, operators	Regulators, manufacturers, operators, "3 rd part developers": Media, IT, Regional blocks (EU, USA)
	Document handling	Mainly paper documents posted before the plenary	On-line document service in Internet
Gatekeeper	No. of active participants in ETSI TC SMG plenaries	~40	~200
Gatekeeper	The Nature of Standardisation Methods	Formal, slow	Evolutionary Complex, more informal, faster, flexible,
Gatekeeper role in technology/ knowledge cycle	System standardisation	From scratch	Based on 2 nd gen. (GSM)
Standardisation role in the Technology/ knowledge cycle	Intellectual Property Rights and their role	An Open standard	IPR's Important, can delay development
Market/policy cycle	Emphasis during the Standardisation Process	Technology focused and driven	Recognise Complex technology + the role of service concepts
Environment Institutional Roles	Geographical span Dominant organisations	Regional/National Regulators/PTTs	Global Manufacturers/PTT's
Institutional function	The Role of the Regulators	Wield power, in spectrum allocation, licensing	Less power, spectrum allocation, licences, still crucial

Table 3. Commonalties and differences in 2nd and 3rd Gen. standardisation process

⁶⁸ Total Access Communication System

Secondly, the disadvantage if the earlier systems was that the users could not take their phone and use it in the large European markets. So, an important concern was the reservation of frequency in Europe, more precisely EU for digital phone services(Interview p.50). The limitations of frequencies were noticed in Europe in the late 70's when EU reserved a frequency band twice 25 MHz at around 900 MHz for mobile communications.

The third and most important factor in the GSM development, was roaming. Its foundation was laid down already in the NMT system in Scandinavia (Interview 15, 19, 35, 50) i.e. the ability to use a mobile phone across the borders. Now we could not imagine the life without this feature. In Europe the system did not have any competitors. CDMA system was available, but it could not provide what operators were looking for.

Finally the right timing (Interview p. 42, 57, 70) lead main players in Europe to start the creation of the 2nd generation system as a single standard. The standardisation process started from scratch within the technology cycle. The technology was developed in an open way. In other words, the key interfaces were publicly defined - free of IPRs - thus enforcing an equal competition environment (following the model adopted in NMT). The development process created also a GSM community in Europe (Interview p.36). The members of community, acting as stakeholders recognised themselves as members of a successful movement. This created synergies. The community started to work as a "self-steering" movement and invited other stakeholders to participate in the work in common interfaces (Interview p.19). The target was to create one mobile telecommunication standard platforms for Europe. They succeeded, and GSM was adopted globally and it today has over 200 million users after 7 years of existence.

After the creation of an open GSM standard the European bodies participating the in standardisation process created also an efficient way of maintaining the standard. The work was done within a "gatekeeper" function. The standard was not only delivered to

the industry, but ETSI TC SMG created a procedure to maintain it. This is the so called change request procedure (CRP) by which regular updates to standards can take place (Interview p. 57). CRP procedure has enabled the GSM system to evolve and to accommodate changes and thus has enhanced its competitive market position and flexible evolution. Successful GSM development, type approval and standardisation process lead to implement the process on a global level. The necessity to obtain regional e.g. European-wide agreements on the fundamental policy, procedural and design issues before the creation of a standards were also implemented in the UMTS decision process.

6.2. Why Timing Is Important?

One reason for the success of GSM in Europe was its timing: it was the first credible digital standard for mobile phones. Politically Europe was in a state of development. There was a political recognition of the value of having roaming and commercially there were a clearly identified customers - PPT's. Timing is dependent on the number of players, their interests, complexity and the novelty of the standard and, the expected market growth. Time scale in wireless standardisation processes is fairly long and thus rises up the question of importance of the right timing (Figure 6). The "gatekeeper" function acts as a major factor when determing when the standard is accepted i.e. standardisation times vary according to who is designing the standard.

After the European success GSM became globally interesting, because there were not only European manufacturers for GSM, but also US manufacturers.

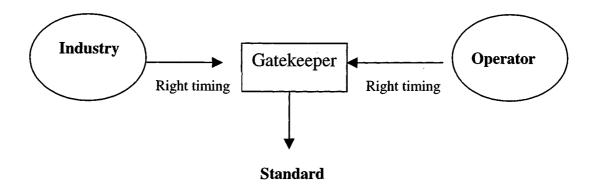


Figure 6. The right timing of Standard

During the 1st generation the telecommunication market included mostly national manufacturers, who were heavily dependent on regulators. An exception was NMT which invited all manufacturers to implement the standard. But also NMT benefited from the right timing and also from the underestimation of market growth which lead to foster cycles of the standardisation. This enabled slower pace before freezing of the specification (Toivola, 1992; Myhre,1998; Meurling, 1994). This enabled that technology could be developed in a slow fashion, without pressure (Meurling et al., 1994). An interesting aspect about the technology pressure is that "in 1969-70 at that time a time scale had to be rather long and the technology was quite mature when the diffusion cycles foster, because we had to do some research and lots of things" (Myhre, 1998). This means that there was not either market push, which would have created technology pull like in later standardisation processes.

As mentioned earlier standardisation is a long term initiative. NMT standardisation took approximately 11 years whilst its whole life cycle is about 30 years. So, we can state that a vital point is to give enough time for specification. There was a lot of uncertainty about what was possible from the technology and market point of view during the start up. GSM standardisation began in 1982, when SMG was set up, and GSM Phase 2+ was finished in 1998, sixteen years later. Both NMT and GSM started with vague a vision without a clear understanding of how to implement it. The development of solutions went hand-in-hand with specification due to the development of micro

processor and semiconductor technology. Thus some services became possible during the inception of the idea and standard. This was an evolutionary way to create the standard and will hardly not happen in the near future in a similar position. In UMTS first discussions began in the late 1980s and its standardisation started in 1992 when SMG allocated UMTS/FPLMTS issues to a specific group. It is scheduled to end in 2000 in Europe, and in Japan this year.

It is possible to reduce the standardisation time to a shorter frame to accommodate market requirements, because the UMTS technology is based on GSM. Yet, like earlier generations UMTS has been developed in spite of the uncertainty concerning potential markets. In several telecommunication standardisation processes scales are longer when compared with computing or internet standards where time scales can be counted in years g. Internet standardisation in IETF. But equally, the right timing matters.

UMTS standardisation should be ready at the end of 1999, in that its approval should take place in February 2000, which will make possible commercial network operation in January 2002 (Table 4). Despite intense work some standards may be delayed. In contrast, some standards will be ready earlier thus ensuring a possibility for some manufacturers and operators to start earlier implementation (Interview p. 87). This depends on the national licensing policy and frequency allocation. In such a hectic standardisation cycle all "components" of the process need to be in close co-operation to form a globally efficient standard.

This challenge has been met by establishing the 3GPP group, as discussed above. One crucial point in creating the group was timing. The other was collecting all parties having an interest in the 3rd generation platforms to work together and providing a solution that has market acceptance. This makes the standardisation cycle faster and reduces the overlap.

	1997	1998	19	99	2000	200:	1	2002	2003-
EUROPE	UMTS: Approval of M1 in ETSI	UMTS Standar			System Phase	n Developr 1	nent,	UMTS Cor operation	mmercial
						UMTS: 1 1: Planni Deployn	ng,		
		1002 1002 1003 1003 1003 1003			Standa	: Phase 2 rds			
			C	SM900	Phase 2	+ impleme	ntatior	l de la companya de	
USA									Deployment 2003-5
									Introduction 2005-10
JAPAN **		Detail Standar n: Basic Service		Standa Modif	ird ication	Service Introdu ction	\$200 F	lardisation: Bit Rate	2003-5 Service introduction
ITU	TG 8/1 Request for candidate RTTs	TG 8/1 Cu of date for evolution reports and decision of key charac teristics	t						X.
		k	etermir ey naracter		Compl Standa	ete rdisation			
3 rd Gen. SATELLITE		10,	iaracici	130103			L		2005-10

Table 4. The Time schedule for 3rd Generation Standardisation in Different Regions

It has also become obvious during the 3rd generation standardisation process that players face huge financial risks. NMT specifications came out without a broader recognition because the interest was so small. GSM was neither recognised in terms of investment, when the first specifications came out. Now, in UMTS the big financial stakes must be dealt at the beginning of the process, even though the process is now completely closed.

During the first standard creation there was a timing difference in investments. One has to invest in the knowledge creation cycle for the 3rd generation telecommunication research and IPRs, and in the standardisation. After that operators can march in with

investments for network services. One critical issue is (p. 86) that operators often apply a too short planning horizon. An interviewee argued that managers are not interested enough looking at the future. Instead they are more interested in the next season sales. Financial risks can be minimised by maximising the efforts of standards developers, in terms of time, but also in terms of understanding and accepting the political and human dimension of standard setting.

6.2.1. Critical Issues of Timing Related to Standardisation Process Model

Figure 7. exhibits time critical issues in the standardisation success. Each part in the model has a number of time critical issues which can affect the entire standardisation process. The time critical issues are frequency, technology diffusion, environment, network externalities and markets. In this simplified figure 7 we do not describe the affecting relations such as forums and associations. The relation between frequency and technology diffusion is simple, because frequency is scarce resource. The relations between technology diffusion, environment, network externality and markets are bidirectional, because of their multiple effects in the standardisation process.

The critical role of the institutional function is frequency management, because once the frequency is allocated for a certain use, it takes long time to change its use. For example frequency policy in US concerning GSM or the 3rd generation systems has retarded the development significantly. The success factors for frequency allocation are WRC, governments, and in Europe EU which can govern the frequency allocation. We can regard WRC as critical factor, because it has organised UMTS frequency issues before the UMTS standardisation began.

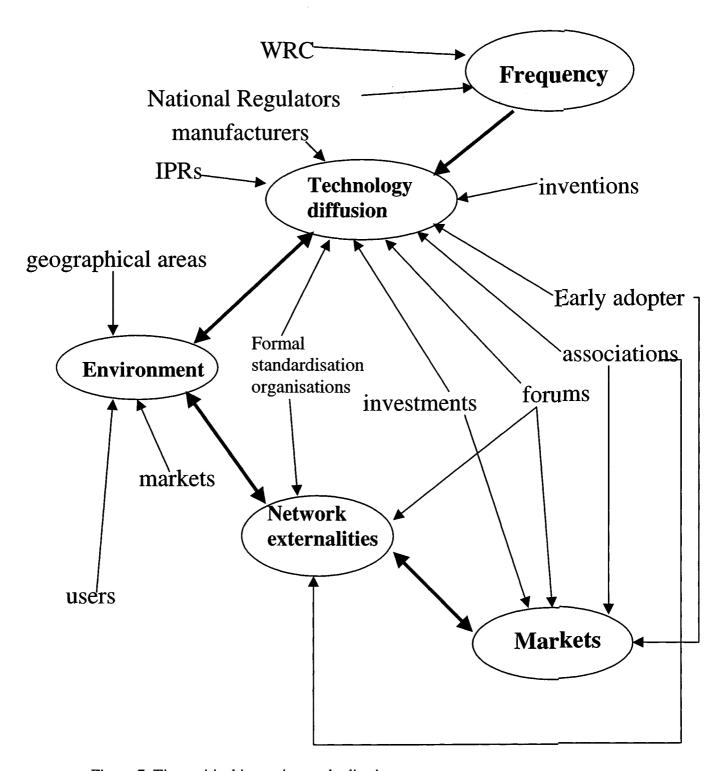


Figure 7. Time critical issues in standardisation process.

Technology diffusion critical issues can be regarded as early adopters, IPRs, manufacturers, association, forums and investments, and R&D inventions. Formal standardisation process is critical because it takes longer time to publish a set of formal

standards. In contrast the longer process reduces the number of unwanted standards and stabilises them. Unwanted standards can be technically excellent, but often standardisation process requires compromises which may change the core of standards. If the standards are produced too soon before the technology is matured we can complain that it is "too costly" to decide the standard. Also an anti-standards lobby can slow down the process (Meek, 1996). Early technology adopters have advantages in markets, but this requires inventions from the R&D. Furthermore, compatible inventions are required to recover from the patent process, which requires also time. Successful patenting implies that IPR issues need to be recognised in the standardisation process. If IPR issues are not cleared, then the process will require more time. Informal standardisation organisation such as WAP Forum, Bluetooth can affect the successful standardisation process by reducing formal bureaucracy and creating new working methods and decreasing uncertainty. For early adopters, for example manufacturers, right timing investments are required at the beginning of the process to ensure competitive position.

The time critical issues of the environment are markets, users, and geographical areas. Markets are time critical because they need to act according to user preferences and their reactions may change in a short time. Users' correct expectations and thus timing are critical because they as end users will demand products and services. Their decisions are difficult to predict when launching a new product or service. In the standardisation we may have also to mobilize geographical areas and markets, which may have adopted different technologies. To change their consuming preferences may take time.

The critical issue is also network externalities. Issues affecting network externality effects various forums, associations and formal organisations. A positive network externality enables better compatibility between standards. This is created by participants in the standardisation process. Organisational networks created save also time and shorten the actual standardisation process. Compatibility of standards can be achieved by forming a two-way discussion gateway between knowledge/technology and market/policy creation cycles. Formal standardisation bodies can successfully affect compatibility of standards at the global level.

Market is a critical issue, because of lock in effects of early adopters, forums, associations, and investments. Early adopters, for example operators, are interested to get returns to their invested money to develop the network and services. Forums and associations are critical to support standardisation bodies to get standards ready in an agreed time. This might cause problems because, too much is outside of the control (Meek, 1996). Also, users are interested in announcements of future services and products. Early adopters for example have an advantage in the competition of expanding markets. Investments are critical, because their right timing is needed to take the system in use.

6.3. The Role of IPR Issues

IPR issues are becoming more important, because the 3rd generation will involve new innovations and consequent patent rights. IPR issues have also become an important part of the business for manufacturers that invest significantly in the leading edge technology. From the knowledge creation perspective, manufacturers want to create open standards, they want economies of scale, and they do not want barriers or pay big royalties. Open standards are available without a significant cost for anybody, but they involve reasonable negotiations between the parties to achieve, "fair and reasonable, non-discriminatory"-agreement. This means that the owner of the patent, the patent related to e.g. ITU or ETSI standards (ETSI, f, 1998), has to deliver this standard to any party on a indiscriminatory basis and it must be available from the owner with reasonable basis. Open standards can benefit a company, because an open standard can diffuse much faster than a proprietary standard. The opposite standard to an open standard is a proprietary standard, which will reward only the owner of that standard (Interview p.44). The standardisation body must ensure that when it produces a technology specification, it does not contain IPR conflicts. The more extensive view of IPRs and standards is given in (Shurmer, 1995).

During the 3rd generation telecommunication standardisation process some industry members have tried to slow standardisation process by debating IPR issues at the global level. According to one interview (p.13) patents can be seen as a technology boundary, because if someone has a superior patent compared to the other solutions and other companies do not want to apply the patent due to its cost, this might lead to a situation where others reject a superior patent.

IPR issues can hold back the standardisation processes, though at the end manufacturers and operators cannot betray big expectations that have been created. UMTS Forum has estimated that by the year 2010 there will be about 2 billion terminals. The adaptation of standardisation bodies' IPR policy is expected to ensure globally a successful standardisation process. That is the only way how a majority of the world population can benefit from the new system. From the ITU perspective there is a big push for standards that can address the needs of developing countries which are not advanced in telecommunications (ITU, 1999). This aspect is different from the most of UMTS standardisation organisations, which have mainly a business motivation in their standardisation.

6.4. Summary

The 3rd generation platform is expected to be in commercial use by 2002. However, the current standardisation process differs from previous processes concerning IPR's, because 3rd generation standards are not *de jure*, or are planned to be, and they do not involve a limited number of players like NMT (Interview p. 30). The standards are planned to be open and participation is expected to be unlimited. So, it is a many-faceted problem to deal with IPR issues: more players, multiple standards from various areas, and different standardisation cultures. Now, 3GPP is acting as a main

standardisation organisation. It was established by organisations which all have different standardisation processes and license approval procedures.

7. DISCUSSION

In this section, we review the significance of our findings. First we discuss the importance of our developed standardisation model. Secondly we highlights the results concerning standardisation principles. Thirdly, we present few recommendations for the standardisation process based on our interviews.

7.1. Standardisation Process Model

We used telecommunication standardisation practices to develop a model of the process of standardisation and related issues. We used it to explain standardisation processes from various angles. This brought to "day light" new issues from the process such as, the difficulty to recognise the final user requirements, timing aspect, the depth of standardisation, technology multiplicity, the new role of the institutional function, the role of the "3rd party developers" and the significance of the "gatekeeper" role as an integrator between technology and market cycles. We can also recognise from the model relations between the components, and thus observe the role of "gatekeeper" as an information trader. In addition the 3rd generation telecommunication standardisation differs from the 2nd generation because it will integrate IT sector, media and telecommunication, which gives a specific character for the whole process. Our model covers also this new feature. Moreover, we can use the model to utilize various theories such as the network externalities and the technology and market diffusion.

We used the model as a framework to organise our interviews. The data we collected was partly available from various publications, but alternatively it was also presented from the interviewee point of view, which gave it a special "flavour". Comparing the data of telecommunication standardisation to IT standardisation ensured the need for a

single standardisation model. For example IT sector standardisation does not have to recognise the institutional function role to the extent as the telecommunication sector does. Also, the gathered data highlighted the "gatekeeper" role in standardisation process.

The model consists of five components: environment, the "gatekeeper" role and institutional function and technology/knowledge and market/policy cycles. Between the components we observed several relations: obtain knowledge, information, technology, administration, market and trends. All the components have a certain role. In the case of the institutional or gatekeeper or both are missing from the process, the process can be regarded as an informal standardisation process. This is the case of *de facto* standardisation process. The roles of the process may also change among the players and during the process.

The environment has changed during the successive generations. The standardisation has become global. We have more players in the standardisation environment: regulators, multinational manufacturers and operators and the new "3rd party developers". At the same time the markets have become heterogeneous.

The number of organisations has increased in the "gatekeeper" function. It has also adopted new forums and coalitions, causing the change in the process speed when compared to the 1st and 2nd generations. These new organisations can create standards more rapidly, because they are more flexible and use ad hoc standardisation forces. Creating standards for several similar issues has also increased the complexity of the standardisation process. Hence, concurrently it appears that standardisation organisations should become semi-autonomous. This will require that standardisation organisations establish efficient approval systems (Interview, p. 43, 62). This is advantageous for the users, as they will get more well defined systems. Also, the complexity of the standardisation process has created pressures for the "gatekeeper" to keep timetables. These are set by industry and operator objectives. On the positive side, standardisation is faster and we can expect new services and equipment to roll out in the promised time. Also, the nature of standardisation process has changed from technology

focus to complex technology and service concepts. This differs from previous standardisation processes where standards concerned only technology.

In the market/policy creation cycle a current issue is the uncertainty regarding the 3rd generation licensing policy. At the beginning of the 2nd generation there was no such issue. This may slow down the investments and affect the timing of commercialisation in spite of significant market expectations. The services are not standardised in the 3rd generation. Only a service "concept" is established, which defines the minimum requirements for services.

To develop further the 3rd generation service concept it is expected that "3rd party developers" will participate equally in the co-operation mechanisms. But this is not the situation (Interview p. 82). The critical point is that they may get involved too late to the 1st phase standardisation of UMTS, and will be left out from the mass market. However, their expertise is needed to develop e.g. banking services, financial services or entertainment services.

The technology/knowledge cycle works towards standards. Yet, differences in the technology cycle were detected between successive generations. During the 2nd generation standards were created from scratch, but the current standardisation process is based on the 2nd generation standardisation practices. The study revealed that IPR issues have been emphasized more than would be advantageous. They have a critical role in the standardisation process due to commercial interests and different standardisation strategies. In the worst case this may imply delays to the standardisation process.

Problems related to IPR's cannot be solved by standardisation bodies. The main industrial players must solve them, by agreements and licences. We must note that the decision of the 3rd generation concerning UTRA decision was an unanimous approval of the solution. In contrast to the 3rd generation the 1st generation standardisation process such as NMT, IPR issues were not even dealt with. Now they have become one of the main issues in the process. GSM was created as an open standard in ETSI. It had a clear

IPR policy. Thus IPR issues were dealt with "behind the curtains". IPR issues of UMTS are dealt with in the same manner as GSM, but they are also submitted to ITU. This issue was dealt with when deciding on UMTS radio technology in Paris (January 1998). The proposal had an unanimous approval, even though some uncertainties in IPR's have got a lot of publicity (Interview p.84).

The institutional roles have changed drastically from the 1st generation to the 3rd generation standardisation process. Institutions have less power and the processes are more manufacturer driven. On the national level institutions have the goal to clear and allocate spectrum and carry out licensing processes. The regulators decide on the frequencies, billing and the strategy of how tariffs in each regions are set up.

We have discussed similarities in functions within cycles, but not their interrelations. The gap between the knowledge cycle and the institutional function is difficult to fill. The technology/knowledge cycle is a generation ahead, from the point of view of the cost and semiconductor capability. Issues concerning licensing, frequency allocation and services fill the gap between the institutional function and the market/policy cycle. The "gatekeeper" integrates all parts of the standardisation process and thus has a specific role that influences whether the standardisation process fails or succeeds.

7.2. Principles of Standardisation

When analysing the interviews we found that telecommunication standardisation processes have changed drastically during the last years. The successful implementation of the 2nd generation GSM standard in Europe by ETSI lead to a further development of telecommunication standardisation practices. ETSI played a dominant role by acting as a "gatekeeper" in the European standardisation process. GSM had certain features, which created the success. First, political will was aligned with the institutional function. Secondly, the regulators needed long sight decisions concerning the frequency

reservation. Thirdly, the timing was correct from the view point of political, technical and commercial aspects. These affected the gatekeeper function to integrate efficiently the technology/knowledge and market/policy cycles. Fourthly, it contained roaming which was adapted from NMT-system. The roaming enabled the mobile phone use everywhere where the system has coverage, at any time, without nation borders restricting the use. Fifthly, GSM was interoperable, enabling mass production of components, antennas etc.. There was enough mass from the start to adapt the new system. Last, a significant feature was that it was created in an open way. This means that all issues were publicly defined and free of IPRs. According to interviews, GSM will continue and improve its services through the CPR process. The growth number of users and the globalisation of the services lead to the development of future telecommunication standardisation.

The partnership project's core idea was to create an environment where all specifications are developed rapidly. ITU should provide a broad framework for global roaming and charging and then regional standardisation bodies, like ETSI will detail standardisation, "put all right labels on things" (Interview p.46). An interesting vision is what will be the future of 3GPP after the current standardisation process has come to an end, and how to maintain the standards on the regional level to meet requirements of the UMTS Task Force (p. 40): UMTS standards must have a solid core and within that core support the exploitation of technology innovation, enhancement of services and the introduction of new products. The standard should have an evolutionary life extending to at least 2025.

7.3. Recommendations for Standardisation Process

Generally, when starting a standardisation process it is difficult to predict whether the standard is a success or not. As we have discussed, we can find many examples of both failures and successes from the previous processes. During the 3rd generation standardisation a specific feature is that the standardisation process is "just in time"

standardisation due to human and financial issues. The possible failure of the 3rd generation standardisation is not seen as a threat to the system (Interview p. 86), because none of the players even think about that, and GSM will exist in any case. The drastic business issues and users requirements seems to require the next generation system development, but no one is willing to forecast the future of the whole system and standardisation (Interview p.16, 33,40,62, 67, 74).

The study revealed that it is difficult to predict the success or failure of standardisation based on the process model, due to the complexity and multidimensional nature of organisations and standards. The process may act as a catalyst for standardisation by indicating possibilities of the standardisation. The telecommunication standardisation process enables compatibility of products and creates network externalities which can benefit all players.

The "gatekeeper" function plays a significant role as a *piazza*, where all players can meet and enable a transparent process. However, the possible success occurs also in the "gatekeeper" function. Acting as a global catalyst "gatekeeper" can evaluate how much critical mass one standard can create, and predict the success of the standard. When one forum or organisation manages to gain a large acceptance globally or regionally, it may lead to a successful standardisation process. Finally, the success of a standard depends on users' adaptation of the product. This is quite challenging to predict as we know from the history.

In analysing future challenges of standardisation we must notice some critical points: standardisation organisations, technology, IPR's, timing, users, and culture changes. The standardisation organisations need legitimacy to keep their central role, as a *piazza*, and networks to collect and distribute information for participants. Technology is critical because users may not be willing to buy expensive technology products. Also, we can request how far it is necessary to develop the technology. Users are critical because, they finally decide on the adaptation of the standards. Technology development leads also to cultural and organisational change, whereby adaptation and its impacts are difficult to predict. We must also remember that all players have their own business

interest and strategies. These issues, the scarce resource - the frequencies - and a lack of critical mass, may lead to a failure of the standardisation process.

The global nature of standardisation process combines a number of technologies within the 3rd generation platform. To reduce the complexity of adopting standards in the process, we must limit the number of used technologies. This has also an effect on the final user. It reduces the costs of the final product.

The expected "3rd party developers" would benefit if they could participate in the standardisation process as early as possible to get the full use of new "multimedia" capabilities. Multimedia terminals offer a capability to take calls, receive and send faxes and emails, video clips, video conferencing and various kinds of value added services provided by banks or media.

Finally, we can summarise our recommendations for the successful standardisation process. Various standards, have each their own contingent standardisation process. However, all these processes can be related our process model. We assume that "gatekeeper" is in all standardisation processes in some form. The lack of one of the other components does not effect the success of the process. They can form a gateway, which enables discussion between various players. The requirement of fastening the standardisation process, which comes from the technology and market cycles, and the growth of number of players and technologies in the next millennium standardisation process set significant challenges for all participants. We suggest for standardisation actors as acting as "gatekeeper" to be semi-autonomous organisations, which can combine formal and informal standardisation procedures. The organisation should have their own CRP procedures, thus ensuring the continuity of standards and follow commonly agreed standardisation procedures to ensure transparency including IPR issues. It should has fairly little bureaucratic to speed the process and recognise the business needs of users and thus ensure the quality of systems.

7.4. Conclusion

This thesis forms an attempt to gain a deeper understanding of the evolution of recent telecommunication standardisation. The research strategy we have used to obtain this understanding was to use interviews and an archival literature study. We have examined current standard technologies, research organisations, markets development, various standardisation organisations, the role of regulators, IPR questions, changes in the environment, operators, services and market trends. Also, issues that affect push and pull factors have been studied.

The evolution of wireless telecommunication systems was presented in chapter 2. GSM and UMTS systems were presented and also some background information about the systems. The evolution of systems is a multilevel process as presented in Appendix 6. We have several technologies, and generations, which all should be compatible, also backwards, which makes the system development more challenging. Meek (1996) has presented the standardisation process by two elements: the breadth and depth. From this figure we can find out the breadth, i.e. how much the standards cover. More difficult is to find out the depth, the deepness of the standard which deals with the domain applicability. Confer the historical process in the GSM development. The system development went hand-in-hand with the development of processor and semiconductor industry, and thus it became possible along the way from the inception of an idea to the technical standard. This was an evolutionary way of creating the standard and will hardly happen in the near future.

In chapter 3 we described the research method and how interviews were organised. 17 experts were interviewed. The interviews were extensive and focused on questions that were relevant to interviewee's expertise. To cover all possible issues in the standardisation field globally, would have required too many interviews and was excluded.

In chapter 4 we presented conceptual preliminaries. Standards enable various players to align their interests to create a common arena where to act according to negotiated rules and frames. The standardisation model was presented in chapter 5. Discussion of commonalities and differences in adopting the 2nd and 3rd generation standardisation was presented in chapter 6. We discussed also why timing is becoming more important and what role IPR issues play.

In future studies we would be interested in know why "3rd party developers" are waiting to enter the telecommunication arena. Equally, we would be interested in research what is the final user expectations concerning markets and try to forecast their behaviour. The more complex research area would be relations and connections in the standardisation process at the level of individual companies and organisations, or to follow one standard life from the birth to an actual document used in various organisations. Also, further study is needed about the connection between telecommunication technology diffusion and the standardisation. An another less researched area is how standardisation organisations will keep their position and legitimacy in various environments so that we can develop compatible and global standards?

To conclude we can a state that the standardisation process cycle has become more complex due to the globalisation and the increased "clockspeed" of telecommunication industry. We cannot expect that a global single standard will be born near in the future. The processes of telecommunication standardisation will remain hectic, complex and multi-layered when moving towards the 4th generation standard.

An important feature is that the focus is not so much on the technology, but in providing mobile and fixed services to users. The 3rd generation UMTS concept is not only about communication technology, but it consists of digital services, thus requiring all players and sectors in the standardisation process to recognise timing issues in terms of investments and cultural changes.

Controversially, if we want to use a future mobile terminal, by integrating telecommunications, IT and media, we must be quite skilled. In the future we can argue

for multimodal terminals, but they might involve a technology barrier against the user. We can expect that the telecommunication technology becomes as invisible as driving cars or using watches.

Moreover, changes from voice to multimedia telecommunication changes user participation. A user is expected to become more active, for example to download new software. Furthermore, this requires that the user has knowledge to understand technology to take advantage of the any system. If the user does not have the knowledge, this creates "two-level" experts among the users.

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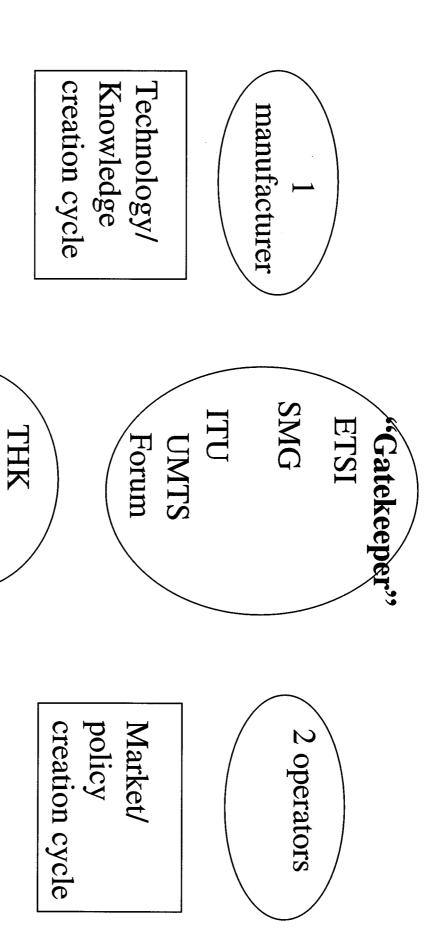
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Interview chart



Function

Institutional

ERO

EU

Teleliikenteen standardointi-tutkimus haastattelu 5.8.1998

"Pelinsäännöt"/Rules of Interview

The interview material will be used only for the research purpose of STAMINA-group and after the interview all material will be handled anonymously. The recorded tape will belong to STAMINA-group and used only as research material. All material can be given for checking for the interviewee before publication when required.

Asema yrityksessä/Position:
Organisaatio/Organisation (manufacturer, regulation etc.):
Työkokemus ja vuodet/Working background and years:
Standardointi organisaatiot, joiden työhön olette osallistuneet/ Standardisation bodies, which work You have participated?
Millä tavalla ja kuinka kauan aikaa/In which way and how long time?
Mikä on Teidän roolinne organisaation standardointi prosessissa? /What is Your role in you organisation standardisation process?
Miten organisaationne vaikuttaa eri standardointi prosesseissa/alueella? How does Your organisation act in the standardisation process/field?

Kenenkä muiden standardointiin liittyvien organisaatioden kanssa teette yhteistyötä? Kilpailijat?/Does Your organisation do co-operation concerning standardisation with others?Competitors?

Miten 3.sukupolven standardointi eroaa aiemmasta standardoinnista?(NMT=>GSM=>UMTS (FPLMTS) Kokemuksia?/How 3rd generation standardisation differs from the earlier standardisation porcess?Experiences?

Mitä trendejä tällä hetkellä on standardoinnissa?/What trends can be found in standardisation process?

Lisäkysymyksiä/Further questions

- 1. Miksi standardoinnissa on niin merkittävä, huomioiden markkina voimat ja hierarkisen kontrollin, että se pitää ottaa huomioon jo strategiavaiheessa?
- 2. Standardoinnin kustannussäästö?
- 3. Miten UMTS:n 3.n sukupolven käden vääntö vaikutti Nokiaan ja kuinka paljon se muutti teidän suunnitelmia, kun uusia yhteistyökumppaneita tuli mukaan? Mikä oli hinta?
- 4. Voidaanko jollekin standardille laskea jokin hinta, jos voidaan niin miten? Voidaanko mitata rahayksiköissä vai missä yksikössä?
- 5. Miten teollisuus sektori huomioi markkinoiden vaatimukset; keskusteletteko esim. operaattorin kanssa vai käyttäjien kanssa vai luotteko asiakkaille itse tarpeita?
- 6. Mikä on henkilösuhteiden merkitys standardointi prosessissa? Kokouksissa ja ulkopuolella??
- 7. Millaisia henkilöitä kokouksiin osallistuu? Kuinka monta hlö/organisaatio
- 8. Millaisia kokouksia järjestetään? Kuka järjestää ja millä periaatteella?
- 9. Mitä eri sidosryhmät on standardoinnissa mukana: uusia/vanhoja?
- 10. Voidaanko havaita eri standardointi organisaatioden välillä toiminta-tapa eroja? Millaisia?
- 11. Euroopassa EU:n merkitys standardoinnille?
- 12. Mikä on kivaa/tylsintä kiinnostavinta/ei-kiinnostavaa standardoinnissa?
- 13. Taajuuksista taistellaan, mikä on Teidän näkemyksenne taajuus asiassa ja siihen liittyvässä politikoinnissa?
- 14. Standardoinnin konvergenssi, divergenssi, fregmentoituminen?
- 15. Mitkä asiat tekevät mahdolliseksi standardoinnin?
- 16. Rajoittavat tekijät standardoinnissa?
- 17. Tulevaisuuden näkymät/suunnitelmat?
- 18.Miten näette suhteen markkinat-teollisuus-teknologia-hallitukset(politiikka) standardoinnissa? Sen vaikutus nyt ja tulevaisuudessa?

Questionnaire November 1998

- 1. History: Have you been in Madeira meeting, when GSM decision were made? What were the reasons at those days which lead to decision select GSM and not the competing systems?
- 2. IPR matters. In Finnish TV was on Tuesday that USA (Qualocomm) is not giving patens for the use of UMTS? Or if they will give they will present clauses? What is the actual situation now?
- 3. Are the timetables realistic?
 - 3a) The network architecture is still open?
 - 3b) What is the meaning of Japan standardization situation, they will have them really earlier.?
- 4. GSM=>UMTS. How do you see that the standardization process have change from 2nd generation standardization?
- 5. The regulators have previously the power in telecommunication field. Now the situation is changing, the power is "sliding" to manufacturers. How this affect to UMTS standardization?
- 6. The UMTS is more service oriented that technical. This brings into also standardisation bodies so called 3rd party developers. What is their role in UMTS standardisation process?
- 7. How rapid internet development has effected to UMTS standardisation?
- 7a) What is the internet role in the service development?
- 8. ETSI has set up 3GPP project recently, but the agreement is not yet signed. How their work affect to SMG work? Are there clashes with the work, because there is not yet much information available.
- 9. How do You see that the integration between IT, media and tele world will happen? How does it affect standardisation?
- 10. UMTS Licenses. In some countries they will have auctions and some countries they will have "beauty contest". E.g. in UK there will be auction for 4 licenses, but there are already now more operators. If we assume that all will take part to auction, meaning that someone will be dropped out. How do you see the situation whom will be left out, how they will continue?
- 10a) What is the role of GSM in these situations?
- 11. In telecommunications field are many association, forums etc. And they are quite young. How do you manage to keep contact with them and follow their work?

- 12. About Paris meeting. Could you describe the happenings and actions before the January meeting, when you made the decision about UMTS technology.
- 13. UMTS is planned as a member of IMT2000 family concept. How these two systems are integrated together in the standardization process and when the unification will exist?
- 14. Mr Pekka Tarjanne has vizioned about telecommunication world in his imaginary speech in Honolulu in 2008. In this speech "The changing telecommunications environment". In that speech he mention this year as "Telecommunications Revolution of 1998" and WTO is know as Global Talking Shop. What is your vision about future telecommunication world?
- 15. The last, but not least question. What do you like most and dislike in standardisation work?
- 16. What are the regulative and political threats in UMTS standardisation?
- 17. The amount of subscribers are expected to grow and thus the frequency requirements grow. There is need for extra spectrum. Was this taken account when the UMTS planing started and standardization?

18. UTRA

19. Has the meaning of standard change during these years You have been working in this area?

NAME	MEMBERS	NUMBER OF MEMBERS	HOME	HEADQ UARTER	
ETSI	Regulators, industry, operators, users	647, 49 countries	France	Sophia Antipolis	Directly influence the standards making process, voluntary standards
GSM Association	Prev. operators, now, industry, regulators	324, 129 countries		Ireland	Promoting and evolving the GSM cellular radio platform world-wide
UMTS Forum	Regulators, operators, industry: full or associate	160	UK	London	To create a condition form UMTS to be produced
ITU	Government, industry	188 coutries, over 500 companies	Switzerland	Geneva	Coordinate global telecom networks and services
CEPT-ERO	Regulatory	43	Denmark	Copenhagen	Promote European coordination and streamlining in the PT sector
ARIB	Operators, industry, MPT	303	Japan	Tokyo	"the Realization Center for Efficient Use of Radio Spectrum"
TTC	Industry, operators: full members, supporting members		Japan		Contribute to standarisation field of telecommunications by establishing protocolsand standars
ANSI	Industry, operators, regulators	1400	US	YN	Facilitate development by establishing consensus among qualified groups

TTA	T1	3GPP
Not available	Individual Member Industry, operators: vote, observer, foreign members	ARIB, T1, ETSI, TTC, TTA: Organizational Partner, Market Representation Partner and
Not available		(5)
Korea	US	Global
Not available		Global
telecommunications and related information services. Not available	Provide standards needed for the planning, design and operations of global end-to-end	3GPP will provide globally applicable Technical Specifications for 3rd Generation Mobile Systems
Not available	1984	1998

