GSM in the rural and urban jungles of Indonesia.

A case study of an emerging localized socio-technical system

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Summary

The subject of this thesis is the process of localization and emergence of the GSM system Indonesian style. This issue is studied through the Societal Construction of Technology (SCoT) approach, and Fleck's configurational and generic technology. Initially, the approach was the Social Construction of Technology (SCOT), but this was changed to broaden the scope, thus be able to equately study and approach the difference of the Indonesian context, in comparison to Western countries.
The theorerical framework of the thesis is ScoT, this approach sees technology development as a process of co-evolution, of which localization is a specific form, between technology and society. The concepts used are: actors, actornetwork, linkages, socio-technical system, and political regime. Actors are people or a group of people,who influence the shaping of the socio-technical GSM system. A specific type of actor are non-human actors, these can be technical elements that have to be taken into account by human actors. The relations between actors are called linkages. The actor network is the whole of actors and linkages, and provides an overview of all parties involved.
The socio-technical GSM system is the combination of social and technical elements that together constitute the GSM system. Basically, this system performs the function of mobile phoning. The term regime is used in the common political sciencitific sense. It is mainly used for the Suharto regime and the regulatory regime.
The GSM technology is studied from the perspective of configurational and generic types of technology. A generic technology is fixed, meaning that innovation is closed when it enters the phase of diffusion. A configurational technology is flexible, innovation takes place in concert with the user. This type of innovation is called innofusion, the collapse of innovation and diffusion.
Technology itself is analysed through a hierarchy of technical elements, namely components, devices, artifacts, and systems. A second perspective is that of software, hardware, orgware, and socioware. In these definitions technology is a very broad concept. For example, socioware is the technology of a society, that is society learning new habits, re-ordering conventions, and so on. In general, the way society handles and deals with a technology.
Mobile telephone systems can be characterised as a network technology. Important issues for network technologies are path dependcy, critical mass, and interoperability.

The research questions that this case study answers are:

> How did the co-evolution between GSM technology and Indonesia take place, and how did the GSM system Indonesian style evolve?
>
> Who are the actors that were involved in the process of selecting the GSM standard, and the process of shaping the GSM system in Indonesia?
>
> How was the socio-technical GSM system in Indonesia shaped, and how did the various actors influence the localization process?
>
> How is the GSM system in Indonesia configured, in terms of generic and configurational elements and their interaction?
>
> Why is the GSM system in Indonesia shaped as it is?
>
> Why did the GSM standard become a success in Indonesia?

The research is conducted through the study of documents, interviewing key actors, and discussions with experts and people knowledgable about the subject.

The story of GSM begins in Europe, where the E.E.C., telecommunications manufacturers, governments, and national telephone providers were instrumental for the shaping of the GSM standard.
General characteristics of Indonesian society are: the importance of communications technology for upholding nationalism, the power of the Suharto-regime, and foreign forces slowly changing Indonesia's policy on technology and industry. These have a bearing on the localisation and shape of the GSM system.

The main actors of the GSM system are: the regulatory regime, which is instrumental in setting the conditions for conducting business in the mobile telephony industry; top power figures who have a major influence on many undertakings in Indonesia; the GSM company Telkomsel, a joint venture that is innovative in rolling out their network; and foreign companies that develop and facilitate the importation of GSM equipment and technology, plus provide the financial resources for the roll out of the network.

The dynamics between these actors are characterised by top-down and bottom-up influences. The Suharto regime, the regulatory regime, and other top figures in Indonesia influence the localization process top-down. The consumer organisation YLKI and Indonesian consumers represent the bottom-up forces. The platform organisation ATSI (Association Telecommunications Cellular Indonesia), and the three GSM providers (Telkomsel, Satelindo, and Excelcomindo) are sort of caught in the middle of these two forces.

The shape of the GSM network in Indonesia consists of software and hardware elements, which are often the same as in European countries. Important elements for Indonesia are the sim card, the prepaid card, the microcell, and the underlay-overlay system. Also, special software is written for Indonesia to deal with the country's characteristics, such as the geographical dimension and the variety of types of backbone. For example, the use of a satellite within a single GSM network, which is unique in the world, requires special software.
In short, special additions and enhancements to deal with local problems and preferences are developed. The possibility to incorporate these additions in the main system, is proof of a flexibility in the technology. I argue that the character of the technological system embodies a configurational side. The software is largely responsible for the potential openness of the system.

Instrumental for the successful localization of GSM are the initial architects from Telkomsel, with a vision and the capacity to realise it, importantly through their cunning ways of manouvering in the Indonesian context. Secondly, the configurational character of the GSM technology – as envisioned from the beginning of the standards setting process – makes it possible to localise the foreign technology and build a GSM system Indonesian style.

To my knowledge SCOT researchers and hence case studies tend to focus on Western Technology development, as part of R&D, and the embedment in societies of the Western world. This case study examines a different context and type of technology development.
The idea of co-evolution of technology and society, and its elaboration and operationalisation as Societal CoT, emphasizes that the technologies-culture complex is not fixed, but evolving. This does not mean that actors can easily change things, however. To develop an analysis of openings for change is an important further step for Societal CoT.

By identifying a variety of actors and factors that are involved in the localization process, change agents may become aware of opportune angles and moments to realise change. In the end, Indonesians may look forward to a truly localised artifact that functions well in their rural and urban jungles.

Glossary

ABRI	Angkatan Bersenjata RI (Armed Forces)
ACES	Asia Cellular Satellite Communication
AMPS	Advanced Mobile Phone System
ATSI	Associasi Telekomunikasi Selular Indonesia
Bappenas	Badan Perencanaan Pembangunan Nasional = National Development and Planning Board
BPPT	Badan Pengkaijan dan Penerapan Teknologi = Agency for the Assessment and Application of Technology
Call attempt	number of calls needed to get a connection
CDMA	Coded Division Multiple Access
CdmaOne	universal term for IS-95 CDMA
GMPCS	Global Mobile Personal Communication Services
GoS	Grade of Service, % of customers that do not get connected
GPRS	GPRS is the common set of standards for the packet data services in both TDMA and GSM networks. It provides seamless end-to-end Internet connectivity to wireless terminals.
GSM	Global System for Mobile communications
IDD	International Direct Dialling
IMTS	Improved Mobile phone System, 1960s USA
Inmarsat	International Maritime Satellite, since November 1993
INTACTS	Inti-Telkom Advanced Cordless Telecommunication System
ISDN	Integrated Services Digital Network
Jabotabek	Jakarta - Bogor - Tangerang - Bekasi
JDC	Japan Digital Cellular
KKN	Korupsi Kolusi Nepotisme
Kso	Kerjasama Operasi - joint operating scheme
MoU	Memorandum of Understanding
MTPT	Ministry of Tourism, Post, and Telecommunicaiton
MTS	Mobile phone System, 1950s USA
NMT	Nordic Mobile phone system
PCN	Personal Communication Network
PCS	Personal Communication Services. FCC terminology describing two-way, personal, digital wireless communications systems.
PHS	Personal Handphone System
PN	Perusahaan Negara = State Company
PSDN	Public Switched Data Network
PT	Perseroan Terbatas (company with limited liability)
PT	Perseroan Terbatas (limited liability company)
PU	Perusahaan Umum
Roaming	Roaming is the ability to communicate with a person in a different area of operation.
SCR	Successful Call Ratio
SIM	Subscriber Identity Module
SIM card	a plastic card with a chip, size 1 by 2 centimeters, with an image from the provider and a 20 character number under the chip. The mobile phone holds a special slot where this small chipcard can be inserted.
SLI	Sambung Langsung International ,BI, - direct international connection
STDI	Indonesian Digital Telephone Exchange
UMTS	Universal Mobile phone System - 3G, European standard
Witel	Wilayah Telekomunikasi - telecom areas
WLL	Wireless Local Loop
YLKI	Yayasan Lembaka Konsumen Indonesia (consumer organisation)

Contents

Foreword

With this thesis, my student days are coming to an end. It has taken me considerable energy, effort, and even soul searching, to complete this last phase of the Philosophy of Science, Technology, and Society education. Quite honestly, I have not regretted choosing this education. I feel that it has opened my eyes and mind to bigger issues, and it has definitely challenged, and hopefully developed, my intellect.

A number of people have been instrumental in the process of writing this thesis. Arie Rip, as first supervisor, has motivated and inspired me. He has been generous with his time and ideas. I want to thank him for his detailed comments, and for getting me acquainted with the craft of writing. And of course, for inviting me to stay at his place – which has really helped me to finalise the thesis.
Nico Schulte Nordholt, actually the person who introduced me to the project, his extensive knowledge of Indonesia has educated me in the complexities of Indonesian society. One of my more dramatic experiences in Indonesia has been eating Durian fruit[1], together with him in Bandung.
Joshua Barker, the leader of the project[2] and also a member of my supervisory committee, initially confused me with his cultural-anthropological views. In hindsight, I see his input as instrumental for collecting in-depth data, and keeping an open mind during interviews. Discussions with him have clarified the stories that were in the data , but difficult to recognise for a graduate student unfamiliar with Indonesia.
Jasper Deuten, who knows little of Indonesia, has been helpful in my keeping a sharp eye on the theoretical concepts used in the thesis, and with his knowledge on network technologies. Despite the fact that our friendship originates from the time that we were volunteers at a local movie theatre, he has been rather sharp and professional in his supervisory role.
The last member, who will join the examination committee, is Dirk Stemerding. His fresh perspective on my thesis provides a more objective basis for judgement.

During my time in Indonesia, Widjajono Partowidagdo, leader of the Postgraduate Development Studies Program at the Institut Teknologi Bandung, has been kind to facilitate my stay at this prestigious and wonderful University. I also had some stimulating discussions with Saswinadi Sasmojo, teacher in the same department.
My actual entry in the world of GSM in Indonesia, was realised with the help of Ibu Yetty, and Bambang Baroto. Ibu Yetty introduced me to some people and from there on my social net expanded, making it possible for me to interview key people of the GSM industry. Naturally, I thank all interviewee's for their cooperation.

And finally, family and friends, whose support and companionship have kept me going.

August 2001 Enschede,

Jan van de Fliert

[1] Durian is considered the "King of Fruit" throughout South East Asia. Although it is banned from airport flights, and many more locations, because of its stench, the meat is very tasty.
[2] Telecommunications and Information Technology from a SCOT perspective.

Introduction

My thesis falls within the research project performed by Joshua Barker and commissioned by Arie Rip and Nico Schulte Nordholt, funded by the Royal Dutch Academic research foundation (KNAW). This thesis can be considered as a case study within the broader approach of the project, which is Telecommunications and Information Technology from a SCOT perspective. The novelty of the approach taken up by the three-year project is the change from social (as used by W. Bijker) to *societal* construction of technology. Theoretically the difference is that with the societal approach social groups also include larger social groups and influences, e.g. institutions, the government, or a cultural-symbolic dimension. This broader perspective is a good starting point for this case, as the Indonesian context is profoundly different from the context of the main body of case studies, which concern technologies within the Western life world.

The general structure of the thesis begins with the definition of the theoretical framework using concepts from SCOT. Thereafter, formulating research questions[3] using these concepts and with the expectation that the chosen direction will unravel interesting stories.

In the second part of the thesis the stage for setting the GSM standard is presented along with its basic technical characteristics. Understanding the GSM system as it was defined in Europe prior to her transfer to Indonesia. The next chapter sketches the Indonesian background, the structure of its economy, the political situation, and social and cultural characteristics.

The choice for GSM is studied in more detail in the next chapter. After GSM was chosen, the first GSM network was operational at the end of 1993. With the roll out of the network the GSM system underwent several changes in the process of localization. This story is related in the following chapter, which contains most of the field data that was gathered in Indonesia

Describing the GSM system in its new shape and understanding the factors and actors active in shaping it, leads to answers of the research questions, and the general conclusion.

The thesis is concluded with a view on future developments in mobile telephony in Indonesia as judged likely on the basis of the material gathered, and a reflection on the use and usability of SCOT in a development context.

[3] The central object of the research questions as phrased in the original proposal is the mobile phone, however after the first month in Indonesia I concluded that the mobile phone was mainly the same technological artifact as in The Netherlands, and most likely, the whole world. For example, internet sites of major mobile phone manufacturers revealed that the various models were being sold all over the world. Consequently there would be little localisation of the mobile phone itself with regards to the Indonesian context. The level of technological artifact was dismissed as entry for the research on the grounds that no interesting results were to be expected. The level of systems however showed more promise. Firstly, because it encompasses much more categories, e.g. network infrastructure, hardware and software, organisation of the GSM businesses, personnel and training. Secondly, people from the GSM world pointed out that the Indonesian mobile phone network offers major challenges. It was therefore decided to change the research subject from the mobile phone to the GSM system.

1 The Framework : applying SCOT in a Development Context

1.1 Introduction

> "The technical is socially constructed, and the social is technically constructed. All stable ensembles are bound together by the technical and the social." (Bijker, 1995, p.?)

From the quote above two movements of development can be distinguished, the social impact of technology, and the social shaping of technology. This distinction is somewhat theoretical and rigid, but the general idea is clear, and captures the central perspective of the field of Science and Technology Studies. In this thesis the process of the social shaping of technology is the main issue, hence technology development.

This chapter continues with an introduction in some general theories of STS, and SCOT specifically. The second section presents a hierarchy of technology and the typology of configurational-generic technology. The third section identifies some of the dynamics of mobile telephony development. The fourth section pinpoints the phase of technology development that is examined in this thesis, namely the phase of localization. After that, the research questions are presented, followed by the concepts used and the method of conducting research.

The central mode of thought throughout this thesis is that Technology and Society co-evolve.

1.2 The History and Background of STS and SCOT

1.2.1 A variety of approaches

Within the field of Science, Technology and Society (STS) a number of approaches can be distinguished, six of which are presented here. There are two main currents, the sociohistoric approach as introduced in "The Social Construction of Technological Systems" (see Bijker, Hughes & Pinch, 1987), and the economic approach as introduced in "Technical Change and Economic Theory" (see Dosi et al., 1988). The following approaches are found in these two books, although they have ties to earlier academic endavours.

Evolutionary economics[4] focuses on economic performance and firms, and heuristic search routines that lead to variations. Basically, these variations can either survive or perish in the selection environment. The **Quasi-evolutionary**[5] approach differs in that it assigns deliberation and anticipation to human interaction. In short, the possibility of the actors of the variation environment to influence the selection environment, thus improving the expectation of success (survival). **Actor-network theory**[6] is a general sociological approach, now applied to technology. The actor-network consists of heterogeneous entities and the linkages between these entities or actors. An actor-network is simultaneously an actor whose activity is networking heterogeneous elements, and a network that is able to redefine and transform its constitution and shape. The **Politics**[7] of technology views technology development as part of, and shaped by, political or power struggles. **Cultural studies**[8] of technology view technology as related to the symbolic order. This approach is especially insightful when technology is studied in other cultures. The basic assumption is that technology reflects symbolic order, and it can change this order. And finally, the **Social Construction of Technology**[9] (SCOT) approach, which will be elaborated in the next section.

1.2.2 The SCOT approach and beyond

In Pinch & Bijker (1987) the term Social Construction of Technology, an approach that combines social constructivism and history of technology, is introduced. The development process of a technological artifact is a alternation of variation and selection, resulting in a *multi-directional* model.

[4] Nelson & Winter (1977,1982), Dosi (1988).
[5] Van den Belt & Rip (1987), Rip (1992), Schot (1991, 1992).
[6] Callon (1987), Law (1987), Latour (1992).
[7] Braverman (1974), Winner (1977), Noble (1984).
[8] Harraway (1985), Sørensen (1988).
[9] Pinch & Bijker (1987).

This is contrary to linear models that are used in many innovation studies. Another important principle of SCOT is to present an approach that explains both success and failure of a development process with the same model, offering a *symmetrical explanation*. The main concepts introduced by Pinch & Bijker are *relevant social groups*, *meanings* attached to an artifact, *conflicts* between social groups, and *interpretative flexibility* concerning the meaning of an artifact. This last concept counteracts a technologically deterministic model[10]. The development process ends in *closure*, i.e. the reduction of interpretative flexbility. This is when problems are solved or redefined, as perceived by the social groups.

The department of Philosophy of Science and Technology at the University of Twente has developed an own approach, led by the quasi-evolutionary model and expanding on that basis. Some of their concepts are agenda building, socio-technical regimes, alignment, path dependency, embedding, expectations and promises. From the rich variety of concepts a selection has been made, to be used in this thesis. These will be elaborated on in the final section of this chapter

For the research project in Indonesia, the original SCOT approach is changed to **Societal** Construction of Technology in order to include broader issues and actors. This change is also valid for this thesis. Some of the changes are the cultural-symbolic dimension, macro political actors, social and cultural values that direct interactions, and global actors like the IMF and the WTO.

1.3 The elements of the GSM system technology

Within the field of STS, and particularly of SCOT, Technology is a concept that encompasses more than technical artifacts alone. Technology may include engineers and users, knowledge and artifacts, infrastructure and culture. For the sake of drawing boundaries and to make the research doable, it is important to define the different elements of Technology. Starting with the technical, Disco, Rip & Van der Meulen (1992) present a hierarchy of technical entities, which is convincing and helpful because it is clear and precise and encompasses all sorts of technology:

- Components (do not function by themselves, but in combination with other components; e.g. materials, buttons, batteries)
- Devices (are an assembly of components which perform a specific function; e.g. a display, a loudspeaker, a light bulb)
- Artifacts (are an assembly of devices, and work by themselves, representing a clear function to users; e.g. a mobile phone, a car, a computer)
- Systems (fulfil a sociotechnical function; e.g. air transportation including airplanes, airports, runways, luggage handling, and kerosene)

Applying this hierarchy to the subject of research, the GSM system, gives a clear notion of the technical elements that are important in this thesis. The definition of the GSM system includes mobile phones, antennas, cables (infrastructure), computers, satellite, microwave transmitters and transceiver, software applications, accessories for the mobile phone, and more. For the moment, suffice it to state that the main focus is on the mobile phone system and its artifacts, since this is the level where the dynamics of technology development take place, especially in relation to Indonesian society.

Another way of looking at Technology is through the categories of **wares**, namely software, hardware (both technoware), orgware, and socioware. Software is the soft or flexible side of technology, often computer applications and programs that can be adjusted to fit a certain context. Hardware is the hard side of technology, the computer, an engine, or a battery. Orgware stands for the technology of an organisation, that is the structure, procedures, and division of labor, that makes a technological artifact function as it should. Finally, Socioware is the technology of a society, the design and structure, which is appropriate to a certain technological artifact. For example, the way a society is organised makes it better compatible to certain kinds of technology. The perspective of wares does justice to the complexity and extensiveness of technology in society.

[10] Technological determinism means that technology is seen as a force responsible for its own development and not being influenced by other forces. Generally this also entails treating technology as a black box and seeing technological development as a lineair process.

1.3.1 Configurational or Generic: a typology of Technology

James Fleck introduced a typology for technology, namely as configurational or generic.[11] A **generic** technology is characterised by a generic identity across the instances, a systematicity in the way elements relate and integrate, and an inherent logical system dynamic which structures development. With generic technology innovation takes place before the diffusion of a technology.
A **configurational** technology is open to contingencies of application, exhibits a necessity for user involvement, and lacks the stability of a generic technology. Configurations sometimes represent an early stage in a larger life cycle, and generic technology a more advanced stage. In the sense that learning and institutionalisation occurs which includes standardization across instances. For the development of a configurational technology, information about the user requirements and local conditions of operation is necessary.
The associated type of innovation for a configurational technology is called **innofusion**[12], here the process of innovation and diffusion collapse. The outcome of the innofusion process is the rise of a local type of technology. These local innovations can sometimes feed back to 'earlier' moments of technology development.

Combining Fleck's typology with the technical hierarchy discussed in the previous section, it becomes clear that Fleck's typology must be modified. Components and devices are most likely to be generic, since they represent a working functional entity that can fit into different artifacts. An artifact can be generic as well as configurational depending on what kind of technology it is. For example, the mobile phone is the same product all over the world, hence it is generic. In general, artifacts that are electronic consumser goods are generic. If one considers a computer program as an artifact, a custom-made program counts as an artifact that is configurational.
Systems technology is the aggregation of a variety of artifacts, devices, and components, making it unlikely to encounter a generic systems technology. An exception are turn-key systems which require their own special environment, like nuclear power plants.
The conclusion is that the three dimensions are correlated: on the scale from components to systems one finds the same technologies as on the scale from generic to configurational type of technology. And the scale from hardware to socioware definitely correlates with the scale from generic to configurational.[13]

A further issue is the relation between technology and users, or context, that is implicit in Fleck's dichotomy, and its integration with the idea of mutual shaping of technology and society. Fleck's case studies deal with informatics and robotics. Taking software as an example, Fleck identifies software that is custom-made as configurational, and off-the-shelf technology as generic. In both cases there is no question of co-evolution of technology and society. He assumes one of the two as fixed and the other as flexible. There is a sort of circularity in the relation between technology and user. A configurational technology is configured by a 'generic' user, and a generic technology configures the user. Just as an off-the-shelf software program configures the actions and mindset of the user, in that it directs his thoughts and ideas in accordance with the possibilities of the program. So, when a person uses MsWord he knows what is possible and what not, and how to achieve certain results. The user has accepted that the program if fixed and that he has to learn the right way to work with it. Vice versa, a custom-made program is developed, configured, in accordance with the desires of the user. Thus the dimension of generic and configurational for the technology and the user is **inverse proportional**.
If one changes Fleck's dichotomy to a scale from configurational to generic, there is room for co-evolution. A technology that has both generic and configurational elements exhibits a possibility for users to make some adjustments. In turn the user does not have to comply with the technology presented to him, but can adjust elements of the technology. At this moment he is not fully flexible, nor fixed, but rather somewhere in between.

[11] Fleck (1993).
[12] Fleck (1993), pg. 16.
[13] This whole argument is irrelevant when one defines Technology as encompassing user and society. Or technoware, orgware, and socioware as all belonging to Technology.

The conclusion is that Fleck's typology is a helping hand in looking at and thinking about technology. Realising the configurational and generic elements of a technology clarifies opportunities for change and influence. For technology development, Fleck coins the possibity that a configurational technology becomes more generic over time. It is important to realise that a technology's character may change over time, and his label aswell, in accordance with the dynamics of technology development. Fleck has been able to capture both extremes of this dynamic with his characterisation of technology.

1.4 Dynamics of Network Technologies

Mobile telephony can be characterised as a network technology, hence its dynamics are similar to those of network technologies. A network technology is a technology with a network infrastructure of cables and radiowave connections, such as television, internet, radio, and electricity. The key features of network technologies are strong network externalities, path dependency, interoperability, and standardization.

1.4.1 Path dependency

Network technologies are characterised by strong **network externalities**, these imply that there are increased returns to adoption, resulting in path depencies and a tendency to one 'winning' product, standard, or dominant design.[14] One important effect is that of **critical mass**. With network technologies the total number of users is an important attraction to potential new users. Vice versa, the growing number of total users makes the technology more interesting to current users. Once a critical mass has been reached, the technology has enough momentum to attract the 'remaining' user base. This creates a **path dependency** caused by sunk investments, specific technological knowledge, user demand, et cetera. Once a space has been conquered within the existing overall network structure, e.g. mobile phoning within the general network of phoning, stability characterizes the subsequent development until a new technology, either from within or without, joins the competition.

1.4.2 Standardisation

For network technologies standards have a major influence on the shape of technological artifacts and the overall system. Standards are set to fomerly deal with strong interoperability requirements to which a new and upcoming system has to comply, in order to function well. In the case of a mobile telephony network, it is connected with existing fixed telephone networks to facilitate interconnectivity between fixed phone users and mobile phone users.
Enforcing a standard reduces the freedom to configure a technology to a specific context. Specifying a standard like GSM, makes certain elements of the GSM technology generic. Understanding the flexibility that remains after the standard is implemented, provides a clear grasp of the potential of the technology to fit a certain context. It is therefore fruitful to look into the type of standard that GSM is, and how the standardization process took place. This will be examined in chaper 3.

1.5 Moments of Technology Development : Localization

Technology development is a very broad term that captures various moments of development, these moments are:

- Basic Research
- Applied Research
- Technological Development : Radical or Incremental
- Product Development
- Production
- Distribution
- Usage

[14] Poel, Ibo van de, p. 286. (Arthur, 1988 - Competing T's; in Technical Change and Economic Theory, Dosi; 1996 - increasing returns and the New World of B. in Harvard Business Review, july 1996, p. 100-109).

It is important to realise that technology development is not a linear process. An innovation, or a new option, can begin in any of the moments above. After which it can be taken up by other areas of development and undergo further changes. This is the idea of multi-directionality of technology development as witnessed in case studies by STS researchers, and part of the philosophy of SCoT. Basically, there is an ongoing interaction between **re-searching** a new option, its function, possible production, etc., and **developing** a new option, its usage, setting up production, etc.[15]
The focus of this thesis is on distribution and usage. More specifically, a technology developed in Europe which is 'distributed' and used in the Indonesian context. This process of embedding a foreign technology will be called **Localization**.

1.6 Research questions

The Societal Construction of GSM Technology in Indonesia is a process of co-evolution resulting in a GSM system Indonesian style. This process of co-evolution, more specifically localization, will be studied by looking at the influence that actors and factors had on the shaping of the GSM technology. Thereafter, identifying the overall dynamics that characterise this process. In the end, this may result in the identification of a pattern of localization.

The specific research questions are:

> How did the co-evolution between GSM technology and Indonesia take place, and how did the GSM system Indonesian style evolve?

The co-evolution is an ongoing process of mutual shaping between elements of the GSM technology and Indonesian actors, crystalling in an emerging socio-technical GSM system. The influence, and mechanisms to achieve influence, that various actors have may be very different. Studying these mechanisms will be a first step in understanding the dynamics of the localization process.

> Who are the actors that were involved in the process of selecting the GSM standard, and the process of shaping the GSM system in Indonesia?
>
> How was the socio-technical GSM system in Indonesia shaped, and how did the various actors influence the localization process?

Fleck's theory of generic and configurational technology will be used to analyse the character of GSM, and the potential of the technology to adapt to local circumstances. The character of GSM has been mainly determined by the standardization which took place in Europe. It is therefore interesting to study the standardization process and its outcome in some detail.

> How is the GSM system in Indonesia configured, in terms of generic and configurational elements and their interaction?

Technologies that are (finally) distributed among users, are usually black-boxed and hard. So, often people do not consider the possibility that the technologies which they are using, might very well have been something different. Technology development is taken as a 'natural' process to which there are little alternatives. Contrary to this general understanding, SCOT recognises that choices were made, and that (technological) options were dropped. In short, the GSM system that Indonesians use and know nowadays might have been different.

> Why is the GSM system in Indonesia shaped as it is?

With foresight of the current status of GSM in Indonesia, it is tempting to speak of success. Namely, the successful implementation and diffusion of GSM in Indonesia. However, this success is not only measured by the total number of GSM users, it can also be determined by the relative understanding

[15] Rip (1992).

that GSM technology is better than other mobile phone systems. This type of success does not rule out the possibility of, or even urgency for, improvements of the GSM system Indonesian style.

Why did the GSM standard become a success in Indonesia?

The research questions will be answered throughout the thesis, and in the concluding chapter.

1.7 The Method of Research

1.7.1 Actors and actor-networks

The first step in this research approach is to map the people and groups that are involved in the GSM system, these entities are referred to as actors. Actors belong to a network because they have a direct or indirect influence on the technology. It can be difficult to decide which actors to include and which to exclude from the actor-network. Each actor has her/his[16] perspective and perception of the situation, acting in accordance with this perception.

Actors are found on a multitude of levels and should be positioned accordingly. For the benefit of structuring the actors a rudimentary distinction is that of micro, meso, and macro levels, which will be used in this reseach. On the **micro** level an actor is a person, a department, or a firm. The **meso** level covers institutions, inter-organisational groups, or platform organisations. The **macro** level covers top political actors that influence complete businesses, Suharto, and international organisations.

Technical elements can also influence the development process, these can be seen as *non-human* actors. Non-human actors have to be taken into account by human actors, influencing their way of thinking and decision making. The more difficult and costly it is to modify a non-human actor, the more power it exerts on the actors and on technology development. This is achieved by sunk investments, successful selling, technological knowledge, and generally by time and money spend on developing one technological option versus other options.

The **relations** between the different actors and the contents of their interaction provide an indication of the dynamics on the actor network. The relations between actors can be studied by describing them in terms of problem definitions, interests, expectations, articulation processes, and dependency relations.

In this case there are two outcomes of interest, the choice of GSM, and the shaping of the GSM system. For the choice of GSM, looking at relations between actors in terms of dependency and power is appropriate. The importance of key figures for technology policy, and the power they wield in their position, is characteristic for Indonesia.

The shaping of the GSM system is the next phase of this research. The development process is the deisgn and production of a technology in Europe and thereafter localised to the Indonesian context. The localization or embedment of a technology is a bi-directional process of change between context and technology. Both the context and the technology adapt to create the possibility for a working technology.

1.7.2 Regimes

The concept of regime comes from political science and is often used as such. Within the field of STS, the term regime has different meanings. Nelson & Winter use technical regime, Staudenmaier and Kaiser use socio-technical regime, and Rip & Kemp technological regime. In general, a regime is a concept used to capture a piece of the world that shares the same rules.

The term **political regime** is often used in this thesis, e.g. the Suharto regime. This is in accordance with the way the Indonesian situation is normally described.

A **socio-technical regime** links together social and technical aspects, and defines the regime through rules of handling technology. But since rules are not the focus of this research, this term will not be used. Instead, the concept of socio-technical system will be used. A socio-technical system is the combination of social and technical elements, that together perform a function. In short, system is used in the common sense way.

[16] To use his or her in this, and comparable, situations remains a gender issue. Not wanting to upset the readers, the choice is the widely accepted use of he, his, and him.

1.7.3 Methodology

The goal of the research is to construct a story of the GSM system coming into existence and taking its context specific shape. Obviously, the level of detail is set by the nature of the research, namely that it is a graduation thesis. Field research has been performed by interviewing key persons of the GSM system. Other important sources of information are documents describing the GSM industry, including statistical information, newspaper and magazine articles.

The interviews were designed as semi-open, leaving the interviewee room to elaborate and providing for freedom to learn about new issues and encounter unexpected information. On the other hand, the interviewer is aware of certain interesting angles and issues that deserved more in depth information or cross-referencing making the information more valid. A healthy tension existed during the interviews between the story of the interviewee and (subtle) intervention by the interviewer.

2 The International GSM industry

2.1 Introduction

Cellular radio telephone was once seen as being of peripheral significance to mainstream telecommunications. Once people realised the potential of mobile communications, the industry gained momentum. The USA basically developed one standard, while half a dozen competing 'second generation' digital systems emerged in Europe. In these early stages there was little effort to coordinate the development of standards in Europe. Political and economic differences were set aside when several European countries produced the GSM standard.

This standardization process is characterised by the fact that it concerns network technologies and the requirement of interconnectivity on an international level. The process was influenced by European telecommunication companies, government agencies, E.E.C. organisations, and the ITU.

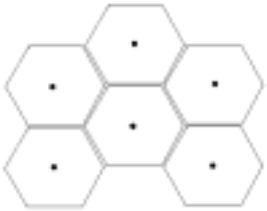
With the completion of the standard (GSM first phase), the actors involved presented the mobile telephony world with a standard with strong features, including fraud resistance, higher capacity, and better sound.

This story provides reasons for Indonesia to choose the GSM standard over other standards, which is the subject in the beginning of chapter 6.

2.2 A short history of mobile telephony

2.2.1 USA

The first analogue mobile telephony system was developed by AT&T, and implemented in 1946. This system consisted of one transceiver station, an antenna in a high location with six FM (frequency modulation) channels. The power needed was considerable, for the car-phone it meant that the car had to be equipped with an extra battery and dynamo.



The development of cellular systems in the United States was driven by Bell Laboratories, who, as early as 1947, presented the concept of cellular mobile telephony. The concept consists of cells with the structure shaped like honeycomb, of which the nucleus of the cell is the antenna. Bell demonstrated the first experimental cellular system in 1962, with automatic trunking[17] and hand-over[18].

Beginning in 1959, the FCC[19] incrementally responded to the call for deregulation, not only because of pressure from the industrial telecommunications coalition but also because of its own learning processes. Natural monopoly conditions were eroding and telecommunications was increasingly seen as a strategic business resource for an information-based economy.

The technical proposal for a cellular standard dates from 1971 and was written by AT&T and its Bell laboratories. This standard is called Advanced Mobile Phone Systems (AMPS). The first commercial networks, however, were not available until the 1980s.

Deregulatory forces in the USA began pressing foreign administrations for "flexibility" similar to what was being achieved in the United States. By the early 1980s, the United States government had moved firmly behind the global liberalization cause. However, sovereignty remained, with a broad consensus that varying mixes of public and private control were viable means to economic and social ends.[20]

[17] Trunking is a spectrum-efficient technology that establishes a queue to handle demand for voice or data channels.
[18] Hand-over is the switching of an on-going call to a different channel or cell.
[19] Federal Communications Commission, a US government agency responsible for setting regulations in the communications industry.
[20] Drake (1994).

2.2.2 Europe

Europe's first mobile telephony system was set up in Sweden in 1950, developed by Televerket (now Telia). The specifications for an analogue mobile telephony system were presented to the Nordic Telecommunications Conference in 1975. This proposal represented an **open standard**, which meant that all manufacturers were free to design and produce under the name NMT as long as the products were in accordance with the standard. A pilot project was demonstrated in Stockholm in 1978, but it was not until 1 September 1981 that the first commercial NMT network went into operation in Saudi Arabia. On 1 October of the same year, the first NMT network started in Europe. At this point the NMT standard was more sophisticated than AMPS. It was, for instance, based on modern digital switching technology.

The Netherlands, in 1981, was one of the first countries to install an NMT-450 network. Other countries in Europe installed locally developed or modified standards. The United Kingdom chose a variant of the American AMPS system, called TACS[21]. Germany started with C-Netz, in which Siemens played a major role. Italy, in 1983, developed a system called RTMS[22]. And France developed a standard called C-2000. In short, different analogue mobile telephony systems were developed all around Europe in the early 1980s.

With the demand for more capacity, the NMT-900 (MHz) standard was developed. It was the first standard that enabled the use of pocket phones.

As early as 1982, Scandinavian Telecom companies and PTT Netherlands started to develop the GSM system.

2.3 Convergence of European efforts

Three power centres came together to coordinate efforts on setting the GSM standard. The first was CEPT, Conference Europeenne de Postes et Telecommunications, which represented the interests of network operators. The second group was the industrial interest group. And third was the EEC, representing 12 countries and about 80% of CEPT revenues and investment.

Later on, CEPT was reinforced by the ETSI, the European Telecommunications Standardization Institute, an European Union institute for the coordination of standards. CEPT was responsible for spectrum allotment and ETSI for the technical standards.

In 1982 CEPT made two important decisions; they set up a working group to develop a standard for Pan European mobile telephony, and they recommended the reservation of a frequency for this system, namely two blocs of 25 Mhz in the 900 Mhz band. The French name of this group was Groupe Speciale Mobile, GSM (which later changed into Global System for Mobile communications). The task of GSM was to coordinate and harmonise the activities concerning a pan-Europan mobile system. The stated goal was to produce harmonised specifications for the interface between the main building blocks in the system, i.e. mobile stations (mobile phones), base stations (antennas), and switching centres. One of the main objectives was to offer international roaming, the possibility to use one mobile phone within all countries of the European Union, thus creating a uniform market for manufacturers of infrastructure and mobile phones.

Another important step was taken in 1986 when the Permanent Nucleus was set up in Paris. This body was hosted by the French Administration and manned by 11 people from CEPT administrations. Furthermore, the European Commission decided to reserve the recommended two frequency blocks of 25 Mhz in the 900 Mhz band for a Pan-European mobile telephony system which would be introduced in 1991. The advantages of digital over analogue led to a standard for digital transmission.

In 1987 the European Commission published the Green Paper on telecommunications, which initiated deregulation of the telecommunications sector. Two objectives were honest and open competition, to be achieved by liberalising the state companies and the markets, and harmonising the varied technical regulations in all member states. In this year a MoU[23] was signed between the EEC and CEPT under which CEPT recommendations could be turned into pan-European standards by giving them the backing of a Norm European de Telecommunication (NET) of ETSI.

[21] Total Access Communication System.
[22] Radio Telephone Mobile System.
[23] Memorandum of Understanding.

In September 1987 thirteen network operators from 12 countries signed a MoU, which created an industrial platform for cooperation. This was a clear sign of support for the GSM standard. Because of the magnitude of the undertaking of designing the whole GSM system, a phased plan for the implementation was set up. Phase 1 involved the basic functions, phase 2 additional services like data transport and closed user groups, and phase 2+ a packet switched data communications mode for GSM.
The introduction date of 1 July 1991 was not achieved. Reasons were that some essential modifications to the original design had to be made, and a delay in the compliance and type approval tests. In 1992 the first GSM networks were launched. And in 1994, 102 network operators and regulatory bodies from 60 countries had signed the MoU.

2.4 Standardization

> *"In engineering terms, standards are design specifications shared by the industry to determine the degree and means of interoperability between both networks and the component on which they are based. In political-economic terms, standards are also a central strategic element in the industry's balance of power. During the monopoly era, international standards were defined by the international administrations and major manufacturers of the industrialised capitalist countries via coordination in the ITU. Today this arrangement and the power relations underlying it are things of the past. "*[24]

In the past standards have frequently been loaded with options in order to please everybody and therefore have been difficult to apply. This was something to be avoided with GSM, and at the same time the intention existed to give designers maximum freedom within the limits set by the standardised **interfaces**. Thus the intention is not to specify the equipment itself, except for certain environmental conditions. Preparation of purchasing specifications is the responsibility of the individual administrations, while the design specifications are to be prepared by the industry itself.
The two most important advantages of **standardization** are: the user can use his equipment in a foreign country or with a different network, compatibility of equipment opens up the possibility of exchanging equipment between countries, and thus, increases the market and gives the Administrations a greater number of suppliers. As such, international standards are vehicles of freedom to users, in that they eliminate the need to be locked to one particular supplier.
Besides the attractive aspects of standards, a telecommunications system requires standardization in order to connect to existing communication networks. Interconnectivity and interoperability are important issues for network technologies, such as telephoning, international satellite tv, and internet.

Standardization for GSM concentrated primarily on the **interfaces** between gateways, signaling and transmission between national extentions. Special attention is required for the interface between switching center and existing fixed networks, because of the dissimilarities of the latter for different countries. An important item, and of great interest, is the **radio** interface**.** The basic questions is: apply the FDMA[25] or TDMA[26] technique to efficiently use the capacity of the frequency bandwidth. At the Conference of NET in autumn 1986 it was decided that narrowband TDMA is the preferred standard.

2.5 The advantage of GSM over other standards

The difference between GSM and previous standards is that the GSM standard describes a complete mobile telephony system, from the switching to the mobile phone. And through the use of interface standards, GSM prescribes the connections between the different elements of the mobile telephony infrastructure, while leaving manufacturers creative space to develop GSM equipment.

One of the characteristics of the radio system is that it is relatively easy to listen to the conversation and other messages exchanged on the radio path. Three aspects cover the problem of **security**: authentication (against fraudulent use), signalling information confidentiality, and user data

[24] Drake, pg. 71.
[25] Frequency Division Multiple Access (for specific information see appendix 9.1 on page 62).
[26] Time Division Multiple Access (for specific information see appendix 9.1 on page 62).

confidentiality (protect the conversation). Since GSM is a digital standard, encoding information which is being channelled over the airways is relatively easy and fraudulent proof. Another asset of GSM in the struggle against fraud is the SIM card.

The GSM system comes with a **SIM**, Subscriber Identity Module, Card. This card is separate from the GSM phone and has to be purchased with a new subscription. With the previous AMPS system, the mobile phone had to be programmed by specially trained engineers from the provider. A process that could take up to several weeks. With the SIM card, a customer can walk into a shop and purchase a new subscription, which can be activated immediately. Another difference with the AMPS system is that a mobile phone is no longer purchased by the provider from the producer and sold in provider exclusive outlets. Telecom shops can purchase the mobile phones directly from the producing company and the SIM cards from the provider, only to combine the two into a functional unit at the request of the customer. Telecom shops are no longer provider-bound, but can offer the customer subscriptions from various providers.This technical novelty opens the possibility for a new approach towards distribution and profit strategy.

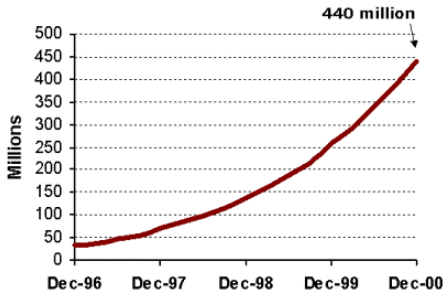
In conclusion, the **advantages** of GSM are: improved spectrum efficieny, higher transmission quality, extensive security facilities, more possiblities for new services, and usage of highly integrated circuits leading to more compact and cheaper phones.[27]

2.5.1 The bright future of GSM

In 1995, three years after the inauguration, GSM consisted of 113 networks with a total of 12.5 million users. In July 1998 this number rose to 100 million users. A comment by Mike Short, chairman of Mobile Data Association and chairman of MoU in 1995,

> *"GSM growth rates have been governed by three major factors,these are: globalisation, China, and prepaid services."*

Currently, more than half a billion GSM mobile phones are now in use worldwide, according to figures by the GSM Association and EMC World Cellular Database. GSM technology allows users to roam to more than 168 countries, with most countries supporting multiple competing GSM networks. It accounts for 70% of the world's digital mobile phones. Nearly 40 per cent of all GSM customers are outside of Europe, reflecting the increasing globalisation of GSM. In fact, the largest single country GSM population is now China with some 82.4 million customers. [28]



Commenting on the figures, Rob Conway, CEO of the GSM Association, said:

> *"They care that the phone they have works seamlessly in another city or country. They care that they only need one number, virtually worldwide. And they care that GSM offers incredible variety in choice of handsets and economies of scale to enable affordable handsets loaded with features."*

[27] For a description of the GSM network infrastructure see Appendix 9.1.
[28] http://www.gsmworld.com/news/press_2001/press_releases_18.html.

3 The Indonesian context: social, political, cultural and economic issues

3.1 Introduction

The broad perspective of the **Societal** Construction of Technology requires the integration of social, political, cultural, and economic issues in the overall framework. So before zooming in on the mobile industry, there are several issues to adress that constitute the scenery for the mobile telephony system. Some of the information presented here is background knowledge, while most of the information directly constitues the scenery surrounding the mobile telephony system. The intention is to create a general understanding of the Indonesian context and its workings before going into the mobile telephony system in detail.

3.2 Emergence of the New Order Regime

3.2.1 The formation of Indonesia

The first foreign presence in Indonesia dates back to 1600, when the Dutch established the V.O.C.[29]. After 200 years the Dutch colonised the peoples of Indonesia, their rule lasted until World War II, when the Japanese invaded Indonesia. On August 17 1945, the Republic of Indonesia is declared, receiving official autonomy in 1949.

The Five Principles, Pancasila, that form the basis of the Constitution are: believe in one god, social justice for all, a representative government (or democracy), civilised humanity, and the unity of Indonesia. In the first 7 years 17 cabinets passed the political battle field, when stability was finally reached in 1956 under the leadership of President Sukarno.

During the late 1950s many foreign companies are nationalised, meaning that the Indonesian government takes possession. These business interests are handed over to the ABRI. Since the ABRI has no experience of running such companies, they call on the help of Chinese entrepreneurs, or Cukong[30], to manage their business interests. Ever since the ABRI and the Cukong are interrelated, and present a powerful alliance.

On 5 July 1959 Sukarno re-instates the Constitution of 1945. An important decision is to give the ABRI[31] a dwi-fungsi (dual function). The dwi-fungsi assigns the ABRI the role of Military force and a societal function to maintain order in the political and economic sphere. From this moment on, the ABRI becomes a powerful actor in Indonesia.

In 1965 the Military takes over by commiting a veiled coup. The next year Sukarno is persuaded/forced to write a letter[32] which states that he transfers his power to the military, in order for them to restore order in Indonesia. The legitimacy of rule is not simply surrendered but rather obtained by pressuring Sukarno. On 11 March 1966 major-general Suharto is officially inaugurated as President. His rule will last for 32 years.

[29] Verenigde Oost-Indische Company, which translates into the United East-Indies Company.
[30] Cukong is Chinese for financier or capitalist. During the Dutch colonial rule Chinese were put in charge of trade and wholesale. Gradually occupying a key position in the national business structure, earning large profits and expanding their capital investments.
[31] Angkatan Bersenjata Republic Indonesi, the Armed Forces of RI.
[32] This letter is known as SuperSemar, an acronym for Surat Perintah Sebelas Maret, this translates to Letter of Command of 11 March. Semar is the most authoritative puppet in the Wayang (shadow) theatre.

3.2.2 The New Order Government

After 1965 the **New Order government** assumes a leading role in determining the process of economic and social development. Wide-spread regulation of private economic and social activities gives it a wide area of jurisdiction. Moreover, people are not allowed to form social or political groups below district level. This keeps them from organising and possibly becoming a threat to the New Order, they are the **floating mass**.
The regime of the New Order is not a democracy, as stipulated in the Pancasila, but a **Presidential system** where the President has virtually absolute power. This centralised power is enforced by a strong hierarchy that reaches down to the smallest level. Within the political party system there are three major camps, the ABRI, the Cukong, and the Golkar, which represents the members of the civil service.

Indonesian **public administration** is characterised by three factors. The Indonesian administration is strongly influenced by traditional Javanese concepts of power, hierarchy, and conflict solution. The outcome is a centralisation of power, patriarchal in nature, and with consensus building and harmony[33] as important values. A second historic influence is the 'indirect rule' pattern of the Dutch colonial adminstration, supporting paternalistic tendencies of the indigenous Javanese administrative elite, the priyayi. They became the most influential indigenous group of the Indonesian society.
In 1974 the Police forces are brought under the control of the ABRI, making the military the monopolist on authority, expanding their scope of control even further, and taking the general centralization of power in Indonesia a step further. Due to the centralisation of power, a small group of people at the top, at the apex of which stands the **Suharto clan**, has a large scope of control. The business empire of the Suharto clan begins with the oil boom in 1974. Indonesia is a country with a wealth of raw materials, including precious metals, timber, and oil. With the increased stream of foreign currency to Indonesia, the ruling power houses begin to acquire serious wealth. Suharto's spouse enters into a variety of businesses, aided by Salim, a Chinese magnate. By taking a percentage of revenues from state-owned companies engaged in cement, oil, petrochemicals, and pesticides for the rice paddies, the business empire of the Suharto clan rises beyond imaginable proportions. It is important to realise that the scale in Indonesia is gigantic, this goes for the surface area, the population, rice production, et cetera. By skimming only a small percentage, large sums of money are quickly amassed. The influence of the Suharto clan on important decisions and their ties into the business community make them a major factor in many undertakings in Indonesia.

Since 1983, there has been a shift[34] in the policy of the Governemnt of Indonesia (GoI) concerning public administration and its role in society. This shift is summarized as **Paket D**, Deregulation, Debureaucratisation and Decentralisation. Excactly how far this shift is carried through is part of the narrative in the next chapters. For the moment suffice it to state that there is a tension within the Indonesian society between old forces and new forces that ultimately has to be settled.

3.2.3 General principles that direct social interactions

There are four important principles that direct social interactions in Indonesia, The first is: Asal Bapak Senang, keep the boss happy. With a sense for the strict hierarchy, subordinates will generally not relay any bad news to their superior. The second is: gengsi, which is all about appearance and prestige. Activities and the mode of interaction are determined by what social class a person belongs to. One does not do something if it is below or above his class. The third and fourth are interrelated, malu, or social shame, is like the idea of 'loosing face' in public, and memojokan which means to be put in the corner is the effect of social embarassment. These social principles will emerge throughout the narrative of the GSM system in Indonesia.

[33] Promotion of harmony can in reality be a front that hides the often shady nature of political and business dealings, exemplified by the carefree Javanes smile which hides inner thoughts and emotions.
[34] This shift is partly induced by increased foreign political influence from institutions such as the IMF and the WTO. The GoI accepts this influence at times when their income from natural resources is not enough to sustain the budget. There is an inverse relation between the extent of foreign influence and the price of oil (Schulte Nordholt).

Three other important principles in Indonesia are Korupsi, Kolusi, and Nepotism, KKN. The general definition of Corruption is the misuse of a public position for private gains. Collusion is the existence of secretive understandings and conspiracies. Nepotism is to favor people that are part of one's own camp or group. Together these principles constitute the shady side of the Indonesian culture.

3.3 Telecommunications in Indonesia

Before the colonisation Indonesia as a nation did not exist. In the formation of what became known as Indonesia, Telecommunications fulfill a special role.
There are many different cultures that constitute the Indonesian Nation. The natural diversity of the Republic of Indonesia has been consciously manipulated in order to install a feeling and image of nationality. The richness in cultures is reflected in the principle of "**Unity in Diversity"**, as one of the principles of the Indonesian constitution.
The central government wields several mechanism to control the enormous Indonesian Archipelago from the centre of power Jakarta. For one, the military is active down to neighbourhood level (RT/RW) and exists next to the police, this is a heritage from the dwi-fungsi and the joining of the Police with the ABRI.
A method to inculcate people with the idea of the Indonesian Nation is through the installment and diffusion of language. The official language, Bahasa Indonesia, is introduced at the beginning of the 20th century, and along with a national language comes nationwide media coverage of which newspapers and magazines were the first important communication media. Later followed by radio, and eventually television. These different media are subject to censorship and manipulation, hence an effective instrument in the hands of the GoI.
All these means of **communication** are of vital importance in wielding control over the Indonesian archipelago and installing a sense of Indonesian nationality in the minds of the variety of peoples.[35]
The diversity of the cultures 'united' in the Indonesian Republic remains an unstable factor. Separatist movements have risen in provinces like Aceh, Sumatra, the Moluccas, and Irian Jaya.[36] But the government has been successful in restraining these uprisings, up to the moment when Timor, which was conquered and nationalised in 1976, gained independence[37] in 1999. If this first example of successful protest and struggle, will be followed by other islands remains to be seen. However, with the forced idea of the Indonesian Nation, there remains an internal tension that needs to be adressed someday.

3.3.1 The meanings attributed to telecommunications

The various groups in Indonesia attribute different meanings to telecommunications and its importance. For **politicians** telecommunication technology has always been regarded as an important instrument in governing the country and broadcasting the idea of the Indonesian nationality. Another group are the **technologists** (or technologues), who believe that progress can be accelerated by importing and developing modern technology. For example the presence of IPTN, the national aircraft manufacturer. Their belief is that such high-technology enclaves will help spur the development of local industries and skills. The most prominent member of this group, which has existed since the 1970s, is Habibie.

As pointed out above, telecommunications is regarded as important by the **Indonesian government**, by controlling communications they control the country. The result of the importance placed on telecommunications and the fact that Habibie has been the Minister of Research & Technology, is that telecommunications became one of ten appointed **strategic industries**, enjoying benefits such as tax exemption and large financial injections. Another effect of being a strategic industry is extra supervision and control, but also the dispensation of company shares among the members of the Suharto clan.

For the **military**, telecommunications is a tool and in the hands of an adversary a hazard that needs to be restricted. Yet another group are **businessmen** active in the field of telecommunications. They

[35] Anderson (1991).
[36] R. Rohdewohld, pg 2.
[37] Timor is currently a special member of the United Nations, and falls under their protective authority.

perceive telecommunications as a good opportunity to earn money and manage a successful business. A special group is formed by separatist **revolutionairies**, riot leaders, and even criminals. They see telecommunications, in particular mobile phones, as a means to communicate more freely than they are used to. And finally the general public, the common Indonesian **user** of telephones, mobile phones, or even the Internet. Since an in-house telephone is something which is unattainable for the majority of Indonesians because of the lack of capacity and of a telephone network that covers the whole of Indonesia. And even if there is a network, the time between applying for a telephone connection and the actual installation, on averge takes between six months and a year. This is the reason that WarTel exist, telephone shops, spread out over Indonesia, which allow the common Indonesian access to the telephone. The same applies for Internet. With no telephone connection at home, most Indonesian Internet users go to a Warnet, an internet café. With this in mind and the knowledge that the yearly average income per capita is US$ 800, a mobile phone is simply too expensive for most Indonesians. A mobile phone is a luxury item in Indonesia, and one that comes with the status of belonging to the wealthy part of society.

4 The mobile telephony system in Indonesia before the introduction of GSM

4.1 Introduction

The mobile telephony system in Indonesia consists of a wide variety of actors which include political bodies, the national telephone operator Telkom, mobile phone operators, mobile phone producers, investors, and the actual mobile phone users. The top-down influence of the government and the Ministry of Tourism, Post and Telecommunications on the entire field of mobile telephony is strong. As are the intricate linkages between the Suharto clan, their cronies and several companies involved in the mobile industry, to name but two of many linkages that shape this actor network.[38] This chapter provides a broad idea of the telephony situation in Indonesia prior to the start of the first GSM activities, beginning in the following section with the history of mobile phone systems.

4.2 The various mobile phone systems[39]

4.2.1 TACS

In 1977 the first mobile phone system is introduced in Indonesia, **TACS**[40]. For the implementation of TACS, Indonesia required a satellite. The launch of the Palapa satellite made Indonesia one of the first countries to own a satellite used for domestic communications. TACS is operated by PT Telkom in cooperation with PT INTI, and is popularly called STKB[41]-INTI. The number of subscribers grows slowly, reaching a total of 32,792 in 1993, when it is abandoned.

4.2.2 NMT

In 1987 the Rajasa Hasana Perkasa (RHP) company starts **NMT**[42] operations with Telkom through a revenu sharing contract. The proportion of revenues is 30% for Telkom and 70% for the mobile operator. Telkom remains the license owner and RHP invests in and operats the network. Normally NMT operates on the 450 MHz frequency. However, in Indonesia this frequency is already occupied by the army, taxi companies, and commercial users. Instead of clearing the frequencies and re-allocating those users, Indonesia adopts a 470 MHz variant. Special equipment is manufactered that operates at this frequency. Thailand experiences the same problem and also adopts the 470 Mhz variant. The consequence of this local innofusion is that equipment is more expensive and that international roaming is not possible. The NMT equipment is manufactured by Ericsson, with an initial price for the NMT mobile phone of approximately Rp. 17 million (US$ 9,500).

4.2.3 AMPS

In 1991 **AMPS**[43] is introduced in Indonesia. The GoI issues licenses on a regional basis, so on a regional scale the operator enjoys a monopoly. The AMPS mobile phones have to be programmed by the operator to activate a subscription. This gives them control over distribution, and without competition they are able to maintain high prices for the phone and its usage. Initially, mobile phones are expensive everywhere, reflecting the high costs of research & development and the small scale of production. Also, the initial investment to install a network is high. However, by continuing these high prices, the market for cellular phone users remains small. The focus of revenue is the sale of mobile phones, which cost around US$ 5000, and not on the quality and coverage of the network and

[38] For a visual representation of the actor map turn to page **Fout! Bladwijzer niet gedefinieerd.**.
[39] There is more information on competing mobile systems and some Indonesian development in appendix 9.2 on page 63.
[40] Total Access Communications System, an analog, non-cellular system originating from the UK, for further information turn to page 17.
[41] Sambungan Telepon Bergerak.
[42] Nordic Mobile Telecommunication, an analog, cellular system originating from Scandinavia, for further explanation turn to page 17.
[43] Analogue Mobile phone System, and analogue, cellular system originating from the USA, for further information turn to page 16.

its usage. This manifests itself in limited coverage with many blank spots and a low quality of service. With the lack of competition, it is likely that customer complaints are not really dealt with. There are few incentives to improve services or expand the network. In this phase of mobile phony, the mobile phone is a status symbol and not a dependable, functioning technological artifact.

4.3 Actors of the mobile telephony system

4.3.1 The Ministry of Tourism, Post and Telecommunications

Two main characteristics of the Indonesian State are centralised power and top-down decision-making. This reflects on the Ministry of Tourism, Post, and Telecommunications (MTPT). In the field of telecommunications, laws and regulations set the ground rules. These rules determine the level of foreign involvement, the fixed share of a joint venture for Telkom and Indosat, tariffs for subscriptions and airtime, etc. In short, they have a major impact on the shape and possibilities of the mobile phone business.

The Ministry responsible for telecommunications used to be the Ministry of Tourism, Post and Telecommunications[44]. In 1998, the MTPT is dissolved into the Ministry of Communications (Hubungan) and the Ministry of Tourism, Arts and Culture[45].

The Ministry of Communications is the main political body responsible to make proposals for laws, regulations and decrees that form the regulatory environment of the mobile phone industry. The Minister is supported by the Directorate General for Post and Telecommunications. Under the D.G. falls the Secretary General for Post and Telecom and three departments, namely Telecom, Radio frequency and Standardization. However, the President is almost omnipotent, and in a lesser degree so is his protegee Habibie, the Minister of Research and Technology.

4.3.2 The regulatory environment : Laws, regulations and Presidential decrees[46]

The policy on technology is influenced by the gradual shift of the political ideology. In part this shift is triggered by foreign agencies like the IMF and the WTO, who set certain requirements for Indonesia to become eligible for a loan or membership.

The first law on telecommunications dates back to 1964. Then, after the Paket D[47] policy and the onset of developments in telecommunications, the GoI issues Law 3 in 1989. This law states that companies which provide basic telecommunication services(including international telephone services) must work in cooperation with Telkom and Indosat. This law effectively appoints Telkom and Indosat as government watchdogs. Since they have a share in every company they can closely guard and even influence the actions and management of a company. Interestingly enough, the government retains a majority share in both companies.

Law 3 also makes a distinction between **basic** and **non-basic** services. Basic is a service which sends and receives information over a telecommunications network directly from the sender to the receiver without processing or modification. Non-basic services are those given with the assistance of computers and other facilities which process and modify the data they transmit. These include electronic mail, facsimile storage and forwarding, paging services, abbreviated dialling, EDI[48] and video conferencing. Mobile telephony is considered a basic service.

The second important Law is **Km39/KS002** of 1992, which states that there are three cooperation forms allowed, namely Joint Venture, Joint Operation, and Management Contract. This law allows more flexibility than what was previously regulated.

The third important Law is **Law no.** 8 of 1993. This laws sets the tariff companies can bill their customers for installation (Rp. 300,000), the monthly subscription (Rp. 58,000), and the costs for calling, or air time (Rp. 270 per minute).

[44] Department of Parawisata, Pos, and Telecom (DeParPosTel).
[45] Department of Parawisata, Seni, and Budaya (DeparSeniBud).
[46] For a diagram of the actors that shape the regulations turn to page 66.
[47] Deregulation, Debureaucratisation and Decentralisation.
[48] Electronic Data Interchange.

With Government D**ecree 91** of 1993 the GoI regulates the maximum prices of mobile phones in Indonesia. In comparison with the previous decree, the prices for mobile phones are lower (see table).
It is remarkable that real prices for the high-end market are higher, e.g. the Motorola Micro Tac Lite costs Rp. 9.5 million.[49] A major factor that determines the price of an imported mobile phone is the high tax rate, namely 30% general tax, and 10% VAT.

Prices of mobile phone sets (phone + line unit) in Rp. are:		
Type	1992	1993
car mounted	2.458.750	2.000.000
transportable	6.000.000	4.000.000
handheld	10.000.000	6.000.000

Source: MTPT, note: including sales tax and vat.

The **technical** side of the law dictates that approval is required from the D.G. for infrastructure and facilities related to the organisation of mobile phone services, including brand names and types of mobile phones offered to subscribers. A powerful instrument to control the brands being imported to Indonesia.
Since networks of different operators have to be able to communicate with each other, the government also set some **standard technical requirements**. Subscriber terminals, facilities, and infrastructure of STBS are required to have at least: outgoing and incoming calls, automatic hand-over between cells, automatic roaming, anti fraud facility, detailed billing, interconnection facility, supervision and control facilities.

a. Licenses

Before a company can begin to install a network, it first has to acquire several licenses from the GoI. There are four licenses to be attained by a mobile operator. Firstly, the **principal** license, which gives the company the right to be an operator. This license is sold via a public tender. Secondly, the type **approval certificate** is required for every piece of equipment that is used. The actual testing of equipment is conducted by Telkom (Bandung). The requirements to meet stem from international agencies such as the ITU and the CCITT. Thirdly, the **frequency** license, which gives the right to use a certain frequency, e.g. for a microwave connection to link a BTS to the network. And finally the **operational** license, which is granted after testing the network. Through this system of licensing the Ministry oversees all important activities in the mobile phone industry.[50]

In sum, the Regulatory Regime on Telecommunications in Indonesia is very visible and active. It determines which companies are allowed to import, sets prices, and appoints Telkom and Indosat as joint organisers by giving them a share in each company.

4.3.3 Telkom

The Indonesian Post and Telegraaf dienst is established in 1884 by the Dutch government. In 1907 the company changes its name to Post, Telegraf, and Telepon, PTT. In 1961 the name is changed to Perusahaan Negara (State Company) Pos dan Telekomunikasi. Due to its rapid growth the company is split up in PN Pos dan Giro and PN Telekomunikasi. In 1970 PN Telekomunikasi changes its status from PN to Perusahaan Umum (Public Company), the new name is Perumtel. The status of the company is changed because it being a state company is seen as the reason for its poor performance.
In 1980 the telecommunications services are divided into domestic and international telecommunications services. Perumtel becomes the operator for domestic telephone services[51], and PT Indosat the operator for international services.
The Government changes the status of Perumtel again in 1991[52] to Perusahaan Terbatas (Limited liability company), giving the company its current name and status **PT Telkom**. The reason for this privatisation is to give the company more freedom in the face of upcoming competition.[53]

[49] There are more examples of a discrepancy between the contents of a law and the actual enforcement, these are presented throughout the thesis.
[50] The price for the GSM license for one year is approximately Rp. 30 million. Other license costs are: Rp 4 million for a BTS, Rp 1.2 million for a microwave link, and Rp 100,000 for each mobile phone sold.
[51] These services include telephone, telegraph, fascimile, telex, telecopier, leased channel, telephoto, and radio communication services.
[52] Government regulation 25.
[53] Perumtel lost its monopoly on telecomunnications in 1989 with the issuance of Law 3.

PT Telkom holds the **monopoly** on local fixed lines, fixed wireless TC services nation-wide, and domestic long distance telecommunications services nation-wide.
The Ministry of Communications controls many factors affecting Telkom's competitive position. The Ministry formulates and approves tariff policy and structure, sets Telkom's universal service obligation[54] and its operations and financial conditions.

PT Telkom used to be the sole administrator of telecommunication services in Indonesia, operating under the supervision of the Ministry of TPT. Nowadays, the regulations setting department at Telkom has shrunk, and people have been installed at MTPT to do the job. This was set off by the plan of Telkom to become a private company, which did not want to engage in the tricky dual function of regulator and operator at the same time. Since this time the company has changed its business focus from offering a public service to a customer oriented service that is professional and offers quality products. Part of the new **image** is Telkom's perceived independence from the Suharto clan. It is still forced to give contracts to certain parties and is instructed on which suppliers to use. Ever since its IPO[55] Telkom has been a blue chip stock[56] on the Jakarta stock exchange.
Because of the large financial pool of Telkom and its potential revenues it remains the object of attempts to corrupt it and channel some of the funds to destinations other than Telkom's business. Due to its size and wide array of joint ventures it is difficult to identify all the actors that attempt this. It is beyond a reasonable doubt that the Suharto clan and the military are involved in withdrawing funds from Telkom and favouring contracts to allies. To give an idea of the size of the funds being extracted, there is a story that the revenues stated in an internal report amounted to US$ 1,100 million, but that the external report mentioned only US$ 500 million.[57]

a. Cooperation forms with Telkom[58]

Even though Telkom is no longer the central organising body for the telecommunications sector, it continues to have shares in virtually all undertakings in the sector and keeps a grasp on the mobile phone operators. There are four different forms of **cooperation** between private investors and Telkom:

- Flat-rate (leasing): the investment made by the private partner in the development of a telecommunications project will be returned by Telkom through fixed payments for a certain period of time.
- Revenue-sharing : the investment made by the private partner will be returned by Telkom by means of a certain share in the revenues from outgoing airtime for a certain period of time.
- Grant : expenses incurred by the private investor are directly transferred to Telkom.
- Compensation : the investment made, will be returned by means of compensation in the form of exemption from airtime charges or installation fees.

During Pelita V (1988-1993) 35 private investors signed cooperation agreements with Telkom.
With the current profit-sharing scheme, the investor supplies funds for procurement and installation of equipment while PT Telkom supplies space, power, transmission towers, and transmission networks. The operations and maintenance of the SBTS network in question are handled by PT Telkom while the marketing of outstation devices is handled by the investor. However the profit share of 30 to 40 % for a period of 5 to 10 years is often not enough for investors to reach break even. Therefore investors have proposed a new cooperation scheme called **joint operation**, in this set up the profit comes from a share of the air time charges.

[54] Universal Service refers to avaibility, non-discriminatory access and wide-spread affordability of telephone service. The level of universal service is statistically measured as the percentage of households with a telephone.
[55] Initial Public Offering, which is the first sale of shares in the process of privatising a formerly state owned company.
[56] A share in a large, safe, prestigious company, of the highest class among stockmarket investments. A blue-chip company would receive the appellation through being well-known, having a large paid-up capital, a good track record of dividend payments and skilled management.
[57] Interview Agus Pambagio, YLKI.
[58] Law 39/1992, in Indonesian Telecommunications Industry 1995, pg. 57.

b. Program : Proyek Telekomunikasi[59]

As a spin-off from the Government program Pelita, Telkom started a program called Proyek Telekomunikasi, Protel. These Protel are initiated to execute the goals and policies as set in the five year programs. The Protel are approved by Bappenas, the national development agency.
The general aim of the two last protels are to improve the management of the telecommunications sector and the modernisation of the sector. The specific goals are the encouragement of competition, the promotion of private participation, accelerating expansion and modernisation of telecommunication facilities.
The initial organisational approach was that of centralised power. During the implementation of the various projects, obstacles and impediments arose out of this centralised control. In 1991 the management of Telkom started to strengthen the organisation of Telecommunication areas (Witels[60]) by delegating more authority to them, the start of a process of **decentralisation**.
The road to modernisation, privatisation and liberalisation is a long one in Indonesia, but for the moment Telkom seems set on achieving these goals.

What follows below is a list of actors that are part of the mobile telephony system, but since their influence is generally small, so is the attention they receive here.

4.3.4 Mobile phone operators

The first mobile operator in Indonesia is **Mobisel** operating a NMT-470 network. The shareholders of Mobisel are Telkom 25 %, Telkom's employee pension fund 5 %, and Rajasa Hasana Perkasa 70 %. Mobisel used to be called Rajasa Hasana Perkasa up to 1994, when the name became Mobisel.
For AMPS there are three operators: **Metrosel**, whose shareholders are Telkom 20.17%, Centralindo 51.23 %, Asia Link/First Pacific Co. of Hong Kong 20 %, Telkom's employee pension fund 3.83 %, and rest shareholders 4.77%; **Komselindo**, whose shareholders are Telkom 35% and Elektrindo Nusantara 65%; **Telesera** (Telekomindo Selular Raya) whose sole shareholder is Rajawali Wira Bhakti Utama[61].
The licenses for AMPS are granted on the basis of regional monopolies. The AMPS operators used a business model that made the sale of mobile phones the main source for profit generation.

4.3.5 Mobile phone manufacturers

There is a large variety of mobile phone brands available in Indonesia. The most prominent manufacturers are: Nokia, Ericsson, Motorola, Siemens, Alcatel, Phillips, and Sony.

4.3.6 PT INTI

PT Industri Telekomunikasi Indonesia (INTI) is officially founded on December 30th, 1974 in Bandung. Before that it was a part of Telkom, who decided to place the manufacturing with a separate company. INTI is recognised as the leader in telecommunication equipment manufacturing in Indonesia.

4.3.7 PT Indosat

PT Indosat is established in 1967 by the US firm I.T.T. to provide satellite-based international telecommunications services to Indonesia. The GoI buys out I.T.T. in 1980 and converts the company to a state-owned enterprise (SOE).

4.3.8 Platform organisations

ATSI, the Asociasi Telekom Selular Indonesia, is the coordinating body for mobile operators. ATSI coordinates inter-operator payments, lobbying, standards, new technologies, and so on. Another organisations are **Mastel** (Masyarakat Telekomunikasi), the Telecommunication Society, which includes producers, providers, network operators, from the whole telecommunications sector.

[59] Ibid, pg 114.
[60] For the provinces that belong to a specific witel, see appendix 9.3 on page 64
[61] The owner of the Rajawali group is Peter Sondakh, another power figure in Indonesia who is related to Tutut, the daughter of Suharto.

The consumer organisation **YLKI** is sort of a watchdog and a mouthpiece for the Indonesian consumer. When Indonesians have complaints about service, coverage, or bills, there is a reasonable chance that they will call YLKI, who in turn channels this information to the parties involved. YLKI's instrument of power is media coverage, which they use to inform the public or to call upon the consumer to protest against particular changes.

4.3.9 Indonesian consultancy firms

Pan Systems is an influential consultancy firm aimed at the telecommunications industry. Its president director is Mrs. Koesmarihati, who used to be the president director of Telkomsel. Among other, Pan systems is involved in making proposals for the further updating of the telecommunications law.

4.3.10 Backbone operators

For local fixed lines the sole operator is Telkom. All mobile phone operators will have to lease backbone infrastructure from Telkom. For international telephone connections there are two companies, namely Indosat and Satelindo.

4.3.11 The business empire of the Suharto clan

The influence of the Suharto clan empire is felt in virtually all business undertakings in Indonesia. Over the years they have expanded this empire to unheard–of dimensions. They have been granted billions of US dollars in loans from state banks, received privileged treatment in tenders for government contracts, and established a variety of agency relationships with foreign firms. In many cases they are the unnecessary middlemen of Indonesia, earning their profits through the exclusive import and export of raw materials and equipment. Financial information on Suharto family-owned business is scarce, but business sources estimate that the combined revenues from operations and investments amount to several billion US dollars a year. One of the industries affected by their actions is the telecommunications industry.

One way the Suharto clan makes money is by being an agent for foreign firms. For the telecommunications industry the following agency relations exist: the oldest daughter Tutut for Lucent Technologies and Motorola, Sigit for Mitsui, and Bambang for Hughes, Deutsche telecom, and Siemens.[62] Bambang is also the majority shareholder of the Bimantara holding, the importance of which will become clear shortly. A general impression of the far reaching tentacles of the Bimantara group can be read in the box. Of the six children, Bambang is by far the one with the largest assets.

> Bambang established **Bimantara** in 1982 with several of his former school mates and with his brother-in-law Indra Rukmana. Between them, Bambang and Rukmana believed to control a majority of Bimantara shares. Initially, capital for Bimantara ventures came from special oil-trading deals Bambang arranged with oil giant Pertamina through a company called Samudra Petroleum Asia, set up in 1981.
>
> In the late 1980s and into the early 1990s, Bimantara expanded rapidly. The group took stakes in vehicle-assembly operations; won a license to ship liquefied natural gas to South Korea; joined with Nestle to make powdered milk; set up Elektrindo Nusantara, a manufacturer of telecommunications equipment; bought a stake in one of Indonesia's largest forestryconcessions; and moved into air-cargo business. Source: internet[]

The effect of the business empire of the Suharto clan is versatile, it hinders the healthy[63] growth of the economy, as well as efficiency improvement, and like a banyan tree, it stifles the emergence of an indigenous entrepreneurial class. How it affected the GSM system will be related in the coming chapters as part of the overall story.

Herewith ends the sketch of the scenery before the arrival of GSM in Indonesia. A variety of actors and the intricate nature of their mutual linkages have passed the revue. It is now time to witness the emergence of the GSM system in Indonesia, hence the process of localising and configuring the GSM system to the Indonesian context.

[62] The Six Suharto children, source Business Week, August 19, 1996.

[63] Even though the average yearly growth is 7%, due to extensive borrowing of money abroad and bad investments, the bubble finally burst in the crisis of 1997/1998.

4.3.12 The challenge of the spacious Indonesian Archipelago

It is often mentioned by people, technical and marketing managers alike, that the Indonesian GSM system is one of the most complex systems in the world. One of the reasons for this is the sheer size. Indonesia is the largest archipelago in the world with an area of 1,919,000 square km, consisting of some odd 17,500 islands. From Sabang (Aceh) to Marauke (Irian Jaya), as is the general expression in Indonesia, measures a distance of 5,000 kilometers, covering three time-zones, and from Kalimantan in the North to East Timor in the South, measures 1,800 kilometers. Comparing Indonesia with Europe, Indonesia covers an area that runs from Belfast to the Oeral, and from the Baltic States to Cyprus.

The vast dimension of the Indonesian Archipelago has always been a challenge for telephone communications. To offer **mobile** communications in one single network of this size is quite unique and a major challenge. The Indonesian government has initiated a plan called Nusantara-21, to cover all islands with a communications infrastructure. This plan includes building the ring of rings[64], building multimedia cities, and community access centres.

[64] The 'ring of rings' is a backbone architecture consisting of a ring for each of the large islands, and a ring to connect all these rings.

5 The Emergence of the Indonesian GSM System

5.1 Introduction

In this chapter the general subject is the ocalisation of the GSM system to Indonesia. The dynamics of the Localisation process are characterised by a relation of reciprocal influence between the foreign GSM system and the local Indonesian context and actors. In some cases Indonesian actors adapt to the GSM technology and in other cases Indonesian actors shape the GSM technology. The result of this process is the emergence of the GSM system Indonesian style with both generic and configurational elements, and some secondary innovations that spring from Indonesia specific problems during the localisation process.

The intricate nature of this process as well as that of Indonesian social linkages creates a story where cause and effect can not always be clearly distinguished. In an effort to present a concise and insightful narrative, the chapter is structured chronologically, providing a good layout to understand the inner logic of the localisation process and the emergence of the GSM system.

Note to the reader
Information presented in text boxes are anecdotes or quotations that do not belong to the immediate line of discourse. It is presented to exemplify and enrich the overall story.

5.2 The choice for GSM is a top-down decision

5.2.1 Introduction

Why did Indonesia choose the GSM standard? There are a number of reasons which include the power of Habibie to decide, Garuda Sugardo getting acquainted with GSM, and Indonesia's relations with Europe. And why was the pilot project set up on the islands of Batam-Bintan? This industrial zone is a safe haven for business enterprises and offers attractive characteristics to set up a GSM pilot project. These two issues, the choice for GSM and the choice for Batam-Bintan, are addressed in the sections below.

5.2.2 Why they choose GSM

It is difficult to pinpoint the exact moment when Indonesians first became interested in GSM and contemplated the introduction of a GSM network in Indonesia. One of the first people involved in this early process is Garuda Sugardo.

Garuda became acquainted with mobile phones in Irian Jaya working as a regional director for Telkom. There are several major foreign companies active in Irian Jaya, involved in mining and forestry. These companies were using mobile phones for their expatriate personnel. When Garuda returns to Telkom headquarters in Bandung in 1991, he is appointed as the coordinator for mobile communication projects.

Just around this time GSM in Europe gains some momentum and looks promising. In 1992 Garuda goes to Europe to do some field research and visit mobile operators in various countries. He recognises the potential of GSM for Indonesia and learns from problems that European operators initially have. In the process he develops a personal vision on the design of a GSM system in Indonesia. Garuda foresees a future for GSM in Indonesia, but it is not his decision to make. He can only promote GSM with various influential people.

At this time Habibie is the Minister of Research & Technology, a position that he secured as a protégé of Suharto. Furthermore, he is a technologue. Thus, Habibie occupies a powerful position that gives him the leverage to make influential decisions, and implement the ideology that high technologies have a purpose in Indonesia. GSM is the first digital mobile phone system available at the time. The idea of modernising the Indonesian mobile communications network with a digital standard must have been very appealing to him. Furthermore, Habibie maintains close relations with Germany. So while people in the United States still use analogue phones, Indonesia has a chance to join with European countries in the further digitalisation of telecommunication services.

Another reason to choose GSM is the fact that it is already the standard of choice in neighbouring countries like Singapore, Malaysia, and Australia. The prospect to offer international roaming and the revenues this generates is a realistic expectation. Also pragmatically, the bandwidth for NMT and AMPS are fully occupied, constituting a need to expand to a new bandwidth.

5.2.3 Why they choose the islands of Batam-Bintan to initiate the pilot project

Besides the decision of operating a pilot GSM network, Habibie and Joop Ave, the Minster of Telecommunications also have to select a location. Instead of choosing prestigious Jakarta and allow wealthy, prominent Indonesians to be the first to use GSM, they choose the islands of Batam-Bintan. The islands Batam-Bintan are part of the Riau island group, situated in the Strait of Singapore (see map).

Batam-Bintan : Habibie's brainchild

In 1971 the GoI initiated a plan to develop these islands to become an area for industry, trade, tourism and transshipment. Taking advantage of its strategic location, the area is developed as an export-oriented free trade zone for Asia Pacific. With Singapore's high costs and shortage of land, Batam-Bintan becomes a favorable location for Singaporeans to start enterprises. From 1978 until 1998, during the Infrastructure and Capital Investment Period, Habibie is chairman of the Batam Industrial Development Authority (BIDA). From early conception till execution and supervision Habibie is involved.

Due to its proximity to Singapore, people on Batam-Bintan can subscribe to a Singaporean mobile operator. The frustration for the GoI and Telkom is that they do not receive any income from this mobile phone traffic. It is a matter of prestige for both to resolve this situation. From the perspective of a mobile phone operator, the islands are characterised by some attractive features, a wealthy population of businessmen that can afford the mobile phone and the costs to use it, and a potential demand caused by the expectation that mobile communications improves business efficiency. The Tax benefit means that a mobile phone is 30% cheaper on Batam-Bintan. For an engineer, offering coverage on an island is attractive because there are natural boundaries that determine the area to cover, and since the islands are rather flat, there is no natural interference from ,for example, mountains. Also the existing backbone is extensive and reliable, so customers are not scared off by a low grade of service.

In sum, by setting up the pilot project in Batam-Bintan, the likelihood that its implementation is successful increases substantially. There is demand, price advantages, and a straightforward implementation of the mobile network. In a way, by selecting the islands, the decision-makers create a strategical niche in which the first experience with the foreign GSM system has time to evolve, without the immediate confrontation of diverse local challenges.

Beyond the possible influence that Garuda had, it is clear that the decision to start a pilot project for GSM in Batam-Bintan comes from the top of the political hierarchy. The power of the top, specifically the Suharto clan, is influential throughout many undertakings in Indonesia.

The actual order to begin a GSM pilot project comes from the Minister of Communications Joop Ave. In effect, Joop Ave was ordered by Habibie, and it is likely that Habibie consulted with president Suharto, who gave his approval. After Garuda Sugardo receives the letter from Joop Ave, the design of the GSM pilot project begins.

The technical features of the pilot project
The nerve centre of the GSM network is the Mobile Switching Center (MSC). Siemens supplies the MSC which is installed on Dangas Hill, Ericsson supplies the Basic Transceiver Stations (BTS). The initial capacity of the network is 3,000 line units, readily expandable to 10,000 line units. For the installment of the network.Garuda calls on the aid of Jan van Rees, a technical expert working at KPN. He is expatriated by KPN for the period of one month, but ends up working in Indonesia much longer.

5.3 1993 : The first GSM Network and the strategic founding of Satelindo

5.3.1 Telkom builds the pilot project

In 1993 Garuda prepares a proposal for the pilot project. In this proposal he includes his ideas on the proper format of cooperation with Telkom, namely that the mobile operator should own the network[65], and that the activities should be coordinated from within Telkom. Later that same year the GSM network on Batam-Bintan goes on-line.

5.3.2 Satelindo : a new actor joins the actor network

On January 29 1993 PT Satelit Palapa Indonesia (Satelindo) is founded, through the partnership of two state-owned companies, PT Telekomunikasi Indonesia (Telekomindo) and PT Indosat, and the private-owned PT Bimagraha Telekomindo, part of Bambang Tri.'s Bimantara group, who takes a majority share. The founding of Satelindo is not based on a consensus of approval. For one, the House of Representatives opposes it. However the issue is settled when President Suharto says that "Satelindo has to be there".

The business activities of Satelindo include offering IDD[66] service and operating two satellites. Up to this point Indosat has the monopoly on IDD, but with the competition from Satelindo they need to rethink their strategy and offer competitive services to customers. This is considered beneficial for the Indonesian public. It also meant the further expansion of the business empire of the Suharto clan. That same year Satelindo engages in the bidding process for GSM licenses.

In hindsight, the foundation of Satelindo shortly before the tender of GSM licenses is a strategic move of Bambang Tri. Besides the other two activities, it is obviously set up to become a mobile operator and conquer a share of the promising Indonesian mobile communications industry.

In 1993 Suharto is awarded the title 'Bapak Pembangunan', father of development, because he ordered many infrastructural projects, industrial activities, and with an average growth of 7% each year, gave the country the status of upcoming Asian Tiger. To remind Indonesians of his merits, his face is printed on the new Rp. 50.000 banknote.

5.4 1994 : The different strategies for rolling out the network

5.4.1 Introduction

After the successful implementation of the pilot project, the Government of Indonesia (GoI) calls a tender for two GSM licenses. One license is awarded to Telkom and another to Satelindo. They start rolling out their networks and encounter a variety of challenges in the process. These challenges include the vast size of Indonesia, the variety and unreliability of the backbone, and the bureaucratic procedures for obtaining licenses. From these challenges originates the GSM system Indonesian style, as can be read in the following subsections.

5.4.2 Satelindo has better relations than Telkom mobile

Running a successful business in Indonesia is a challenge. There are several powerful groups that set the general conditions for business operations, and remain competitive among themselves. A key factor is the relation a company has with the regulatory regime, be it Suharto, Parliament or a

[65] This is similar to common practices in Australia, Europe, and the United States
[66] International Direct Dialling.

Ministry. In this subsection it will become clear that Satelindo and Telkom mobile belong to different camps and have different strategies on how to operate a mobile network.
After the successful implementation of the pilot project, the government sells one license for a 10 MHz bandwidth to Satelindo, and one of 7.5 MHz to Telkom. There is no exact information on the prices paid for both licenses, but one interviewee said that the preference[67] for Satelindo is the result of KKN. It is remarkable that the GoI does not offer two equal licenses and with it sets equal conditions for fair competition. This issue exemplifies the upcoming of the Suharto clan and Telkom not being able to match the influence of Satelindo with the Minister of Communications.
After receiving the license, Satelindo begins to operate their network in December of 1994 in Jakarta, starting with an initial capacity of 30,000 lines. They begin in Jakarta because it offers the best prospect for mobile communications demand. Their roll-out strategy is to continue expansion in Jakarta and establish a customer base before moving out of Jakarta.
From the pilot network on Batam-Bintan Telkom mobile expands to the island of Sumatra, which is closest to Batam-Bintan. The city of Pekanbaru is chosen because the presence of a local oil industry means the potential of a sufficiently wealthy user group together with an business interest to use mobile communications. They install 5 sites with a capacity of 1,500 lines by the end of 1994.

The **expansion strategy** of the two companies varies greatly. Telkom mobile, with its historical link to Telkom, its engineers and telephone traffic approach, wants to offer top of the bill technology, quality and nation-wide coverage. Satelindo, with its strong ties to Bimantara and their banker mentality, is more focused on returns on investment and high profit margins. This difference explains why Telkom mobile faces more challenges and needs to be innovative in order to overcome them and achieve quality services, as will become clear throughout this chapter.

5.4.3 The Complex Backbone Infrastructure and the unique concept of national roaming

The size of Indonesia and the complex backbone are two non-human actors that are driving forces in shaping the GSM System. In the process of 'listening' to these non-human actors, Indonesian operators have adapted the concept of national roaming.
Apart from the size, Indonesia's complex backbone offers an infrastructural challenge. The existing **backbone** structure, which is needed to link GSM switching exchanges, includes Palapa satellites, submarine cables that connect the various islands, terrestrial cables, and fibre optic cables. Most of the backbone is operated by Telkom or one of its joint ventures. For satellite links and international connections there are two operators, Satelindo and Indosat. Especially the use of a satellite backbone within a single network is unique for GSM.
The consequences of these different types of backbone and the large distances, come out in transmission characteristics, the speed of the transmission, and the set up time of a call. The diversity and distances also make the system more vulnerable to break-down, apart from the estimate that the general reliability of the backbone is not high. That is why Telkom mobile has installed a software system to supervise and control the traffic around the nation, and in case of a break-down of a node in the network, to re-route traffic along alternative paths. They call this supervision system, Superman (see picture).

A consequence of the large distances for mobile phone traffic is the use of the **national roaming** concept, where people have to pay to use their mobile phone outside their home area, and a distance fee for calling over large distances[68]. The national roaming fee applies to both making and receiving calls, this is similar to the concept of international roaming. The fee that is charged for roaming

[67] The advantage of 2.5 Mhz seems to be 33%, but because of radio frequency characteristics, the real advantage in telephone capacity is 40%. This in turn means that for one site, Telkom mobile can simultaneously run 27 lines, whereas Satelindo can run 38 lines. A serious advantage that is valid for the entire network.
[68] There are four distance categories to determine the fee for long-distance calls and roaming, these are 0-30 km, 30-200 km, 200-500 km, and more than 500 km.

depends on the distance between the caller and his home location. The distance fee is charged according to the distance between the home location of the caller and the home location of the callee. Another consequence of the size of Indonesia is the existence of three time-zones, which is important to determine whether a call was made during peak or bottom hours.

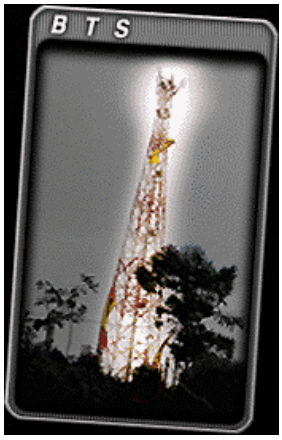
All these aspects are implemented into the **billing system** software, making it more complex than billing systems in countries without national roaming, distance fee, and time-zones. Due to the modular nature of most of the billing systems software it is possible to integrate these changes in the system. In the case of more rigid software, an extra piece of software has to be engineered and implemented. An extra burden for the billing managers is when an **update** of the software is released. Then they have to rewrite the custom-made part of the software and perform tests before they can bring the updated version online, a very stressful moment in the life of a billing expert. Generally Indonesian providers have been able to tackle these problems by attracting foreign experts who manage the software and train Indonesians in-house.

National roaming example

I live in Bandung and from there I call a friend who lives in Jakarta. If he is in Jakarta at that moment, I have to pay the distance fee. However, if he is walking beside me in Bandung, he is charged with roaming. The third possibility is that I am in Jakarta, in which case I have to pay roaming.

The flexibility of the software, that is part of the GSM system, makes it possible to integrate software changes in the system. In short, to localise the GSM technology to suit the Indonesian context.

5.4.4 The process of installing an antenna



The process of installing a Basic Transceiver Station (BTS), which is jargon for an antenna, reveals the strict hierarchy of Indonesian local government and its often bureaucratic procedures. Besides receiving approval from government officials, permission is needed from the lower level officials and the neighbourhood in which the operator wants to install the BTS. To circumvent these lengthy and bureaucratic procedures an operator needs good political relations and be willing to use incentives to speed up the process.

The first phase in the roll-out, is for the operator to determine where he wants to place a new antenna. The general strategy is to choose a location that meets a demand criterion and the promise of a healthy return on the investment. These locations include the capital cities of the 27 provinces, industrial zones, highways and railroads. In general, places where people live, work, or move, and who have enough income to afford a mobile phone. After rolling out the initial network, a new site may be installed inside the area serviced to cover a blank spot in the network or to increase capacity. Network engineers keep track of the degree of occupation of each site to determine if extra capacity is needed. In practice they still have to determine the exact location of a site. In order to determine a good location for a site, a special team visits the area and measures interference from buildings, traffic characteristics, and the proper place within the existing network. The most favourable locations are put on a shortlist which is handed to an intermediary agency that will negotiate with the local parties involved.

Before permission from local parties is negotiated, the governor is approached. He is an influential actor who operates on the provincial level. To speed up the process the governor might receive a mobile phone with a sim card free of charge, meaning that he does not have to pay for his mobile phone usage. In return, he will be asked to sign a letter that basically states that he wants to be able to use his mobile phone and that people, lower level officials, should cooperate with the provider to facilitate a prompt installation of the local GSM network. With the permission from the top level, cooperation at the various intermediate levels is almost guaranteed.

The next party to contact are the people living in the neighbourhood around the site. This negotiation process is run by a local agency. Besides purchasing or paying rent for the actual site, the local community is also rewarded for their prompt cooperation. The reward can be new toilet facilities, a badminton court, a playground, or funding for a school. Approval is needed because otherwise the

local community will not accept the installation and might even sabotage the site. If the negotiation process takes too long or the price remains too high, the provider will start negotiations for the second best site, as determined by the site location team.
After the approval for placement from the governor, the district head, down to the level of RT/RW (city district), and from the local community, the site can be installed. After installation the new site has to be connected to the network. Before bringing the new site online, engineers run performance tests, where after the new cell is integrated in the software that controls the telephone traffic.
As people become more informed of mobile phones and the large sums of money that are involved, so do the demands and costs rise for acquiring permission to install a new site. Especially Garuda Sugardo receives media attention and becomes a public figure. One of the conditions of the local community can even be that they want to meet Garuda in person.
It is often mentioned by foreign business people that in order to run a business in Indonesia, one requires the assistance of a local agent who is familiar with the informal aspects of the regulatory regime. This also goes for the mobile communications industry.

5.4.5 The GoI opens the mobile industry to foreign parties

In 1994 GoI regulation 20 comes into effect which opens the telecommunications industry to foreign investors. They are allowed a minority share in a joint venture with Telkom and other local partners. The reasons for the government to allow foreign involvement are, the fact that investments in telecommunications for the Indonesian Archipelago are gigantic, to facilitate the transfer of technology and expertise, and also political pressure from the West to open the Indonesian border to foreign investors. A reason for the Suharto clan to allow this is that with the flow of foreign capital to Indonesia, they are generally able to secure a portion for their own benefits.
Another change in regulations is the reduction of the import duty on mobile phones from 30% to zero. This gives the sale of mobile phones a boost and lowers the entry costs for first-time users, thus stimulating market demand for mobile communications. Through this regulation the regulatory regime accepts and stimulates the shift in the GSM System from a focus on the sale of mobile phones to the generation of mobile phone traffic. In this way they side with the strategy of Telkom mobile.

5.5 1995 : The end of Satelindo's monopoly in Jakarta

5.5.1 Introduction

In 1995 Telkom mobile counters Satelindo's strategic move of sole operator for Jakarta and gains on Satelindo as the largest provider. Telkom mobile joins with Indosat in the joint venture Telkomsel and Satelindo receives foreign financial input by starting a joint venture with Deutsche Telecom.

5.5.2 Telkom mobile is allowed to start operations in Jakarta after two years

The Jakarta region is highly promising to mobile operators due to its concentration of wealth, business, and people. However, during the first two years of GSM activities Telkom mobile is not allowed to roll out in Jakarta, so Satelindo enjoys a monopoly in Jakarta and acquires the largest customer base. This privilege comes from the control that the Suharto clan has over the regulatory Regime, specifically the Minister of Communications. This situation continues until mobile users begin to notice the inconvenience, namely the limited coverage of Satelindo versus the large coverage of Telkom mobile.

Satelindo customers from Jakarta who travel on Java or to Sumatra, places that are outside the network of Satelindo, are not able to use their mobile phone. Many of them take out a second subscription with Telkom for when they are outside of Jakarta. Telkom confronts the monopoly by applying Maoist guerrilla tactics. Basically this strategy is to begin with winning

GSM acronym Gerak Sedikit Mati
During the introductory phase of GSM, the network had many blank spots and capacity problems. This challenged the Indonesian creative mind, that came up with an alternative meaning for GSM, namely Gerak Sedikit Mati – Move a little, it (the connection) dies.

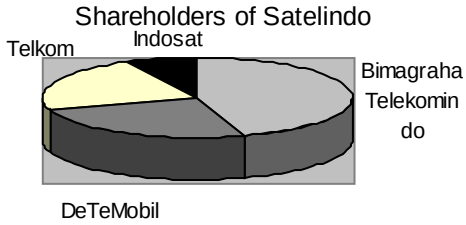
people's minds in the country side, there after moving in on the cities, where people are experiencing the onset of the change. In the case of rolling out a network, people have to realise that they are missing out on a better service and that they should have a choice.

After Sumatra, Telkom mobile continues expansion on Sumatra and Java, including cities like Medang and Bandung.

The final move begins by including Jakarta's satellites, Bogor, Tangerang and Bekasi. Thus making people that commute between the suburbs and inner Jakarta, aware of the wide coverage that Telkom has to offer. After closing in on the inner Jakarta area, news reaches Parliament of the situation that Telkom does not cover Jakarta and its inconvenience to many. The three sources of this news are the politicians themselves that experience the inconvenience, lobbying by Telkom, and public opinion. When the Minister of Communications is asked for a specific reason as to why Telkom is not allowed to operate in Jakarta, he replies that he has not (explicitly) forbidden this. Two weeks after this meeting Telkom goes on air in Jakarta. This is possible since they already installed the equipment and were just waiting for the approval of the Minister.
This story is an example of the sometimes unofficial manner in which high power government officials wield control. The unofficial nature makes it difficult to counteract people that have strong linkages with influential regulatory actors. The cunning strategy of Telkom and also the cooperation from certain politicians made it possible for them to break Satelindo's monopoly and overrule their linkage to the Regulatory Regime.

5.5.3 Deutsche Telekom joins Satelindo

On 3 April 1995, Deutsche Telekom Mobilfunk Gmbh (DeteMobil)[69] joins with Satelindo. DeTeMobil secures a 25% share of Satelindo through a capital investment of US$ 570 million. The proportion of shares for the other shareholders becomes Bimagraha Telekomindo 45%, Telkom 22.5%, and Indosat 7.5%. The choice for DeTeMobil is a logical one since Bambang is the agent for both Deutsche Telecom and Siemens, thus enforcing those linkages and increasing his profits as agent.



5.5.4 Telkom and Indosat form the joint venture Telkomsel

In 1995 Indosat, the international gateway provider, has plans to go public, but wants to raise the value of their shares before the IPO[70]. The Minister invites them to join with Telkom in a new mobile company. On 26 May 1995 the joint venture Telkomsel is established between Telkom (51%) and Indosat (49%). Telkom contributes through their infrastructure and Indosat pays cash for their share of the company. With this move the two communication giants of Indonesia form an alliance that enables them to counteract actions from Satelindo or the Suharto clan.

5.6 1996 : A new operator joins the GSM scene

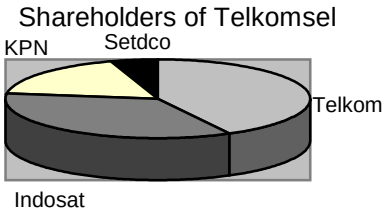
5.6.1 Introduction

In 1996 Telkomsel also invites foreign investors to be a partner in the joint venture, in order to strengthen their financial reserves and knowledge base. Furthermore, a third GSM provider secures the last GSM license and joins the competitive mobile telephony arena.

[69] Indonesia has a population of approximately 200 million people and a low telephone density of 3.25%. The potential market demand for telephones is gigantic, this prospect attracts large foreign multinationals from all over the world.
[70] Initial Public Offering.

5.6.2 Dutch KPN and Setdco join Telkomsel

Telkomsel's strategy to roll out a national network as quickly as possible requires large investments. With the issuance of regulation 20, Telkomsel begins to look for a strategic partner. After a fierce bidding process between Cable&Wireless (USA), Telstra (Australia), Hong Kong Telecom and Dutch KPN, KPN is selected as the new partner. Part of the deal for KPN is that they have to stand surety for a local investor, Setiawan Djody. This news reaches KPN shareholders in 1999, who see it as an act of KKN. The outcome of this process is presented in a later section. For now, this fact offers a good argument to explain why KPN is successful in obtaining the shares over other larger multinationals. By accepting the way of Indonesian dealings, KPN is able to beat large multinationals.

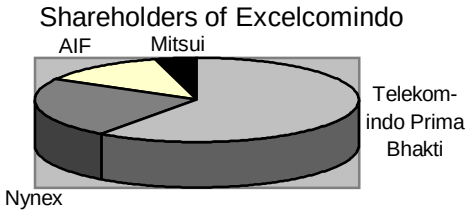


In March 1996 KPN invests US$ 370 million and Telkom another US$ 100 million to replenish Telkomsel's working capital. Further contributions by KPN are in the form of software, personnel, and training for Telkomsel employees. Besides KPN, local investor Setdco Megacell Asia (owned by influential businessman Setiawan Djody) joins with Telkomsel and acquires 5% of the shares. KPN is allowed to purchase 17.78% of the company, which leaves Telkom with 42.72% and Indosat with 35%.

By December 1996 Telkomsel is the first operator that achieves nation-wide coverage. They only needed two years to roll out a nation-wide network, a very respectable achievement. To celebrate this , the marketing department of Telkomsel launched 27 different SIM cards[71], for each province a picture of a person wearing a traditional garment, emphasizing the national coverage of the Telkomsel network and applying the 'unity in diversity' principle in their **marketing** strategy.

5.6.3 The emergence of new competitor Excelcomindo

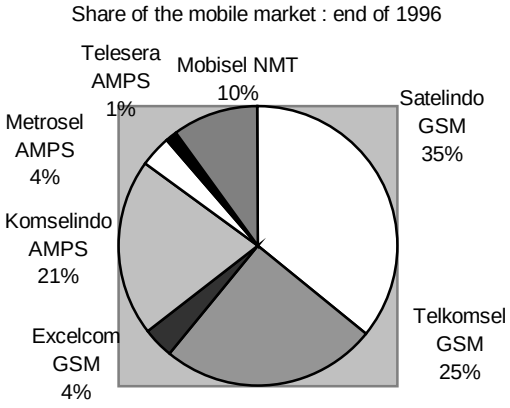
In October 1996 new operator Excelcomindo comes on stage. The primary stockholder is Telekomindo Prima Bhakti with a 60% share. The Rajawali group, owned by Peter Sondakh, owns 84% of Telekomindo and Telkom another 9%. The Rajawali group has more interests in the telecommunications industry, making it a powerful player. Also, Sondakh maintains close relations to Tutut Suharto, linking Excelcomindo to the Suharto clan.



Further partners are Nynex Indocel, a subsidiary of Verizon (formerly known as Bell Atlantic), with a share of 23.1%, the Asian Infrastructure Fund (12.7%), and Mitsui Co Ltd. (4.2%). Once again this is logical choice since Tutut is the agent for Lucent Technologies and Motorola, both American companies. Sigit Suharto is the agent for Mitsui. It appears that the Suharto clan has divided business interests roughly per country.

It is remarkable that neither Telkom nor Indosat get Excelcomindo shares. By law, Telkom as organising body should have a stake in each basic service telecommunications company. Through their share in Rajawali they have an indirect share of 5.4% in Excelcomindo. If this indirect share is also valid according to law is not clear. It is very possible that the influence of the Rajawali group is enough to bend the law slightly.

By the end of 1996 the mobile phone market is shifting towards GSM, as can be seen in the chart on the right. The total number of mobile phone users reaches 550.000.



[71] See Appendix **Fout! Bladwijzer niet gedefinieerd.** for images, and sim cards from the other providers.

5.6.4 Image and numbers

Of the three providers, Telkomsel enjoys the best public image since it is not linked to the Suharto clan. Telkomsel is also renowned for quality and keeping up with technological advancements. The image of Satelindo is contrary to that of Telkomsel. They offer the cheapest rates for a lower quality and are directly linked to the Suharto clan. The image of Excelcomindo is that of a technologically advanced operator, with good services. They distinguish themselves from the other two by not charging national roaming. They can afford to do so because their network is limited to Java, and because they have installed a fibre optic backbone. They are the only operator who owns a backbone. Indirectly they are connected to the Suharto clan through the Rajawali holding corporation.

In Indonesia people tend to pay attention to the operator that someone uses, as it reflects on the person. And since the operators all have different telephone numbers (the first three digits) it is easy to know where someone belongs. Besides the operator-part of the phone number, Indonesia people tend to pay attention to the kind of phone number they get with a subscription. In stores there is usually an ample supply of numbers to choose from. Depending on how nice the number is, the price can rise up to about 1 million Rupiah. The logic behind the attraction of numbers is rather intangible, sometimes a mathematical order is good, or lucky numbers, or a rhythmic sequence. In general, Indonesians attribute a magical dimension to numbers.

1997 : The onset of the crisis and the prepaid solution

5.6.5 Introduction

In the year 1997 some exciting changes take place in the GSM system. Telkomsel introduces innovative technologies that adequately tackle capacity problems in Jakarta. They also introduce the prepaid concept to Indonesia and take over the leading position of Satelindo. 1997 is also the year of the onset of the economic crisis and political turmoil.

President Suharto designates 1997 as the **Year of Telecommunications and Cooperative consolidation**. To make it a successful telecommunications year, the Minister of Communications invites all Indonesians to take an active role in the telecommunications Discipline Movement through the proper use of Telecommunications.

5.6.6 Tension between foreign political pressure and open/free market mechanism

A way to earn money in Indonesia is to be an exclusive agent for a foreign company. The mechanism is straightforward, the agent imports the products, adds a percentage and delivers it to an Indonesian company. It is precisely the method that Suharto clan members use to acquire wealth.
In general, companies in Indonesia are not allowed to import themselves but have to use the services of an agent, adding to their costs. Even the choice of suppliers is mainly dictated by the government. At the time of NMT (1986), Ericsson is the main supplier. After Habibie gets involved, this changes to Siemens who provides all the switching equipment. Obviously, Ericsson is very dissatisfied with this and protests. Consequently some equipment is purchased from them. Thereafter, the US embassy pressures Indonesia to purchase Motorola equipment, the quality of which, allegedly, is lower.
By 1997 Telkomsel is already using equipment from three suppliers, Siemens, Ericsson, and Motorola. To import equipment they have to use PT INTI as an agent. Driven by the capacity problems in Jakarta, Mr. Sugardo and Mr. Van Rees decide to buy Nokia equipment, for the simple reason that Nokia has developed an algorithm called frequency hopping[72] which increases capacity. Experience with Nokia equipment in The Netherlands confirms the smart solution they have developed. Consequently, Telkomsel moves the Motorola equipment to the outskirts of Jakarta and installs Nokia in the inner Jakarta area. US representatives are upset with this, as is the Indonesian government. The result of this disobedience is a complete replacement of the board of directors at

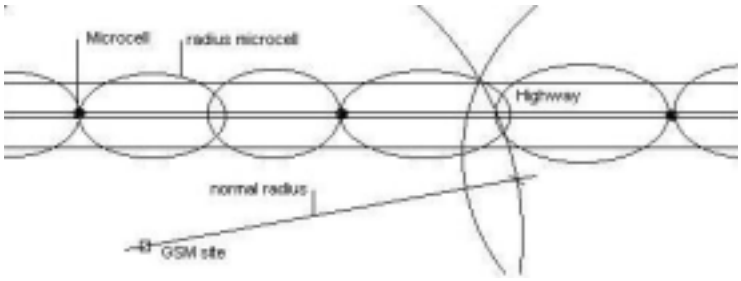
[72] Frequency hopping = A technique in which the instantaneous carrier frequency of a signal is periodically changed, according to a predetermined code to other positions within a frequency spectrum much wider than that required for normal transmission.

Telkomsel. Another reason for replacing the board is the large investments Telkomsel made in the process of rolling out and offering nation-wide coverage[73] within two years.
It is clear that Telkomsel people made a sound enginerial decision by introducing Nokia's promising equipment, in the process they ignored certain actors at their peril. To remind them of their position, those actors reacted and sacked the whole board. The message is clear, disobedience is not tolerated. Despite the upheaval, Nokia equipment continues to service the central Jakarta area. Nokia gains a foothold in a mobile industry with high potential, and will continue to expand from there on.
As Indonesia opens its borders to facilitate technology transfer and foreign capital injections they become more vulnerable to political pressure by foreign Administrations. Another factor that plays a role in this process of mixed business and political interests is the financial attraction of being a member or beneficiary of global organisations like the World Trade Organisation and the International Monetary Fund. In this new era of openness Indonesian politicians have to walk the fine line between protecting national interests and meeting foreign requirements to gain access to new financial resources.

5.6.7 The challenge to offer mobile communications in crowded Jakarta : the implementation of micro-cells and the overlay-underlay system

The inner Jakarta area poses challenges to mobile operators that are quite unique. With an estimated population of 10 million people and 2/3 of all GSM users, Jakarta harbours a large pool of potential and real mobile users. The traffic situation in Jakarta with large numbers commuting between the inner Jakarta area and her satellites, Bekasi, Tangerang and Bogor, causes major traffic jams during rush hour. Stranded in daily traffic jam, people use their mobile phones a lot, causing peak demands that are quite unique. Other locations that are prone to peak demands are popular weekend outings, conference centres, hotels, and shopping malls.

The regular GSM equipment did not offer an adequate solution to this problem. One manufacturer that recognised this need is Nokia; they developed the **micro-cell** which is perfectly suited for peak demand locations. The micro-cell looks like a small plastic box. It is a GSM site with a coverage area in the range of hundreds of metres instead of several kilometres. For Jakarta the standard coverage of the micro-cell is 100 metres. The second feature of the micro-cell is that the shape of the cell is not circular but oval and can be adjusted to suit local conditions through the use of a directional antenna
When the micro-cell is used during normal traffic hours, with cars travelling at normal speed or high speed on a toll road, a caller has to be handed-over[74] to the next cell within several seconds. This causes the network to easily overload and lowers the network capacity because during hand-over two channels are busy. The conclusion is that the micro-cell cannot take over all types of mobile phone traffic. To tackle this problem, Nokia developed the **overlay-underlay system**. The underlay system consists of micro-cells that absorb slow-speed moving callers, the overlay system consists of regular GSM sites to absorb high-speed moving callers. The basic graph of the overlay-underlay system is shown here.



[73] Nation-wide coverage does not mean a 100 % coverage of the whole Archipelago but the presence of GSM services in each of the 27 provinces.
[74] Hand-over is the process by which a call is automatically handed from one BTS to another while the subscriber is moving.

Apart from being used to deal with the traffic variations, a micro-cell is also used for indoor coverage when the interference from concrete walls and iron cabinets is too heavy for the normal signal to penetrate the building. Typical places to install a micro-cell are shopping malls, hotels, conference centres, or train stations. For example, Telkomsel installed six micro-cells in Taman Anggrek Mall, the largest mall in Jakarta, to be able to service the large crowds that shop there.

In sum, the configurational nature of the GSM system and the technical solutions developed by Nokia through a process of innofusion, is coming up with a solution to deal with local problems after the initial diffusion of the technology, are a continuation of the localisation process 4 years after the pilot project. The problems are specific to high-density urban jungles such as Jakarta, Mexico, Sao Paolo, and Hong Kong, to mention a few.

5.6.8 Prepaid as a solution to bad paying clients, to increase market demand, and give users some control over their GSM expenditure

In the first two years of the GSM operations, the number of non-paying customers reaches 30% of the total customer base, a very high percentage. The ATSI, Asociasi Telekomunikasi Selular Indonesia, a platform organisation for mobile phone providers, decides to draw up a **black list** of non-paying customers to prevent them from switching between providers. This method is only partly successful due to the naming convention in Indonesia, with the possibility to switch the first and last names. Also fraud with the KTP (identity papers) is a common practice, making it hard to draw up a concise and definitive black list. At a certain point it became almost socially accepted to fraud. Once people realised that they can not afford their bills, they will run them up high before the number is disconnected, sort of a sport.
The problem is aggravated by the lack of a credit status system and an incomplete population register. Extensive efforts of the providers to check a new customer's credentials does reduce the number of non-paying customers. The procedure to accept a new client can even involve visiting the customer at home in order to verify that their home address is correct - a rather costly enterprise.
Another problem with the black list is that the operators are reluctant to hand over names for the black list since some of the non-paying clients are heavy users and it is difficult to assess whether the client's behaviour is temporary or structural. Hence, they might risk loosing a good client. It is also possible that the client does not want to pay because he is unsatisfied with the service from an operator, in which case an operator might place the customer on the black list to avoid the person from changing operators.
One reason for many customers to run up high bills is their unfamiliarity with the costs of mobile phoning. This is not a specific characteristic of the Indonesian user; it can be witnessed in many countries. With the onset of the economic crisis the number of non-paying clients rises to 40%, causing immediate revenues problems for the operators.

> "The introduction of new services is often based on the availability of new technologies, these are introduced before our clients know it exists at all, and so without any clear demand for this piece of technology. However, the prepaid service was based on requests from our clients, they wanted to be able to control their expenses better when the crisis began."
> Source : Interview Garuda Sugardo

A technological innovation in the shape of the **prepaid** card relieves both sides of these financial problems. For the prepaid card the operator has to install a separate computer system that keeps track of a customers' credit balance and of prepaid cards issued and used. The prepaid system is run by an Intelligent Network (IN) machine, intelligent in the communication between telephone and computer system. For example, constantly updating and showing the balance in the display of the phone.
The operator issues cards with a numerical code and a pin code that the customer can purchase at a wide range of outlets. After connecting to the IN by calling a special number from his mobile phone, the client enters both numbers and his credit balance is immediately recharged. When the customer makes a call, the costs are almost immediately subtracted from his outstanding balance. If the balance reaches a prior set threshold, the computer sends an sms to the customer informing him of his low credit balance.
The first company to install a prepaid system is **Telkomsel**. They launch this new service, called Kartu SimPATI, in the Jabotabek area in October 1997.

Together with Schlumberger, a company that develops complete smart card solutions, Telkomsel develops a prepaid card system that is configured to function in the Indonesian environment. As commented by Sugardo, Telkomsel selects Schlumberger because they have installed similar systems in Hong Kong. This is another example of Telkomsel being the innovate leader for the GSM system in Indonesia.

> "SimPATI offers significant opportunities to accelerate our network penetration at a time of rapid economic development, and provides users with important additional benefits", commented Bapak Garuda Sugardo, Telkomsel's Director of Engineering. "Telkomsel selected Schlumberger because of its extensive experience in supplying complete smart card solutions and its success in developing and proving pre-paid SIM cards for the Hong Kong region."
> Source : http://www.1.slb.com/smartcards/news/97archives.html

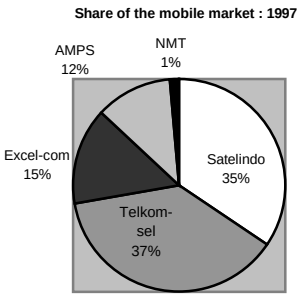
5.6.9 Onset of the crisis

In July of 1997 the Asian currency crisis slowly sets off. Indonesia widens the Rupiah trading band to the US dollar. In August, Bank Indonesia decides to abolish the exchange rate management altogether, thereafter the Rupiah begins to slide. Rumours that President Suharto is ill worsen the situation, with stocks on the Jakarta exchange plunging. By the end of 1997 the Rupiah exchange rate is 50% lower.
Reasons for the crisis are the large outstanding debt burden of US$ 130 billion, bad investments in for example infrastructural projects, and Indonesian companies lending money to other Indonesians without hedging against the weakening of the Rupiah.

One effect of the currency crisis is that the role of agent is no longer attractive, since they have to pay in dollars and get paid in rupiah. PT INTI, who is the agent for Telkomsel, no longer wants to be the agent for Telkomsel. Hence the crisis changes some of the existing distribution practices towards a more liberal structure. A factor that is beneficial is the presence of foreign joint venture partners. They have access to foreign currencies and financial backup, so they can rescue the joint venture from immediate bankruptcy and from being cut off from foreign supplies.

5.6.10 The size of the customer base in relation to revenues

By the end of 1997 the total GSM market has increased by 106% over the last year, from 403,000 to 832,000 customers. Telkomsel becomes the largest operator with a customer base of 361,000, Satelindo has 330,000 customers, and newcomer Excelcomindo 140,000 customers.[75]



Besides the size of the customer base, there are other factors that influence the income of GSM providers. These factors are the proportion prepaid and post-paid customers, the percentage of non-active customers, the average amount of calling time per customer, and the roaming habits of customers. An obvious difference between the providers which influences the total customer base figure, is the grace period for a prepaid subscription, during which the credit balance is zero but the sim card is still active. For Satelindo this period is 6 months, but for Telkomsel and Excelcomindo it is 2 months. The effect is that non-active customers will be eliminated sooner for the latter two, thus presenting a more realistic image of the real customer base. The explanation of one interviewee is that the 6 months grace period is part of Satelindo's strategy, since they are looking for a new foreign investor, a larger customer base allows them to ask a higher price for their shares.

[75] Dataconsult.

5.7 1998 : The Rupiah plummets causing financial problems for the operators, Suharto resigns his Presidency

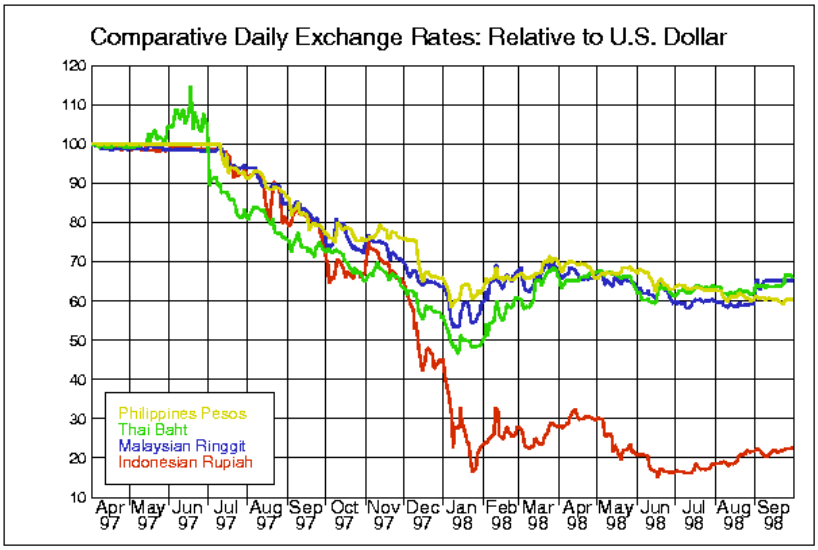
5.7.1 Introduction

In January of 1998 the Rupiah suffers another severe fall. Only by a US$ 40 billion aid package is the fall of the Rupiah restrained. The monetary crisis culminates at the re-election of Suharto on 11 March for his 7th term. The political turmoil and riots in Indonesia cause foreign investments to cease, expatriates to leave the country, and the number of mobile phone users to plummet. On 21 May Suharto steps down and vice president Habibie succeeds him.

5.7.2 The crisis of 1998 and its effect on the GSM industry

The economic crisis hurts the mobile operators in two ways. First, they are unable to continue network expansion and they get into financial problems caused by the expensive US dollar needed to pay off loans, interest, and import GSM equipment and expertise. Second, their subscriber base drops by approximately 15 percent, while uncollectable bills soar to 40%. The exception is Telkomsel that is able to book a small increase in subscribers over the whole year. The best explanation for this is that they are the first to offer the prepaid card service.

Due to the devaluation of the Rupiah the income of providers from traffic generation, as regulated by the government, sinks to US$ 3 ct. The providers start a lobby through the ATSI, the platform organisation, to raise the basic tariff. The government agrees and raises the tariff by 15%, from Rp. 275 to Rp. 325.
With the crisis, prepaid becomes very popular, because subscribers do not have any monthly fixed expenses. Postpaid subscribers migrate to prepaid, and a new group of users is tapped who want to try out mobile phoning without being stuck to a subscription for one year or more.
Thus the crisis accelerates the demand for prepaid, and since this is a service that analogue operators are not yet able to offer, it stimulates the growth in the number of GSM users, increasing their proportion in the mobile communications market even more.



5.7.3 The GoI issues third generation licenses to 12 companies

At the end of October 1998, the Ministry of Telecommunications announces the tender winners for a telecommunication system using PCN/PCS[76] technology. This system consists of a DCS-1800 (Digital Cellular System) developed in United States and a PHS (Personal Handphone System) developed in Japan. Its strong features include higher capacity, smaller cells, better propagation. A main attraction to users is that they will pay pulse at local rates.

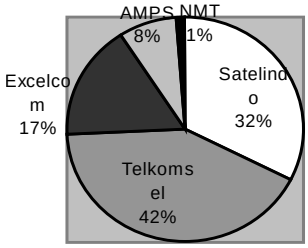
[76] Personal Communication Network / Personal Communication Service

In contrast to the GSM licenses, the PCN/PCS licenses are granted on a regional monopoly basis. The license for Jakarta, the most promising market, goes to Telkom Personal. This is a clear indication of the power of Telkom which has become greater than that of Suharto clan companies.
With the entry of another standard in the mobile communication market competition is stimulated further. According to the GoI the system will complement the dominant GSM system. GSM operators consider the entry of new competitors as undesired. They argue that with the large investments involved to roll out and run a mobile network, too much competition will damage the viability of current and new mobile operators, and ultimately not offer better services to customers.
A risk is that competition can become so fierce that operators focus on marketing and less on the roll out and quality of their network. Also companies that enter in the price competition risk losses and may well face bankruptcy. This is clearly not in the interest of users. However, from the perspective of the government the sale of licenses is an attractive source of income. It also sends out the message that Indonesia is keeping pace with new developments and continues on its path of modernisation.

By the end of 1998 the total GSM market has grown to 980,000 customers, the same level as a year before, considering the crisis a remarkably quick recovery for the GSM industry.

5.8 1999 : GoI issues a blueprint for the new telecommunications law

Share of the mobile market : end of 1998



5.8.1 Introduction

Ten years after Telecommunications Law 3, a new Law is in the making, clearly reflecting the fast developments in the field of telecommunications. Another issue is the difficult relation between Telkom and Telkomsel, stemming from problems involving joint ventures and corporate cultures. 1999 is also the year in which PT Inti decides to produce an Indonesian GSM phone.

5.8.2 The paradoxical relation between Telkom and Telkomsel

Telkom's monopoly on the local fixed telephone network and the backbone gives the company a powerful position. They rent their backbone to the different mobile operators. As the largest shareholder of Telkomsel they have an influential position with the company. Telkomsel is required by Telkom to rent Telkom buildings for the installation of sites, but according to one interviewee they later discovered that they were paying a price above market level. Telkom also collects 100% of the international roaming income of Telkomsel, even though Telkomsel generates the traffic and bears the risk of non-paying customers. Telkomsel is left with the normal fee for airtime but not the financially attractive fee for international roaming. This unfortunate set up is contested by Telkomsel and after fierce discussions they managed to secure 15% of the international roaming income.[77]
Telkomsel's point of view is that Telkom should leave profits with the company so it can invest in the further roll out of the network. Telkom on the other hand treats Telkomsel as a cash cow and tries to channel funds to the mother company before it has to share final profits with the other shareholders.
The variety of approaches is also encountered in the **corporate culture** of Telkomsel. The culture is formed by employees from different backgrounds. They originate from one of the three shareholders, Telkom, Indosat, or KPN, and continue to maintain relations with their background. These employees do not fully identify with the company, often because they are working there for a limited period of time. The suggestion is that people confer with their original companies and channel information. The exception are people newly hired to work for Telkomsel, as they lack the linkage to a shareholder company; in time they will most likely form the new Telkomsel culture.
These problems occur with joint ventures in general. To which company is one's loyalty? Telkom actually rotates personnel frequently so they do not become too attached to the joint venture and remember where there roots are.

[77] Interview.

Another aspect of Indonesian business culture is what foreigners perceive as a laid-back attitude. One interviewee commented that at Telkomsel employees are committed to meet deadlines and work over-time. The challenge of the fast and dynamic industry of mobile communications together with examples from foreign workers and driven by foreign management calls upon the Indonesians to 'adjust' their perceived laid-back nature and adopt to a new situation, which they do admirably. The effects of this local change can be the onset of a society-wide alteration in the direction of a more Western-like business mentality, only to be witnessed as time progresses.

5.8.3 The crisis continues

As the Rupiah remains weak, the operators ask the government for another increase of the telephone tariff. A raise for fixed telephone is on the political agenda shortly before the raise for mobile phones. Public opinion and the consumer organisation, YLKI, are very much set against the raise for fixed telephones. They succeed in halting the intended raise by extensive media coverage and mobilising public opinion. Consequently, Parliament decides to also postpone the raise of the mobile phone tariff from March 1999 to December 1999. This demonstrates the power of YLKI to mobilize public opinion and influence political decision making, rendering them as an actor to be reckoned with.

In July 1999 the DPR approves a rate increase of 15 percent, but the Ministry of Communications, backed up by the ATSI, rejects the proposal on the grounds that it is insufficient. The two sides are unwilling to compromise, with the paradoxical effect that while rates remain frozen all parties agree that the rates are too low.

While mobile providers were initially hurt by the crisis, they are recovering quickly. Prepaid cards are instrumental in their fast recovery. Industry representatives say that the number of GSM users has increased because of the popularity of the prepaid. Since the introduction of the prepaid cards in October 1997, over 50% of GSM users are using prepaid by the end of 1999.

> The latest innovation by Telkomsel is to possibility to use one's atm card for recharging the prepaid balance. After entering the prepaid amount of choice, the atm produces a voucher with a code. This code is typed into the mobile phone and the credit balance is registered to the proper subscription. The atm can also be used to fulfill a postpaid bill.

5.8.4 The new Telecommunications Law nr. 36

A sign of the rapid developments in the telecommunications industry is the fact that the Law 3 from 1989 is replaced in 1999 by Law 36. The Telecommunications Law before 1989 dates back to 1965. The thrust of the new law is to end monopolies, lower the Indonesian share in joint ventures to 5%, which will allow foreign companies a decisive influence on management and strategy, and no more distinction between basic and non-basic services. This distinction is replaced by network operator and service provider. The monopoly of Telkom on local loop runs until 2010, and on international local loop until 2005. Indosat's monopoly on international telephoning ends by 2004.

After Habibie approving the blueprint of Law 36, Parliament is the last party to approve the law and make it official, which they do in the year 2000. The next phase is the issuance of regulations, the practical documents that instruct the mobile communications industry.

Effectively, the Law reflects a policy of the Indonesian government that is willing to meet some of the requirements set by international organizations, namely ending monopolies, creating better conditions for foreign investors, and stimulating competition.

5.8.5 The local development of a GSM phone by PT Inti

The state-owned PT Industri Telekomunikasi Indonesia (Inti) has set a target to produce 16,000 cellular phones by the end of 1999 under Siga-1 and Siga 2 brand names. PT Inti is responsible for all aspects of the manufacturing process, from engineering design to the finishing touches. The Siga-1 has obtained quality certification from Zelestyretsun of Sweden. But whether or not an Indonesian GSM phone will be able to compete with strong global brands such as Nokia, Ericsson, or Motorola, remains to be seen. The image of the Siga is not strikingly fashionable, which will make it hard for them to compete. Also the benefit of economies of scale do not apply with an output of 16,000 phones, making the whole undertaking a

hazardous one. From the perspective of PT Inti it is frustrating that the GSM business is booming and that they, as largest telecommunications equipment manufacturer, do not benefit from it.

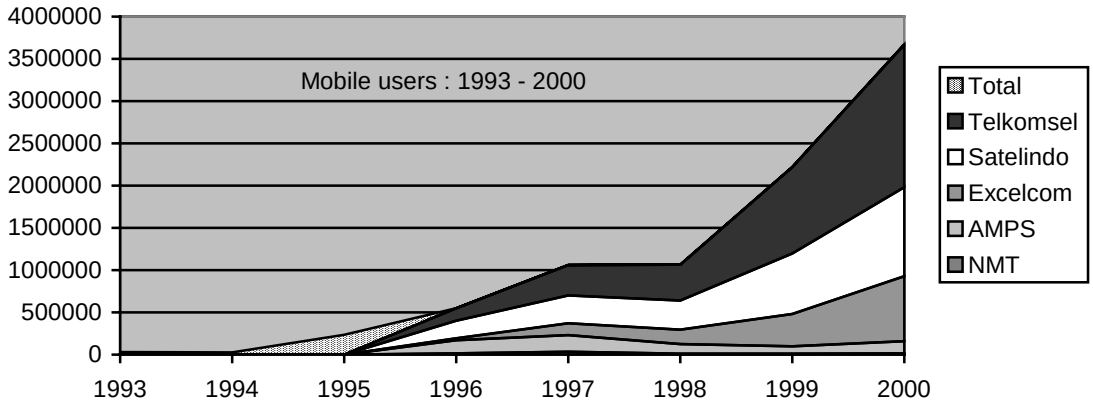
A remarkable development in Indonesia is the wide variety of **accessories** that are available for the mobile phone. Coloured casings, antennas, and touch-pads in all colours and shapes can be used to personalise one's mobile phone. Clearly meeting a demand to makes one's mobile phone appear in accordance with one's image. Remarkable is the existence of a special casing for the Ericsson 788 which makes it look like the Nokia 8810, a mobile phone four times as expensive.

5.9 2000 : The successful localization of GSM

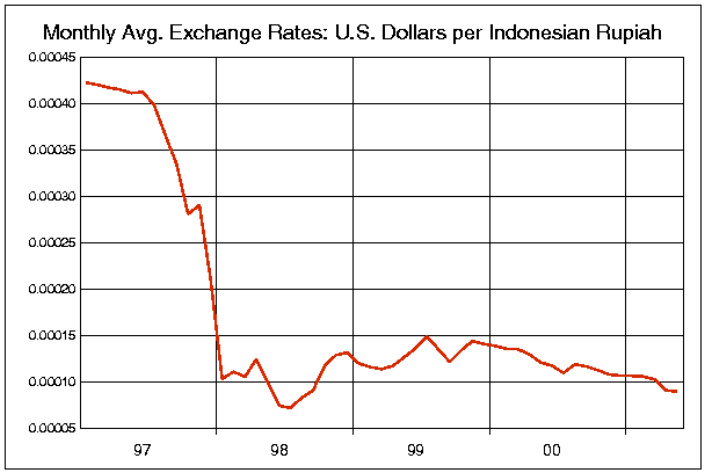
5.9.1 The trend of mobile users from 1995 to 2000

Looking at the growth trend of mobile users, the first thing that stands out is the trend break in 1998 caused by the economic crisis. Even more so is the continuation of the trend already the next year, even though the Rupiah only recovered slightly in 1999. Another effect of the crisis is the delay of the roll out of the latest standard PCN/PCS, providing the GSM operators with the opportunity to continue their conquest of the Indonesian market. The longer it takes for the PCN/PCS operators to start building their network, the more difficult it will be for them to compete with the extensive coverage, the quality, and familiarity with GSM.

Once a network technology, which mobile communication systems are, reaches a critical mass it really takes off. This phenomena is witnessed in countries such as Finland and The Netherlands that experienced a yearly doubling of GSM users, after a critical mass had been reached. The more people use a mobile phone the more attractive it becomes for others to join. The general tactic of operators is to stimulate market demand by sponsoring the mobile phones, up to the level where they are offered freely. This reduces entry costs for newcomers, and reduces their possible hesitation, which leads to reaching the critical mass quickly.
Another way in which entry costs are lowered in Indonesia is through the lively second hand market, partly driven by the crisis and by the entrepeneurial spirit of Indonesians. A well-known place to purchase mobile phones, and other electronics, is Glodok in Jakarta. Glodok is located in Chinatown, which was partly burnt down by the riots. It is a free-zone where black market and 'illegal' activities are allowed to flourish. It is also the place where people can buy cordless home phones that are banned by law but somehow still find their way into the country. These cordless phones interfere with the GSM signal and cause quality and capacity problems for GSM providers. In case interference from these cordless phones is too strong, the GSM provider can track it down and call in the police to confiscate the phone. These cordless phones come into Indonesia either through direct smuggling or through agents that have a way around the law and official importing licenses.



By the end of the year 2000 the number of users has grown 65.2 % overall, from 2.22 million in 1999 to 3.67 million. The NMT system recorded a 9.7 % increase, which is remarkable for a standard that dates back to 1986. The GSM operators recorded a 65.3 % increase, and AMPS came first with 72.2%. The reason for the growth of AMPS users is the migration to the digital version of AMPS including CDMA technology. However, looking at the total user base, GSM operators service 95.7 % of all mobile users in Indonesia, an undisputed success.
Of the 3.67 million users 60 % have a prepaid subscription, this translates in acquiring 2.2 million users in just over 2 years, proving that prepaid is very suitable to the Indonesian situation.



5.10 2001 : Update and future prospect

With the arrival of 12 new third generation operators, competition among operators is expected to become fierce. For the older technologies NMT and AMPS analogue it is a matter of trying to survive. AMPS operators Komselindo and Metrosel are planning to merge. After the merger, the two companies will seek a new license to operate with nationwide coverage. Komselindo will use Code Digital Mobile Access (CDMA) technology.
With all this traffic, the backbone of Telkom is near its maximum capacity. The story is that operators are buying trunk-line[78] equipment for Telkom because it is not upgrading fast enough to support the explosion of their business. A spin-off effect of the growth of the mobile market is that the backbone, which is also used for the fixed telephones, is upgraded and fulfills a condition for the progress of fixed telephones.

[78] Trunk-line = A single circuit between two points both of which are switching centres of individual distribution points. A trunk usually handles many channels.

The economic crisis has left Satelindo with an estimated debt of US$ 600 million. In the process, Bambang Tri. sells his shares to Indosat and capitalizes on his assets, partly driven by the unpopularity of Suharto clan companies and possible corruption charges and financial repercussions. Despite the poor prospect of Satelindo, DeTeMobil hangs on to their interest in the company. Actually, the relation between DeTeMobil and Satelindo has not been a fruitful one. It has surprised local companies that Satelindo did not use the expertise of Deutsche Telekom in its operation.

There is a serious lack of **experts** on GSM software, especially for the billing system, but this issue is world-wide problem. In Indonesia operators recruit technical personnel with a background in electronics and computer sciences, and train them in-house. There is talk of setting up a new curriculum at a college or university to educate students in the specifics of the mobile phone system, but whether this is already achieved or not can not be determined since no up-to-date information has been gathered on this particular subject.

And as for third generation mobile communications, which has not even set off in Europe, it is estimated that it will take quite some time before Indonesia, particularly Indonesians, will implement this newly evolving technology.

5.11 The overall picture : highlights from the GSM System Indonesian Style

The story of the localisation of the GSM system in the Indonesian context has presented detailed information, of which important elements will be highlighted here.
Caught between top-down and bottom-up forces and having to compromise to achieve their goals, are the three GSM operators and platform organisations like ATSI.
Top-down actors are found on the side of the government and Indonesian power structures, like the Suharto-clan, local-Chinese business conglomerates, and the military. These include the President, the Minister of Communications and to a lesser degree his department, and to a large extent the top of Indonesian telecommunication companies. Two other major actors are Indosat and Telkom. They separated from the Suharto clan, and 'fought' their way back to the top of the telecommunications world in Indonesia, however top executives remain sensitive, and often susceptible, to influence and control from the military, or similarly powerful actors.
The actors that have a more **bottom-up** actors are the consumer organisation YLKI, and the Indonesian mobile phone user that determine the usage and the market dynamics.
Then, besides the local actors, foreign actors also have a bearing on the shape of the GSM network; GSM hardware manufacturers like Nokia, Ericsson, Siemens, and Motorola, are important; Software producers from all over Europe and the United States; and Joint-venture partners who expatriate employees, transfer knowledge and funds. Finally, the IMF and the WTO, who stimulate Indonesia to open its borders, and to pursue free competition.

The joint venture GSM operators employ Indonesians and foreign expatriates as an initial basis to implement the GSM system, beyond that point foreign experts are hired and suppliers offer assistance in installing and maintaining their equipment. The platform organisation ATSI was formed to coordinate some general issues between all mobile phone providers, including inter-payment and lobbying. The government of Indonesia and the Ministry of Communications updated laws and regulations, reflecting the policy and direction they had intended for the mobile phone industry. Foreign companies were responsible for importing equipment and knowledge, and also for the development of innovations, partly influenced by feedback and input from Indonesian actors. And finally, by actually using the GSM phones, the Indonesian customer localised the technology by making complaints or channelling ideas or desires to the providers, who in turn applied some of these inputs in their strategy.

The **linkages** between these actors are very complex, partly because of the complex structure of social relations in Indonesia, and because of the often informal nature of the more important linkages.

[79] Foremost is the wide scope of influence President Suharto exerted. The practice of Suharto's offspring to be agents for foreign companies and controlling stakes in joint ventures. A general mechanism is to distribute important positions in companies to allies, creating linkages that can be called upon in the future. And finally, operators who need, or simple have, friends in high places who can get around bureaucratic procedures and other social or political barriers.

The shape of the GSM system in Indonesia consists of software and hardware elements, which are often the same as in European countries. Important elements for Indonesia are the sim card, the prepaid card, the micro-cell, and the underlay-overlay system. Also, special software is written for Indonesia to deal with the country's characteristics, such as the geographical dimension and the variety of types of backbone. For example, the use of a satellite within a single GSM network, which is unique in the world, required special software.

The overall picture and highlights that are presented in this section, have provided some answers to three of the initial research questions:

> Who are the actors that were involved in the process of selecting the GSM standard[80], and the process of shaping the GSM system in Indonesia?
>
> How was the socio-technical GSM system in Indonesia shaped, and how did the various actors influence the localization process?
>
> How did the co-evolution between GSM technology and Indonesia take place, and how did the GSM system Indonesian style evolve?

[79] For a newcomer in the Indonesian society uncovering linkages beyond the formal and obvious is difficult. Still, it is precisely the existence of informal linkages and alliances, and their intricate nature, that are a central part of the Indonesian dynamics. While the data concerning this item is limited the importance of the informal and 'off stage' is unquestionable in beginning to understand the inner workings of the Indonesian society.

[80] This question is not answered here, instead turn to page 31 for the answer.

6 Conclusions : the dynamics of the Localisation process of GSM Technology are unmistakable Indonesian

6.1 Introduction

The process that is the subject of this thesis is the localisation of a foreign cellular telephone system in the Indonesian environment. Determining the flexibility of this foreign technology needed to adapt and function successfully in the Indonesian context, is investigated through the perspective of SCOT and Fleck's configurational technology approach. The SCoT approach provides a profound insight in the process dynamics of technology being shaped by various social influences. Fleck's framework is concerned with the flexibility of a technology at the time of diffusion and uptake, thus appropriate to study the localisation process.
Analysis of the research data as well as discussion with people knowledgeable about the subject of my thesis allowed identification of patterns of technology dynamics and localisation.

6.2 Configurational elements of the GSM system

> How is the GSM system in Indonesia configured, in terms of generic and configurational elements and their interaction?

The development of a standard seems contrary to the openness of a configurational technology. However, by specifying the interfaces, there is still room for configurational technologies or elements within the GSM system. Configurational elements of the GSM technology spread out over the whole range of what is defined as technology, including hardware, software, and business practices..
With the GSM system there is one (consumer) artifact that is completely generic, this is the mobile phone itself. The only novelty in Indonesia is the wide variety of accessories available to personalise one's mobile phone, clearly fulfilling a consumer-driven demand.
Special additions and enhancements to deal with local problems and preferences have been made. The possibility to incorporate these additions in the main system, is proof of a certain flexibility in the technology. I argue that the character of the technological system embodied a configurational side. The software is largely responsible for the potential openness of the system. Also new or existing hardware is installed in combination with a new piece of software to link it to the existing system.

To characterise the GSM system, the distinction between software, hardware, orgware, and socioware, can be used.

a. Software

Operators had to develop a billing system, in cooperation with software manufacturers, to manage the requirement of national roaming. They also required a specialised traffic control system to manage the variety of backbone infrastructure.
Telkomsel's development of a central coordinating and controlling software application, which linked the software from various producers, is another example of a locally constructed configuration.

b. Hardware

The development by Nokia of the micro-cell has proven particularly useful for the crowded central Jakarta area. And even though this technology is also applied outside the Indonesian context, this does not imply that it can be automatically discarded as a configurational element of the Indonesian GSM system. But without the data to verify or falsify the idea that Nokia developed the micro-cell as a solution to the problems of busy mobile traffic in Jakarta, the inference drawn here is that the concept of the micro-cell was developed in a later stage of GSM operations and was intended for a specific surrounding. So although it is not exclusively developed for Jakarta, it is very appropriate and in that sense, local. Moreover, this development is an example of innofusion, and proves that GSM system is more configurational in nature than generic. This also applies to the underlay-overlay traffic control system and the capacity increase derived from the frequency-hopping algorithm.

c. Orgware

Orgware basically is the way an organisation handles technology, and is part of the technology as well. The transfer of knowledge and tools, e.g. network planning tools, reflects the generic side of the GSM system at the level of orgware. Also the way the companies are organised seems to be directed by the GSM system. However, since not much information was gathered on this subject and there is little information on organisations in other countries, which is required for comparison, the basis for arriving at these answers is limited.

d. Socioware

Socioware is the side of technology that meets society and the consequences this has. The socioware of a technology is specifically designed with this in mind. For example, the law in The Netherlands, to be issued soon, that people are not allowed to use their mobile phone in the car unless it is handsfree. Or the fact that, nowadays, restaurants and bars attempt to prohibit the use of a mobile phone on their premises. For Indonesia, this case study has not found any specific types of socioware.

6.3 The success of GSM in Indonesia

Why did the GSM standard become a success in Indonesia?

The general features of GSM are attractive to providers and users, explaining why GSM is a success world-wide. These features include, better fraud resistance through the concept of the sim card, it is more difficult to eavesdrop on a conversation since it is encoded before the digital information is broadcast over the waves, better propagation of the radio signal creating better sound quality, and finally the GSM standard prescribes a complete mobile phone system. These features are attractive in any environment, also the Indonesian. But it still does not answer the question why previous mobile phone systems did not become widely spread. The most obvious answer is that people cannot spend US$ 5000 on a mobile phone. In the beginning the mobile phone was a status symbol and not an artifact that offered true mobility since there were many blank spots in the network and the coverage was limited to Jakarta. It faced a threshold which is typical for network technologies. The first users, the early innovators, are charged with a disproportionate share of the R&D costs. The second group, the early adaptors, pay a lower price. But it is not until market demand passes a threshold value that prices become really competitive and as such affordable to a large part of the population. And with Telkomsel changing the focus of revenue to traffic generation and offering nation wide coverage, two important factors that made the GSM phone attractive to the public are identified. Another key factor is the decision by the GoI to change the policy of regional monopolies to nation-wide competition between three GSM providers, which truly stimulated the providers to make an effort to attract users by price setting, quality, and service. These are the main reasons that explain why GSM became a success in Indonesia. While some of these forces are general in nature, in that they are valid in any country, the case study has also identified Indonesia specific forces. Hence, the dynamic of the localisation process consists of both general as well as Indonesian characteristics. Exemplary of the dynamics are the actions by Telkom mobile, later on Telkomsel.

The first company to initiate GSM operations in Indonesia is Telkom. Later on, Telkom's mobile unit became Telkomsel, a Joint Venture between Telkom, Indosat, KPN, and Setdco. Two leading figures since the beginning are Garuda Sugardo, the visionary, and Jan van Rees, the technical expert. Together they are the architects of the GSM system Indonesian style. With the ideas of Pak. Sugardo, the technical knowledge of Mr. Van Rees to implement those ideas, and a new company with motivated and professional people, Telkomsel became the nations innovator in the field of GSM operations. They were able to roll out the network and offer national roaming after only two years. They introduced a new business model where the revenues originate from the mobile traffic generated and no longer from the sale of mobile phones. They were creative in their marketing strategy and enjoyed an image of being a professional, unattached mobile operator that offered state-of-the-art technology. Furthermore, Telkomsel in collaboration with GSM equipment manufacturers was instrumental in developing the prepaid card. A new concept that tapped a new user group and boosted market demand for GSM, not just in Indonesia but all over the world.

In conclusion, instrumental for the successful localisation of GSM are the initial architects, with a vision and the capacity to realise it, importantly through their cunning ways of manoeuvring in the Indonesian context. Secondly, the configurational character of the GSM technology – as envisioned from the beginning of the standards setting process – made it possible to localise the foreign technology and build a GSM system Indonesian style.

6.4 The shape of the GSM system

Why is the GSM system in Indonesia shaped as it is?

In the process of localising the foreign technology of GSM to the Indonesian context a number of **features** arose that needed to be addressed by Indonesian operators and GSM manufacturers. These features and conditions include the size of the Archipelago, the variety of types of infrastructure, the needs of the Indonesian customer, restrictive laws and regulations, and the Indonesian way of conducting business.

Within the Indonesian sphere, central Jakarta by itself poses an even greater challenge. With some rather unique **features** such as traffic density, a population of 20 million people, concentration of wealth and business activities, the challenge of providing mobile telephony in this environment becomes even greater. Due to its almost unique features and the fact that technological innovations were in part developed and in part tested in Jakarta, the city can be labelled as a place from which specific innovations spring, an **innovation interchange**. The idea of being an innovation interchange is that environments that share the same features are likely to accept the deployment of technological innovations developed at the interchange.

The outcome of the localisation process is the GSM System Indonesian Style, of which the main elements have already been mentioned in section 5.12.

6.5 The conflict between historical power structures and the liberalising and reformative forces of Indonesia

The further co-evolution of the GSM system in Indonesia is ongoing process with many contingencies. However, with the basic knowledge of the dynamics of the process, some comments and inferences into the future can be made.

The power that money exerts in Indonesia is prominent, it is sought after on the one side by the power houses to acquire abundant wealth and maintain their alliances, and on the other side by people who want to use it for the advancement of Indonesia. The mobile telephony industry is very appealing to local and foreign investors because of the large population of Indonesia and the low penetration of fixed telephone lines which create promising expectations for the near future. With large multinationals interested in the Indonesian mobile market, Indonesian power figures and businessmen saw an opportunity to increase their wealth and attempted to seize it.
The Indonesian society is still largely dominated by the principle of KKN, Collusion, Corruption and Nepotism. It is difficult for reformers to root out this historic principle and start a new order of transparency and accountability. Even though the influence of historical power structures, such as the Suharto clan, has been reduced over approximately the last five years, they continue to have a grasp on the country's major industries by cleverly adapting to the newly emerged conditions. Formally the new laws and regulations are aimed at liberalisation of the Telecommunications industry and opening the border to foreign financial and technological resources, but through the existence of more informal alliances the power houses succeeded to gain a share in new founded joint ventures operating in the mobile phone sector and wielding their influence to protect their business interests.
For example Satelindo, of which Tommy Suharto owned 60%, was allowed to monopolise Jakarta during the first two years of GSM operations. Already at the tender was Satelindo successful in securing a bandwidth of 10 MHz, whereas the other two providers received 7.5 MHz. The monopoly in Jakarta ended when lobbying and public protest reached Parliament.

In sum, there is a conflict between the meta-regime of the New Order and the upcoming regime of a more reformative nature. Indonesian legislation is determinative in setting the ground rules of the GSM industry, but slowly the grip of the meta-regime is loosening. Bottom-up forces, like the consumer organisation YLKI who can mobilise public opinion, begin to counteract this influence.

In the end it seems likely that old power structures will fall and that a new regime will rise. about the nature of this new regime one can only speculate. But it will certainly influence the GSM system, as well as profit from what GSM does already. One can imagine that the old tradition of backroom dealings no longer needs to take place in secretive locations, instead with GSM, place is no longer an important issue. Off stage dealings, and communication, are bound to take a different form with the use of mobile telephones.

7 Reflections on SCOT in the development context

7.1 Introduction

The main body of case studies in the field of SCOT is concerned with technology development in the Western world. The potential danger of this is that there are aspects of SCOT research that are unconsciously taken for granted, like blind spots, because of a level of uniformity of the various contexts and countries in the Western world. This problematique is the red line in the following three sections, and is enriched with personal experience.
The reflection starts by positioning SCOT as a particular and fruitful approach to capture the co-evolution of technology and society. This implies that one should acknowledge the specifics of technology as well as society and not rush ahead and apply the Western SCOT approach in a development context as if it were an all powerful tool. Secondly, doing SCOT studies (and especially when taking specifics into account) creates a picture of the co-evolution process which can be taken up by actors to ask questions about direction and possibilities to modify the process. For the reflective analyst this means that there is a possible normative side to the Localisation process and the SCOT approach, which should be considered. Thirdly, the analyst is also an actor in the context he or she studies. For the purpose of this study, I limit myself to a brief consideration of practical implications for (and personal experience with) conducting research in Indonesia.

7.2 Theoretical reflection and consideration on the appropriateness of SCOT for the context of a developing country

The overall co-evolution perspective will be used to raise questions about what SCOT has to offer to study technology development in the context of a developing country, how appropriate the approach is, and whether the SCOT framework requires changes or enhancements for fruitful research?

The basic principles, as followed by SCOT researchers, of multi-directionality of technology development, multi-causality, and multi-level approach towards actors and technology, when combined with contributions from sociology, economics, political science, and (cultural) anthropology offer a powerful explanatory approach in any context. The diversity and broad scope of the approach and the potential to present a complex, realistic story of technology development, allow capturing and constructing the story of technology development in a developing country. However, there may well be elements that are taken for granted because they are so obvious to researchers in the Western world that they no longer notice them. Already the widely accepted use of developed, or Western, versus developing points to a basic and possibly simplistic view of the difference between the various worlds.

The co-evolution of technology and society is always distributed, geographically and in terms of actors and sectors involved. In the case of technology and developing countries, this distribution takes on additional forms. One major distinction between the developing and developed world is that often, especially in the case of modern/high technologies, a technology is developed in the Western world and transferred to developing nations. The first implication of this for developing nations is that the technology is not developed within the confines of their culture and society, hence a Fremdkörper. In this way it is different from the phenomenon of invisible technology, as when electricity production technology is invisible to the users of electricity, or when the hardware, say the backbone of the Internet, is assumed to be available, somehow, and allowing for the services to be used with its help. The Fremdkörper might be very visible, but it is recognised as different, as not (originally) belonging to the society. The reaction might be hopeful, as in views of modernisation through technology, or just better control of society, or reluctant, when the technology is seen as an intruder.
The awareness of this circumstance leads to the realisation that it is important to identify what **type** of technology development activity is the subject of study. In general, the type of activity in developing nations concerns the transfer and localisation of technology. Hence, the co-evolution of Technology and Society is different, as Society is less influential in shaping the Technology. The scope

of innovation is smaller, mainly characterised by local feedback loops to adapt the technology to the local context and make it work properly. At least, that is how things start.
Another consequence is that the role of users (e.g. users of the GSM technology are network operators, service providers, and mobile phone users) is prominent – that's where the socio-technical innovation occurs. The interest in users has not been very strong in most of the earlier SCOT, or even STS, case studies.[81] What 'users' are is not simply given, however. The brief list for GSM technology indicates the variety. For many other technologies in developing countries the complexity is even greater because there are also sponsors (customers of the technology can often not pay for the technology) and intermediaries, in particular NGOs. GSM is a relatively simple technology in terms of co-evolution!
The dependency relation with Western Technology suppliers has been noted and commented on extensively in the literature. Actors in a developing country take different positions, and may actually embrace relations with Western technology providers. The "technologue" Habibie would be an example. In the uptake of Internet in Indonesia one sees also how actors embrace new technology, but in most cases from the bottom-up, with a strong bricolage element. This possibility has to do with the presence of a strong cadre of Indonesian engineers – an important issue for any developing country, and not always discussed in SCOT-type studies, possibly because of the focus on specific cases.[82]

These considerations show that it is important to take issues into account that are studied by political economy and political sociology, and by modern cultural anthropology. In order to do justice to the awareness of limitations of the SCOT approach by people of the overall project (see general introduction, pg. 9), Social COT became Societal CoT This represents a broader approach than SCOT, including societal actors, cultural aspects, and political actors. The analysis of GSM technology in Indonesia followed this approach, but could not cover all relevant aspects. One example of Societal COT is the importance of "back office" dealings in Indonesian society, where technology is both victim and ally (also sometimes an ally for those who have no access to the back offices, because it offers an alternative source of power).
The contribution from cultural anthropology is partly incorporated in Social COT already, but also deserves attention in its own right. The general merit of SCOT is that is it designed as a framework that requires a certain level of 'going-local', derived from the idea that this leads to more profound knowledge and understanding of technology development and social processes. In a way, SCOT can be the anthropology of technological development (for further arguments see Latour "De Berlijnse sleutel").
The addition of a cultural anthropological perspective, which introduces a broad and profound understanding of a people/nation, will add to the explanatory strength of SCOT. Theoretically, this perspective adds a cultural-symbolic dimension on customs, values, and general interaction patterns. And also large, 'abstract' issues such as poverty, political turmoil, instability, freedom, modernisation, democratisation, empowerment.[83] Issues that capture the situation of developing nations in contrast to developed nations.
In the end, the process of co-evolution of technology and society is better explained with the Societal COT approach because it takes more dimensions into consideration, leading to a deeper understanding of the process and its outcome.

In sum, there are substantial differences between conducting technology development research in a developed or development context that need to addressed. The Social Construction of Technology approach is a beginning, but requires adjustments as suggested above. The new label Societal COT only partially covers the adjustments, however it offers a promising starting point because it takes into account the fundamental differences between the developed and the developing world

[81] A few welcome exceptions are case studies by Cowan, Sørensen, and Cockburn & Ormrod. Recently, there are many attempts to include the topic of users in the studies, and publications focusing on the role of users are coming out.
[82] Disco, *Made in Delft*, discusses the engineering profession also in relation to case studies of reinforced concrete and the Dutch-East Indies radio connection.
[83] The case study of the Norwegian motorcar by Sørensen provides an example of identifying the importance of this dimension and working it out convincingly.

7.3 Normative reflection on the possibility of change

Society is shaped by Technology, and Technology is shaped by Society, hence there is co-evolution, but it can be categorically different depending on the context. The question is how one can evaluate the mutual shaping: some patterns of mutual shaping might be better than others. And linked to this is the question how fixed, or at least insensitive, the co-evolution process is to attempts by individuals to influence it. The overwhelming impression is that influence is possible, but much easier along the gradient of modernism and centralised control, than along other, alternative gradients.
It will be clear that this raises normative questions. For the purpose of this thesis, the specific question is what the role of SCOT can be and what it should be. Bijker's later publications are important here, because he emphasises that SCOT case studies and background theory are an 'academic detour', and should feed into the discussion of larger, normative issues.

The arrival of foreign technologies in Indonesia is a rather undemocratic process which limits the opportunity for change by Indonesian actors. Given our interest in the normative side of technology, Bijker's analysis of Technological Culture and his suggestions for democratisation is relevant.
In his inaugural speech[84], Wiebe Bijker introduces the Democratisation of the Technological Culture, of which he sketches four elements. These four elements are, the non-existence of privileged groups, two kinds of power, two kinds of hardness of Technology, and the idea of a strong democracy.[85]
Firstly, a symmetrical approach to relevant social groups entails that there is no category of privileged groups. However there are power differences, namely a semiotic power structure in which technical artifacts are elements fix meanings. This fixation creates possibilities and also constraints, leading to the sensation of technological determinism dictated by fixed meanings. Actors with different levels of inclusion, determined by the level of guidance of their actions by a technical frame, can influence the attribution of meaning to an artifact. The more stable this technical frame becomes, the more power it will exert and the 'harder' the artifact will be. To a person a technology can manifest itself in two kinds of hardness, stubborn or confining. The kind of hardness depends on the level of inclusion of an actors. An actor with a low inclusion is faced with a stubborn Technology, and can choose to either accept or to reject the Technology. An actor with high inclusion does not consider rejection, he is confined by the technical frame and will attempt to shape its meaning to his preferences. Finally, Bijker's idea of a strong democracy calls for participation, high(er) inclusion, with the technical frame. Through public participation in Technology development, Bijker arrives at the Democratisation of the Technological Culture.
These thoughts offer an interesting starting point to reflect on the normative aspects of mobile telephony for Indonesians and Indonesian culture.

Looking at GSM in Indonesia through the perspective of Bijker a few interesting points stand out. Since GSM is mainly developed in Europe, Indonesia and Indonesians have the choice to accept or reject.[86] There is little room for inclusion, or participation, of Indonesians in the design of GSM. To Indonesians GSM appears as a hard Technology. A Western configurational technology will often appear as generic in the context of developing nations because it is already fixed and black boxed. Apart from some minor innovations, GSM basically remains the Technology as designed in Europe. But there is an example of a modern network Technology that is softer: Internet, in particular the existence of Internet cafes is an indicator of this softness – at least at the side of services and their organisation.[87]
While Indonesians do not fundamentally shape Technology, GSM Technology does have an impact on Indonesian Society. All in all, the co-evolution is out of balance and reflects a rather **undemocratic** process of localisation and shaping. Indonesians associate mobile phoning with freedom of communication, with modernisation and progress, and with wealth – that is their technological[88] frame.[89] Cultural anthropology can contribute here, and normative reflections have

[84] Democratisering van de Technologische Cultuur (1995).
[85] Ibid, pg 18 to 23.
[86] Here, Bijker's technical frame seems less applicable because the Technology is not developed in the context of a developing nation, but rather transferred and localised.
[87] Paper by Merlyna Lim (forthcoming).
[88] By now the term socio-technical frame is perhaps more appropriate than technical frame, however in this final and reflective chapter I will not introduce a new term, and so continue with technical frame.

become important in this domain already (e.g. post-colonialism). GSM, and other Western technical artifacts, in all its modernity and high tech, is a harbinger of modernisation to developing nations, and potentially Westernisation. Potentially and realistically, unless there is an angle for inclusion of developing nations in the Technology development process.

One might argue instead that a mobile phone is a **neutral** artifact, or that at least by itself it is not sufficient to trigger Westernisation. Mobile phoning offers the same benefits to users all over the world. It offers means of coordination and enhancement of control , both for users at the top and at the 'bottom' of the power hierarchy. So in this sense, it appears as **non-discriminatory**. It does require effort to get it working as a system in each society. New alignments are necessary, and old alignments might be disrupted or become obsolete (cf. Abernathy and Clark on architectural innovation, but now applied at the macro-level). The normative point of calling a technology, here GSM, non-discriminatory is not that there is no discrimination in the co-evolution, but to indicate that the technology allows for other uses. So spaces are opened up.[90]

In the end, the important normative question is: "How much culture is incorporated in a technological artifact, and how fixed is it?". In the case of GSM in Indonesia, Indonesians, for the moment, seem to use the mobile phone in their own way, even though the technical artifact is largely similar to its initial Western design. The "own way" is visible in … and … .
Trying to estimate the overall effect of mobile phoning on the Indonesian society is premature, but one can start by looking at older network communication technologies. A basic pattern is visible. Radio and television have been used by Indonesian politicians to broadcast the idea of nationality. And later on, by censorship, to subject to country and the people to centralised control and a diluted form of military dictatorship. The point is that these two Western communication technologies, which heralded and actually brought modernisation, did not come with a fixed political system, economic system, nor a fixed cultural symbolism.
Communication technologies are instruments for communication of which the shape is (often) set by Western technology developers, but the content and purpose of use is undetermined. This has to do with their dual nature, as carriers of services, where the carriers are more or less fixed and the technology for the services is visibly further developed. As the case of GSM shows, the infrastructure is sometimes adapted to allow better rendering of services.
The cumulative effect of the appearance and uptake of all these foreign technologies may very well change the culture of a nation. Not necessarily Westernisation, even if elements of Westernisation may be strong.
The idea of co-evolution of technology and society, and its elaboration and operationalisation as Societal COT, emphasizes that the technologies-culture complex is not fixed, but evolving. This does not mean that actors can easily change things, however. To develop an analysis of openings for change is an important further step for Societal COT.

7.4 Practical reflection: the researcher in a foreign culture

Conducting research in a foreign culture is an extra challenge, or complication if you will. First, and all permeating, is the **language** barrier that needs to be crossed. No matter how globally spread English is, a basic knowledge of the local language is necessary in establishing trust and a more empathic relation with the people. This is especially important for developing countries, where a large part of the population does not speak English.
In the practical sense of conducting research, it means talking to people over the phone for setting up an interview, reading articles and newspaper clippings. The effort of learning the language shows interest and respect for the people and their culture. This in turn creates a favourable setting for a more trusting relation between interviewer and interviewee and the possibility of acquiring rich, valuable, and sensitive information.

[89] And within the culture, it is another symbol of the haves, versus the have-nots, or the rich and the poor, since most Indonesians cannot afford using a mobile phone.
[90] Similarly, the emphasis in (early) SCOT to show that there had been historical variety before there was closure into one "dominant design" and technological frame, had an emancipatory purpose: opening space for new variety.

Working with interviews and conversations is important in a culture where documentation is limited. In Indonesia, this is reinforced by the tradition of back-office dealings.

The general **competence** and mind set of the researcher are of vital importance for uncovering treasures of information that make up a realistic, insightful story of the case. A Western researcher is faced with new and additional challenges when conducting research in the context of a developing country. These include adapting to the local etiquettes in social interactions, developing a cultural sensitivity and competence. Foremost, these capacities are necessary for building a network of people to be interviewed, and to be able to interview people in a culturally fluent way.
Anthropologists know about the importance of informants and building up a local base. Building out one's contacts from a specific base does imply path dependency, and this may introduce limitations of the findings especially if the study is limited (in time and effort). In the present case-study, the link with ITB provided a strong local base which allowed access to actors in the ICT world and also in companies and government departments. It did also create a certain identification of the project with ITB and its role in Indonesian society. There is probably little bias in the findings because of this effect, because the emphasis has been on reconstruction of the Localisation of GSM. It does show the additional difficulty of conducting research in a country which has no tradition of independent research for academic purposes. A researcher will always be viewed as linked to one or another group or interest.

Another important issue is the structure of the **interviews** and the research questions. A state of openness to unexpected information, allowing oneself to submerge in the locality, translates in open, unstructured interviews in the beginning of the research. This allows the interviewee to unfold and reveal his personal, original view on the subject. After identifying important actors, issues, and events, the interviews can be more structured to further enrich the information gathered until then and to check the validity of the earlier interview data.

In closing, technology development and conducting research in the context of a developing nation is very different from common Western styles of technology development and research. The type of technology development, and co-evolution, is structurally different. It requires a different and new theoretical framework, as well as a new approach towards conducting research.
In a country like Indonesia the opportunity to influence technology development is very different compared to the country from which the technology originates. This situation of unbalanced co-evolution seems to be characteristic for a large number of transferred technologies. One way to tackle this unbalance is to place a Western technology in a strategic niche to allow the technology time to unravel and create room for the conscious localisation of the technology, before setting it loose in society at large.

This thesis has explored the idea of a configurational technology, which requires contextualisation to function properly, and the process of localisation, and has identified both as the right type and moment to create an opportunity for change. By identifying a variety of actors and factors that are involved in this process, change agents may become aware of opportune angles and moments to realise change. In the end, Indonesians may look forward to a truly localised artifact that functions well in their rural and urban jungles.[91]

[91] Photograph by Mette.

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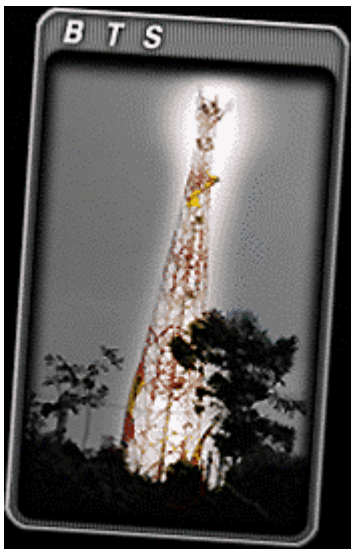
9 Appendices

9.1 Basic lay out of the GSM system

9.1.1 Network aspects of the GSM system

The GSM network consists of **several functional entities**. The Home Location Register which contains which contains the subscriber parameters and the location information for all mobile stations registered in the HLR. The location information is stored as a mobile statio roaming number which is an ISDN number required for routing a call to the MSC where the MS is located at the time of the call. Then there is the Visitor Location Register which contains information for all mobile stations currently located in the geographical controlled by the VLR. The VLR allocates the MS Roaming number. The dual registration of every MS in the HLR and VLR makes automatic roaming possible. The Mobile-services switching centre is the interface between the fixed network and the GSM network. In the GSM system several MSCs may share the same VLR, or may be fully integrated. This allows flexible network designs where the location of MSCs, VLRs, ad HLRs may be determined by national requirements.



The requirement of always dialing the same number is handled by translating the number to the MSRN in th HLR in order to provide the routing information required by the fixed network. In the VLR the RN is translated into th Internation Mobile Station Identity (ISMI) or the temporary mobile station identity (TMSI) for identification of the MS on the radio path.

Functions of the GSM system may be divided into four categories:

1. network functions required for basic service provision (call handling, subscriber authentication, emergency call)
2. network functions required fo cellular operations (location registration and handover)
3. additional network functions for call handling (queuing, off-air-call-set-up, security related services)
4. operation and maintenance oriented network functions

9.1.2 Software

Intelligent Network is a general term which is used for a computer system that operates when a person makes a call. A pre-paid system is a good example of a IN, when the call is being made the computer deducts the costs for the time on line from the existing pre-paid amount. Another example is when a set limit is reached the computer calls the person and informs that person that the pre-paid saldo is running low. With Satelindo a client can call a specific number, for free, and receive information concerning the saldo on the prepaid card and until when the card is still valid.
Another part of the software system of a GSM network is the voucher management system, a voucher is the card, actually a code, which increases the saldo on the pre-paid card.
The SIM cards which are inserted into the GSM phone, also need to be produced and the data of the SIM cards has to be input into the software.
Billing system is the system that analyses all call records, adds them up and produces a bill. The billing system consists of hardware and software. It is very complicated because the information comes from various sources, from the fixed telephone network, international roaming, SMS, and pager.
Voice-response systeem
Customer service is a more general software application consisting of a database which keeps track of the contact customer service people had with a client, complaint, credit history, etc.

9.1.3 Technical information : Radio wave characteristics

When the radio frequency is higher, the propagation is better (reaching inside buildings for example), the coverage area is smaller, and the active time of the phone battery is longer. With NMT 450 the coverage area, and thus distance between antennas, is 30 kilometers. With GSM 800 this is reduced to 5 kilometers, and with the 1800 band up to 1 kilometer.

9.1.4 Technical Information : Frequency modulation

a. FDMA

Frequency Division Multiple Access, with this modulation algorythm, the frequency range is divided into different channels. A certain frequency width will be channel dedicated, and available continuously. Due to the division, the frequency width will be small.

b. TDMA

Time Division Multiple Access, with this modulation algorythm time is divided into to slots, and every time slot is dedicated to a channel. The whole frequency range is available, but for a limited amount of time. For example, when eight channels are assigned, each will have a few milliseconds before the next channel, and after seven other users, the frequency will be available again. It looks like packet switching, sending small packages over a network, which are deconstructed at the senders end, and constructed at the receivers end. Amps is based on TDMA technique.

c. CDMA

Coded Digital Multiple Access, is an modulation algorythm with a random signal allocation. Because the signals are mixed there is little change of, without requiring a SIM card, like GSM. CDMA was invented by Qualcom and developed by Motorola, AT&T, Northern Telecom Canada, Nokia and Lucky Goldstar.

This method increases network capacity by ten times compared to AMPS. CDMA provides better service quality through reducing busy signal, cross conversation, unsuccessful call, and better voice quality. CDMA can also use mobile or cellular satellites. A dual function would make it possible for the mobile phone to link up to the AMPS system and directly with a satellite.

D-AMPS uses CDMA, and AMPS is adaptable for improvement to the CDMA based standard. For this operation modules have to be added and new software, and subscribers have to change their handsets.

9.2 Competing mobile phone systems

9.2.1 Inmarsat

Inmarsat, International Maritime Satellite, is a digital satellite system system. It is used to operate the nationwide STBS-N network. Because it uses satellite remote areas, like seas and backland forests, are covered. Due to the high prize for telephones and of telephone rates, the use is limited to special companies like oil, mining, shipping, or plantation. The Inmarsat system was first used in Europe in November 1993. The system is supported by four satellites which orbit above four different oceanic regions.

9.2.2 Aces

Aces, Asia Cellular Satellite Communication, is a sophisticated satellite mobile telephone network which will be operated by a consortium of three telecom companies, PT Pasifik Nusantara of Indonesia, Philippine Long Distance Telephone Company, and Jasmine International Overseas Company Ltd of Thailand. The five main components are the Garuda Satellite, Satellite Control facility (SCF), Network Control center (NCC), Access Gateway, and subscriber terminal. Other consortiums offering services using geostationary satellites are ASC (Afro-Asian) and AMT (Asian Mobile Telecom.). The estimated investment for the Aces project is US$ 700 million.

9.2.3 Intacts

INTACTS, Inti-Telkom Advanced Cordless Telecommunication System, is the initiative of PT INTI in low speed cellular systems. INTI cooperates with Telkom and Japan Radio Company. Intacts system has a cell coverage of 200 meters, is low in battery consumption, and suitable for low speed mobility. Is has been developed to use in densely populated areas. The network consists of 3 main subsystems, namely cordless exchange, handset, and radio terminal.

9.2.4 NMT-450i

Another plan is the upgrade of NMT-450 to 450i. The advantage is that the i-version is more suitable for high speed (cars) and the voice transmitted is clearer. The NMT system has three times the coverage of GSM. In 1997 Mobisel will start transmission with 80 to 100 RBS units from Lampung to Lombok and increasing its radio microwave to enlarge its coverage.

9.2.5 D-AMPS

Operators are now taking steps to upgrade from AMPS to D-AMPS, this digital version uses CDMA technology. An operator which has been ready for this is Komselindo, and intends to start operations in October 1997. Construction of the CDMA network will be undertaken by Lucent Technologies. This project will cost US$ 150 million, including seven switching units with a total capacity of 165.000 lu. The units will be placed in Jakarta (2), Bandung, Padang, Ujungpadang, and Mandano. Komselindo has an AMPS network operating in West-Java, North Sumatera, and Sulawesi. Presently 70.000 subscribers (mar. 1996). Their plan is to transfer the AMPS equipment to rural areas and concentrate D-Amps in the Jakarta area.

9.2.6 PCN

Personal Communication Network is a further development of the GSM technology. It uses high frequency, 1,900 Ghz, has a coverage area of 1 km, and better voice quality than GSM. PCN is sensistive to blank spots in its antenna network. The coverage of a cell is smaller than GSM, this can be benificial in areas of high subscriber density. Investement for PCN is twice that of GSM due to the shorter coverage. PCN is suited for low speed mobility, maximum 25 km/hr. Local dialing is much cheaper, but over 100 km celular is cheaper. The price of a PCN/PHS handset is about a third of a cellular phone. Battery life of 200 hrs compared to the standard 30 hrs of the cellular handphone.
PCN consists of various types such as DCS-1800 and PCS-1900 (Europe), and PHS (Japan). DCS-1800 system will be operated by Cellnet Nusantara, while PCS-1900 will be operated by Primasel.

A PCN trial project is under construction. Telkom will start a joint operation, or, as hinted by the government, a consortium will undertake PCN. This system would serve as a supplement to the existing systems. PCN can be used for pedestrians or in times of traffic jams. The PCN system is currently on trial run in Jakarta and Surabaya. In Jakarta the governement appointed Cellnet Nusantara consortium (Sudwikatmono and Mamiek Suharto) in cooperation with a Business Unit of Pebabri and Telkom. The Surabaya network is operated by Northern Telecom in cooperation with Yamabri and Telkom. PT INTI has been able to produce PHS [or type-o, should be PCN?] handsets, in cooperation with Japan Radio Company. Many investors have indicated interest in operating the PCN system. A tender will be opened by MTPT in 1997. Multinationals, like Motorola, Ericsson, Siemens, and Nokia, are also interested in developing PCN equipment. After the trial project was succesful the government approved PCN in June 1997.

9.3 Witels - Telecom regions

I. DI Aceh, North Sumatera
II. West Sumatera, Riau
III. South Sumatera, Lampung, Jambi, Bengkulu
IV. DKI Jakarta
V. West Java
VI. Central Java, DI Yogyakarta
VII. East Java
VIII. Bali, West Nusa Tenggara, East Nusa Tenggara
IX. Kalimantan
X. Sulawesi
XI. Irian Jaya

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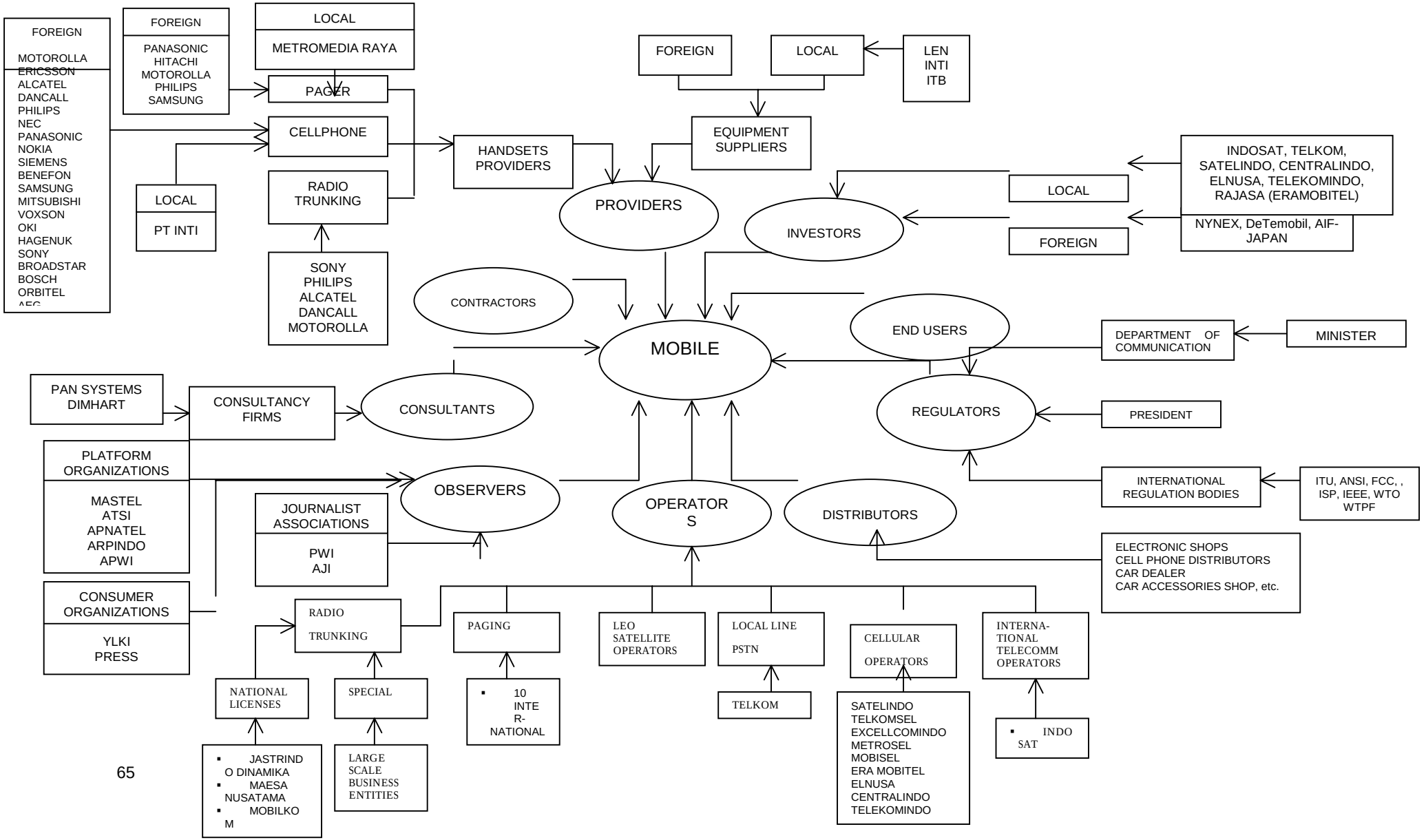
9.4 ACTORS SHAPING THE MOBILE REGIME



9.5 ACTORS' INFLUENCE ON THE FORMULATION OF TELECOMMUNICATIONS LAWS AND REGULATIONS