STELACON

The telecommunications market in Sweden

1997

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A survey of the competition situation and the development of the Swedish telecommunications market for 1997

This report was commissioned by
The National Post and Telecom Agency

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SUMMARY

For the fourth consecutive year, the National Post & Telecom Agency has commissioned an external company to carry out a market analysis of the development and competition situation on the Swedish telecommunications market. The brief is to describe the year 1997, developments during the years 1994-1997, and an analysis by Stelacon of a number of trends that will include the sector in the years ahead. This is the second year AB Stelacon has conducted this analysis.

The extent to which competition in the telecoms market has developed during 1997 has been more or less the same as in 1996. What we mean by this is that the number of active players is the same as in previous years, the technology used is broadly the same as in 1996, and the number of new services launched has been limited. As in 1996, competition during 1997 was greatest in the mobile telephony, international call, long-distance call and Internet segments.

During 1997 there were in Sweden about 40 companies operating fixed and mobile telephony services. The value of this market grew over the year by about 10%, ie from SEK 29 billion to SEK 32 billion. It is worth noting that the percentage growth in fixed telephony services was almost on a par with the growth of the market for mobile telephony services, with growth rates of 9% and 13% respectively. A significant portion of the increase in fixed telephony services is a direct result of a sharp increase in calls from the fixed network to the mobile network. Telia's increases in the call connection charge are one reason for the increase; another is that the growing Internet traffic is generating ever greater traffic volumes on the fixed network.

The value of fixed telephony services to the end-customer, excluding the operator’s interconnection revenue, was just over SEK 23 billion during 1997. The largest segments are fixed charges, local calls and calls to mobiles. The areas where competition is keenest, long-distance calls and international calls, suffered from severe downward pressure on prices. For international calls, this has resulted in a drop in the value of the market. As for market shares in fixed telephony, Telia is the dominant player, with 92%. During 1997, Telia lost 2 percentage points. Tele2 is next in size, with 6% of the market. However, Tele2 has 22% of the market for international telephony and 14% of the market for long-distance calls. Competition in the local call market was largely non-existent during 1997. The result of the price changes implemented by Telia at the end of 1997 and in April 1998 is that there is now competition in this market as well. During 1998, both Tele2 and Telenordia began to offer competitive prices on local calls - both to businesses and homes.

During 1997, the market for mobile telephony services grew at about the same rate as in 1996. The increase is in the GSM market, which is taking over more and more from the NMT market. The major part of the increase in the number of subscribers comes from the residential market. Telia also dominates the mobile telephony services market, with a 66% market share. However, they are losing market share to their competitors Comviq and Europolitan. But if we consider only the GSM market, it can

be seen that Telia is increasing its market share relative to its competitors. The range of contracts and services on offer increased in 1997, for example the launching of new prepaid SIM cards, the development of unified messaging, etc. The emergence of prepaid SIM cards has led to an increase in the market for used telephones, and this has made it easier for mobile operators to reduce the subsidy proportion of their costs. There were no major changes in the prices of mobile telephony services over the year. In order to target their services at new groups of customers and to exploit their network resources more efficiently, mobile operators have run campaigns directed mainly at the residential market. This has to do with the fact that the load in the mobile networks is lower during evenings and weekends than during office hours.

Telia started using the new 1800 MHz frequency band at the end of the year. The other operators have built similar networks and are expected to start using it around the middle of 1998. This added frequency space means that they can increase customer numbers and develop new services. So far, however, the slow speed of the GSM network sets limitations to the development of services, and this is one of the reasons why data communication (with the Internet, for instance) has not yet made a breakthrough in this market

Telia is also the dominant player in the market for network capacity. The keenest competition on this market comes from Banverket, Teracom and STOKAB, who are offering black fibre and/or connections at over 2 Mbit/s. All players in this market segment own their own network infrastructure. Players who lease network capacity and repackage it as leased connections in multiples of 64 kbit/s, eg Tele2 and Telenordia, have found it much more difficult to compete with Telia. The main reason for this is their lack of access to their own network structure, combined with Telia’s relatively low prices for network capacity services. To become a proper alternative to Telia, these operators must have access to cost-effective network capacity. The present alternative networks do not amount to comprehensive complements, since they are lacking in bandwidth, geographical coverage or spread. However, there are future possibilities for the operators to make use of other technologies such as cable TV, satellite, electricity networks and radio-based local loops. Stelacon believes that local loops based on GSM will gain a large share of this market, for example for the direct connection of homes. Where cable TV and electricity supplies are used as local loops, IP technology will be used to a large extent.

With the developments taking place in new technology, convergence between markets such as fixed/mobile telephony, data communication and the introduction of such things as operator access codes and number portability, the near future will mean the development of new services and ever keener competition. Increased competition and greater freedom of choice mean that developments will be governed to a greater extent than hitherto by what the customers want. This is often overlooked in a market that has, over the years, focused more on technology than on the actual needs of customers.

CONTENTS Page

1. BACKGROUND 4

1.1 PURPOSE 4
1.2 APPROACH 4

2. INTRODUCTION 5

2.1 THE TELECOMMUNICATIONS MARKET 6

3. TELEPHONY SERVICES 10

3.1 DESCRIPTION OF THE COMPANIES 11
3.2 THE MARKET FOR FIXED TELEPHONY 14
3.3 ISDN 21
3.4 EFFECTS OF COMPETITION FOR TELEPHONY SERVICES 22
3.5 OTHER FIXED TELEPHONY 25
3.5.1 Call-back *25*
3.5.2 Telebrokers *26*
3.5.3 Private networks *27*
3.5.4 Virtual moves to the competition *28*
3.5.5 IP telephony and telephony over the Internet *28*

4. MOBILE TELEPHONY SERVICES 31

4.1 DESCRIPTIONS OF THE COMPANIES 31
4.2 DEVELOPMENT OF THE MARKET 33
4.2.1 Development during 1997 ..... *38*
4.3 PREPAID CARDS 39
4.4 GSM 1800 40
4.5 TYPES OF SUBSCRIPTION AND SERVICES 41
4.6 DEVELOPMENT OF PRICES 41
4.7 SUBSIDIES 42
4.8 MOBILE TELEPHONE NETWORKS AND COVERAGE 43
4.9 THE MARKET PLAYERS 43
4.10 THE FUTURE DEVELOPMENT OF MOBILE TELEPHONY SERVICES 44
4.10.1 The mobile and the fixed telecoms network *45*

5. NETWORK CAPACITY 48

5.1 DESCRIPTIONS OF THE COMPANIES 49
5.2 SERVICES OFFERED 52
5.3 MARKET SHARES 54
5.4 MARKET CONDITIONS 55
5.5 THE NEED FOR AN ALTERNATIVE NETWORK INFRASTRUCTURE 56
5.6 NEW ALTERNATIVE LOCAL LOOPS 58

6. FACTORS AFFECTING COMPETITION 63

6.1 INTERCONNECTION CHARGES 64

6.2 PRESELECTION 65
6.3 LOCAL LOOPS 66
6.4 NUMBER PORTABILITY 67
7. TRENDS ON THE TELECOMMUNICATIONS MARKET 68

Appendices 1 and 2

1. BACKGROUND

The National Post & Telecom Agency (Post & Telestyrelsen, PTS) commissioned a market analysis with a view to obtaining an impartial picture of the way the Swedish telecommunications market is developing and of the of the competition situation in that market. PTS commissioned AB Stelacon to carry out this analysis of the telecommunications market in Sweden.

Stelacon's brief covers:

1. telephony services
2. mobile telephony services
3. network capacity
4. other activity that requires a licence or that must be notified
5. changes in the telecommunications legislation and their effects
6. trends on the telecoms market

1.1 Purpose

The purpose of the study is to describe the competition situation and the way the Swedish telecommunications market is developing. The main object of the analysis is to describe the market for 1997, but it also reports on how the market has developed from (and including) 1994 up to the end of 1997, distributed over the areas mentioned above. A further purpose of the report is to consider to some extent how the telecommunications market in Sweden is likely to develop over the next two or three years.

1.2 Approach

Most of the material held by PTS is not publicly available. This means that this study is based on other material.

The study is based on:

- about 40 face-to-face interviews and about 10 telephone interviews with decision-makers in companies/organisations associated with the Swedish telecommunications market (see Appendix 1).
- information from market studies carried out by AB Stelacon on its own account
- other secondary information.

PTS has also had market analyses of this kind done for 1994, 1995 and 1996. Those analyses were carried out by:PA Consulting Group; "Marknads- och konkurrensanalys

av den svenska telekommunikationsmarknaden", (Marketing and competition analysis of the Swedish telecommunications market), 1994
- Bohlin & Strömberg; "Utvecklingen av den svenska marknaden för telekommunikation", (Development of the Swedish telecommunications market), 1995
- AB Stelacon; "Marknaden för telekommunikation i Sverige", (The telecommunications market in Sweden), 1996

It is a principle of this analysis that comparison with the above reports should be possible. In certain areas the definitions differ from the earlier reports. These deviations have been commented on and the definitions used are described. The reason for using a different definition is also explained.

The terminology used conforms to the definitions of the telecommunications legislation. However, we wish to draw the reader's attention to certain terms used in the report. When the terms "new telecoms operators" or "alternative telecoms operators" are used, we are referring to all telecoms operators except Telia. In the section on network capacity we have chosen to use the term network providers for players who offer network capacity based on their own network infrastructure.

All price information is exclusive of VAT. The values used by Stelacon in the report are set out in Appendix 2.

Stelacon is responsible for the numerical data and for the conclusions drawn in the report.

The study was carried out between 23 February 1998 and 4 May 1998.

2. INTRODUCTION

The report focuses on those services for the operation of which a licence is required under the Telecommunications Act.

According to the Telecommunications Act (1993:597), a licence from PTS (Post & Telestyrelsen, The National Post & Telecom Agency) is required for the provision of certain types of telecoms services. This applies on condition that the scope of the activity in terms of area covered, number of users or other comparable factors is significant for the functioning of telecommunications in Sweden, and that the service is offered in a public telecommunications network.

The services for which a licence is currently required are:

- telephony service to a fixed point of connection to the network
- mobile telecommunication services

- network capacity

Rules governing the obligation to notify were added to the licensing requirements of the Telecommunications Act on 1 July 1997. This duty means that PTS must be notified before services may be provided on a public telecommunications network. The obligation to notify exists regardless of the extent of the activity, but no prior special scrutiny of the activity is required. Compliance with the requirements of the Telecommunications Act is ensured by virtue of monitoring by PTS. The reason for introducing the obligation to notify was to make it easier to establish and conduct telecommunications activity. The obligation to notify is only intended to cover those areas of activity that are needed for fulfilment of the telecommunications policy goals[1].

Services currently subject to the obligation to notify are:

- telephony service to a fixed network connection point
- mobile telecommunications services
- any other telecommunications service that requires allocation of capacity from the telephony numbering plan
- network capacity

As far as the areas covered by this report are concerned, there are 17 different licensed telecommunications operators[2]. We have not included those companies that have licences for paging (ERMES) and terrestrial flight telecommunication system (TFTS), which are outside the scope of the brief. In addition to the licence-holders there were 33 companies notified to PTS in January 1998. It is interesting to note that the number of companies notified to PTS had increased to 54 by the end of April 1998. The notifications were distributed as follows:

January 1998	**April 1998**
Telephony service - 9 companies	Telephony service - 15 companies
Network capacity - 24 companies	Network capacity - 39 companies
Other telecoms service - 6 companies	Other telecoms service - 10 companies
Mobile telecoms service - 5 companies	Mobile telecoms service - 7 companies

As this table shows, the greatest increase is in the area of network capacity. About half of these 39 companies are energy companies owned privately or by local authorities.

2.1 The telecommunications market

[1] 2§ of the Telecommunications Act; "That individuals and official bodies shall have access to efficient telecommunications at the lowest possible cost to society"

[2] This number is exceeded if licensed companies or notified companies in each area are added together. This is because the same company may hold a licence, or be notified, for activity in more than one area.

As a starting point for its assessment of the way the telecommunications sector has developed, Stelacon has limited itself to activity relating to fixed and mobile telephony services in Sweden. We have excluded network capacity from the assessment, but that area is dealt with later in the report. When putting a value on the sales of the telecommunications sector, Stelacon has tried to give the clearest and the fairest picture possible. We chose to take as a basis the activity offered to the final customer, and only the part that relates to the companies' external revenue; revenue within the group is not included. The stated revenue includes only the portion that relates to telephony services; revenue from other activities is not included. Telecommunications operators' revenue from interconnection charges to other providers are not included. In these respects, this valuation of the telecommunications sector differs from the three earlier reports.

The values below include companies licensed to conduct telecommunications activity, those who are notified and companies with closely-related activity that is not subject to the obligation to notify. During 1997 there were about 40 companies operating in this market. Of these, 15 companies had licences from PTS to supply fixed or mobile telecommunications services, 13 companies had notified PTS that they were conducting activity in the field. In addition to this there are a few companies operating in this areas which are not covered by the obligation to notify, such as call-back companies, telebrokers without their own switch, and so on. The reason why these companies are not required to notify PTS of their activities is that they do not provide telephony services in a public network.

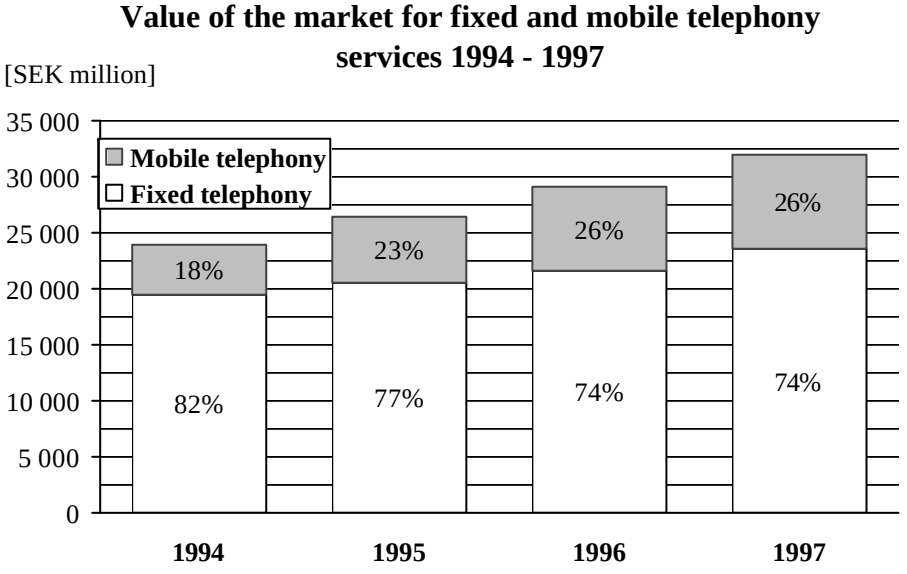


Figure 1: : *The value of the market for fixed and mobile telephony services for the years 1994 - 1997. The value relates to revenue from the final customer; it does not include intra-group revenue and any interconnection charges.*

During 1994, fixed and mobile telephony services together turned over SEK 23.9 billion, which had increased to SEK 32.0 billion during 1997, an increase of 34 percentage points. Over this four-year period the market has increased at a constant

rate of about 10% per year. Even though the market for mobile telephony services is increasing more, relative to the fixed services, there is remarkably little difference between the two areas, especially during the most recent year, when the market for fixed telephony services grew by 9% and for mobile services by 13%. However, a significant part of the increase in fixed telephony services is a direct effect of the fact that more calls are going from the fixed network to the mobile network. In addition, the growing Internet traffic means higher and higher revenues for fixed telephony services.

As for mobile telecommunications services, the part that does not relate to mobile telephony services, such as paging, terrestrial flight telecommunication system (TFTS) and so on, has been excluded. These areas account for a relatively small proportion of mobile telecommunications services. For 1997, Stelacon estimates this value to be about SEK 300 million.

Value of the market for fixed and mobile telephony services broken down by operator, 1994 - 1997

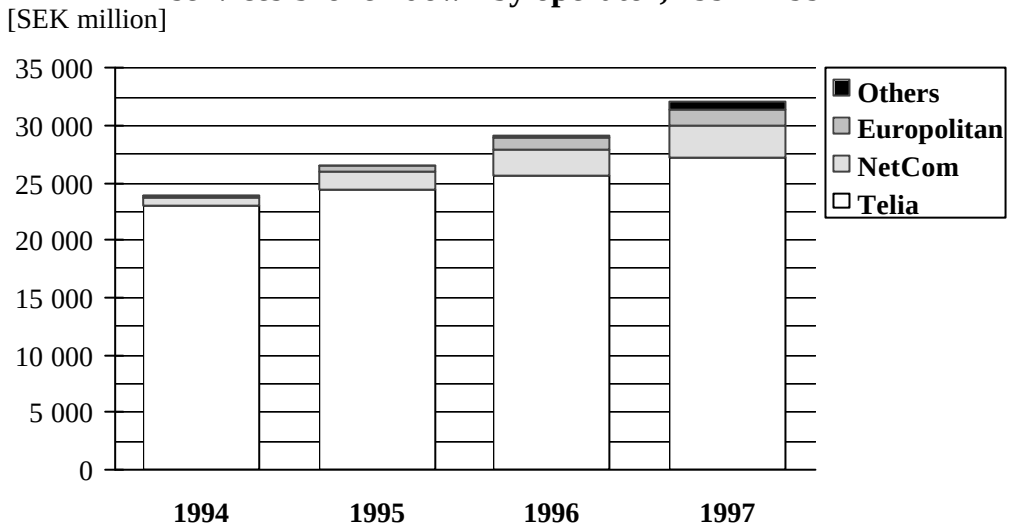


Figure 2: *The value of the market for fixed and mobile telephony services, broken down by telecommunications operator, for the years 1994 - 1997. The value relates to revenue from the final customer; it does not include intra-group revenue and any interconnection charges.*

The market is dominated by Telia, whose revenues from fixed and mobile telephony services amounted to just over SEK 27 billion during 1997, compared with about SEK 23 billion in 1994. In addition to Telia there are two major players, NetCom Systems AB and Europolitan AB; these companies' sales for 1997 were about SEK 2.8 billion and about SEK 1.5 billion, as shown above. As far as Europolitan AB is concerned, when calculating these figures we only included revenue attributable to Europolitan AB, not the portion relating to Europolitan Stores AB. NetCom Systems AB was the parent company of both Tele2 and Comviq GSM AB during the period covered by analysis, which is why we chose to present the revenues of the two subsidiary companies under the name NetCom Systems AB in the diagram above. At the turn of the year 1997/98, Comviq's activity was integrated with Tele2's and now

comes under the subsidiary company Tele2 AB. However, in the section headed “fixed telephony services” we have chosen to describe NetCom System’s activity under the name Tele2 and in the section headed “mobile telephony services” under the name Comviq.

Table 1: *Market shares for fixed and mobile telephony services, 1994 - 1997.*

Market shares	**1994**	**1995**	**1996**	**1997**
Value of the telephony market (SEK billion)	23.9	26.5	29.0	32.0
Telia AB	96%	92%	88%	85%
NetCom Systems AB	3%	6%	8%	9%
Europolitan AB	1%	2%	3%	4%
Others	0%	0%	1%	2%

One aspect of the development of market shares is that Telia is losing share to its competitors. From a market share of 96% in 1994, Telia had 85% of the market for fixed and mobile telephony services in 1997. Other players have together increased their shares from 4% to 15% during the same period. As we mentioned earlier, NetCom Systems AB and Europolitan are dominant among these players. Other companies’ market share was only 2% in 1997, and their share was more or less negligible in 1994.

The sections below will consider each area, ie fixed telephony services, mobile telephony services and network capacity. To begin with we can state that no major changes took place in the Swedish telecommunications market during 1997 compared with 1996. The number of active telecommunications operators has not increased significantly, the technology used is the same as that used in previous years, and few new services have been launched. In the main, competition has been limited to the following areas:

- mobile telephony
- international telephony
- national long-distance calls
- the Internet

3. TELEPHONY SERVICES

I January 1998, there were 13 telecommunications operators licensed by PTS to supply telephony service. Since 1996 the number of licensees has fallen by one, the company Enator Networks, which is no longer operating in this area. In addition to these 13 licensed operators there are a further 9 companies who have notified PTS that they are doing business in the area. The 22 companies have established themselves on the market to a varying degree, which leads to the way they are grouped below. The grouping is based on their sales of telephony services.

Companies with a 1997 turnover of at least SEK 1 billion for telephony services.

- Telia AB
- Tele2 AB

Companies with a turnover of at least SEK 50-200 million for telephony services in 1997

- Telenordia AB
- Global One Services AB
- Telecom Finland AB
- MFS Communications AB (MFS WorldCom AB)
- RSLCOM Sweden AB
- NetSource AB (telebroker; not required to be licensed or to notify PTS)

Companies with a turnover of less than SEK 50 million for telephony services in 1997

- NETnet International S.A.
- Nordiska Tele8 AB
- Tele 1 Europe AB
- TeliTel AB
- CallMedia Telecom CMT AB
- Singapore Telecom Int. Sv. AB
- Viatel Sweden Inc
- Linenet Oy
- Oy Finnet International Ab
- NetSystem International AS
- T.M.I. Sweden
- Europolitan AB
- Long Distance International Ltd
- GLOCALNET AB
- Utfors Datakommunikation AB

Of the unlicensed companies who offer public telephony services, only telebroker NetSource has sales of more than SEK 50 million. Some local-authority-owned companies also offer telephony services to nearby concerns such as the county council, but this activity is on a very small scale and need not be notified.

3.1 Description of the companies

Telia: Telia is still the market-leading telecommunications operator in Sweden and is likely to remain so for the foreseeable future. Apart from the fact that Telia offers all kinds of telecommunications services to all companies and homes, they are also market leaders in data communication services and the Internet. Telia's aim is to hold on to the largest possible share of the market for telecommunications services in Sweden, and to extend its activity to new markets, for instance via Telia InfoMedia in the field of media and value-added services. Telia is also a market leader in cable TV, telephone directories, and the financing of telecoms solutions.

Tele2: Tele2 is currently Telia's biggest competitor in telephony services. Tele2 offers direct connection of businesses and indirect connection[3] of smaller businesses and homes. Together with Telia, Tele2 dominates the market for Internet services. Of the new telecommunications operators, Tele2 is the company that has invested most in leasing or purchasing its own network infrastructure; in the long term this may give them lower costs than telecommunications operators without their own network. Among the new telecommunications operators, Tele2 is the one that has positioned itself as the most credible alternative to Telia – for both companies and homes, in both urban and rural areas. However, Tele2's competitiveness is stronger in urban areas than elsewhere, and, like other operators, for reasons of profitability they prefer customers with the highest possible traffic volume, in other words businesses.

Telenordia: Telenordia is currently the third largest telecommunications operator in Sweden, after Telia and Tele2. Telenordia offers direct connection of businesses and indirect connection[4] of small businesses. From the beginning of 1998 they are also offering indirect connection of homes. Telenordia is also number three on the market for Internet services. Telenordia too is investing in leasing or purchasing its own network infrastructure but Tele2 must be seen as ahead of them in this field as well.

Global One: Initially, Global One concentrated on national and international data communications services, but in 1996 it branched out into telephony services. The primary target is the occasional large company, which is offered direct connection. Small businesses and homes are not a priority for Global One. Instead, network over-capacity is sold to businesses such as telebrokers who operate in this market. Global

[3] The service is accessed with the prefix 007
[4] The service is accessed with the prefix 0087

One focuses strongly on STATTEL[5], and this has resulted in advanced services in the Centrex field.

Telecom Finland: Among telecommunications operators in Sweden, Telecom Finland is the one that focuses most on data communication and on technologies that integrate speech and data, such as ATM[6]. Telecom Finland's primary target group is companies that need advanced solutions. They also offer Internet and telephony services, as well a telephony over the Internet. During 1997, Telecom Finland purchased Enator's national data communications network Komnet. Many of Sweden's local authorities are Komnet customers, so this deal increases Telecom Finland's competitiveness in this customer segment. During 1997, Telecom Finland also acquired 91% of Geddeholm Callcenter. On 15 May 1998, Telecom Finland changed its name to Sonera Sverige AB.

MFS WorldCom AB: WorldCom's business idea is based on having its own resources in the business centres of the world. Its activity has been significantly broadened by its merger with Internet operator UUNet long-distance operator MCI. In Sweden, WorldCom is a niche operator which aims primarily at communication-intensive companies, which are directly connected via the ring network that they lease from STOKAB. WorldCom sells any overcapacity it has to other operators and Internet service providers who service the market that WorldCom itself does not prioritise, in other words small businesses and homes, and rural areas.

RSLCOM: Like Global One and WorldCom, RSLCOM is an international company locally represented in Sweden. Because RSLCOM has extensive international resources of its own, they can offer competitive rates for international telephony. The main target group is medium-sized companies, but also homes that make large numbers of international calls. Indirect connection is offered via RSLCOM's own prefix[7]. RSLCOM also sells network overcapacity to firms such as telebrokers.

Local authorities: Only around twenty local authorities in Sweden state that they offer telecommunications services to external customers. Just over half of these municipalities have a fibre or radio link network of their own. This activity is very limited. The few customers who take telecommunications services from the local authorities are usually organisations operating in related areas, such as the county council. On the whole, local authority revenue from telephony services is negligible at present.

Other telecommunications operators: The other telecommunications operators in the market only have limited activity in telephony. Even so, they increased their activity during 1997, compared with 1996. These telecommunications operators are mainly niche operators and have limited their primary target group geographically, by

[5] Statens teledelegation (National Telecommunications Delegation). Stattel has been in charge of the procurement of telecommunications services etc by the Swedish government.
[6] Asynchronous Transfer Mode
[7] The service is accessed with the prefix 0085

company size, by communication needs and so on. Few of them offer services to the residential market. The majority of these telecommunications operators have concentrated on offering the lowest rates for international calls, but in Sweden, international telephony is a market with lower and lower margins. Most of these players have expanded their activity to the rest of the Nordic area. Examples of other telecommunications operators are Nordiska Tele8, Tele 1 Europe, CallMedia, TeliTel.

3.2 The market for fixed telephony

In 1997, the market for fixed telephony consisted of about 6 million subscriber lines, distributed as follows: 70% homes, 25% business and 5% second homes. In addition there were about 200 000 ISDN B-channels at businesses. The telephony market is made up of the fixed charges for the 6 million subscriber lines, plus the traffic revenue generated in the form of phone and fax calls and data communication with the Internet, for instance. In addition to these traditional telephony services there is revenue from various value-added services such as premium-rate calls, freephone services, calling line identification presentation (CLIP), voicemail and so on. When segmenting the market we have chosen to use Telia's definitions of local, regional and long-distance calls that were in force from 1994 until 7 November 1997.

In the field of telephony services, interconnection revenue accounts for a significant part of the revenue of telecommunications operators. Interconnection revenue is not revenue from final customers, ie it does not belong to the competitive market, and should therefore be excluded when calculating the size of the market. Stelacon has excluded interconnection revenue when calculating the market for telephony services. Stelacon estimates that the market for telephony services during 1997 amounted to about SEK 23.59 billion, broken down as shown below.

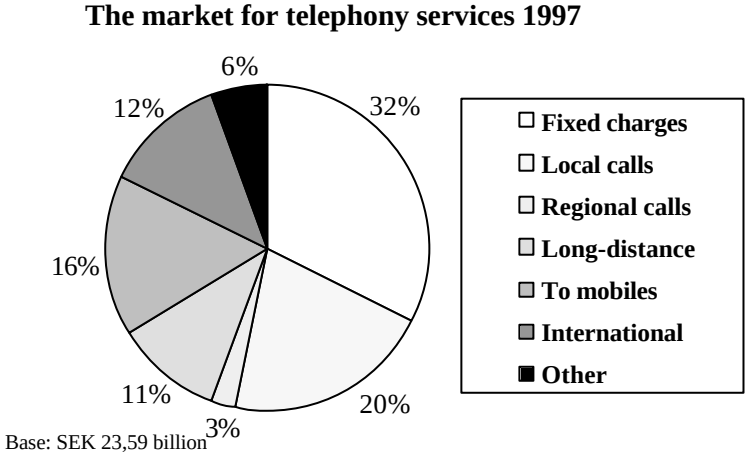


Figure 3: *The market for telephony services, 1997, in value terms, broken down by area. Any interconnection revenue to the telecommunications operators has been excluded.*

Since 1996, the market for telephony services in Sweden has increased by about 9%. The largest item during 1997 is fixed charges, followed by local calls and calls to mobile phones. Fixed charges include quarterly line rental charges as well as certain services such as calling line identification display (CLID) and voicemail (answering machine on the network), services that have grown rapidly during 1997. Stelacon estimates that 33% of the total sales for fixed telephony comes from companies with

PABXs, 2% from companies with ISDN-connected PABXs, whilst the rest, 65%, is accounted for by homes and by businesses without a PABX.

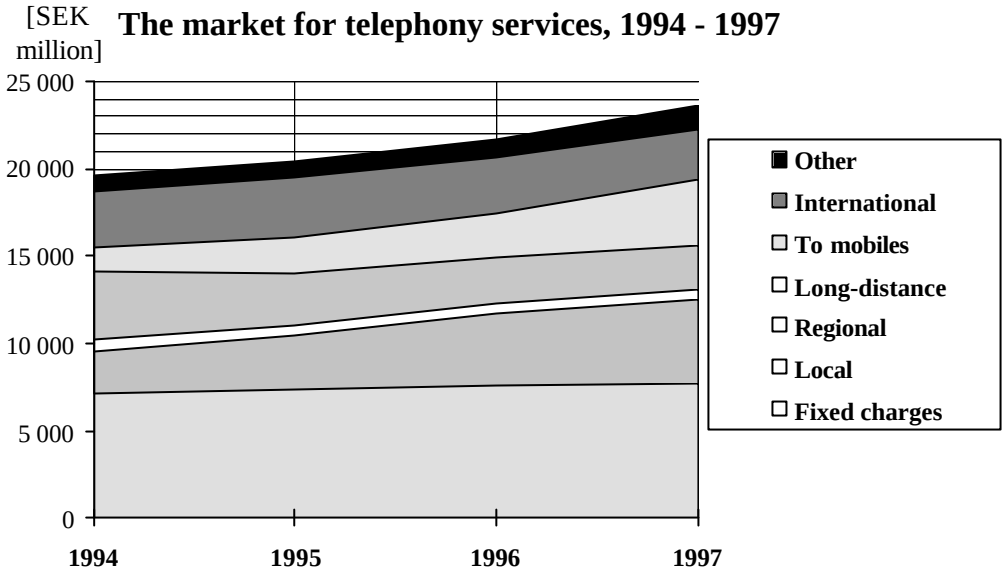


Figure 4: *The market for telephony services, 1994 – 1997, in value terms and broken down by area. Any interconnection revenue to the telecommunications operators has been excluded.*

During the period from 1994 to 1997 inclusive, the market for telephony services increased by 20%. The greatest increases were in local calls and calls to mobile phones. Local calls increased by SEK 2.424 billion (102%), as a result partly of price rises, and partly of increased volumes generated mainly by Internet accesses via modem. Since 1994, the market for calls to mobile phones has increased by SEK 2.348 billion (164%). The cost of calls to mobile phones has in principle been unchanged during the period, so that the increase is not a result of price rises but of growth in the number of mobile phones in Sweden.

The value of the market for international calls increased by 9% from 1994 to 1995, but has fallen every year since then. Increased traffic volumes in combination with moderate price reductions contributed to the increase during 1995. From then on, the sharp price reductions could not be compensated by increases in volume, and the market decreased by SEK 526 million compared with 1995. Long-distance call prices have been reduced every year since 1994 and since the volumes have not increased at a corresponding rate, the market has decreased since 1994 by SEK 1.398 billion (36%). Consequently we can conclude that the value of the types of traffic that have been the object of keen competition has fallen during this four-year period.

Even though the value of long-distance calls has fallen sharply, it has been possible to compensate for this by the increase in local calls, and since 1994 total traffic revenue from national calls – local, regional and long-distance – has increased by 14%.

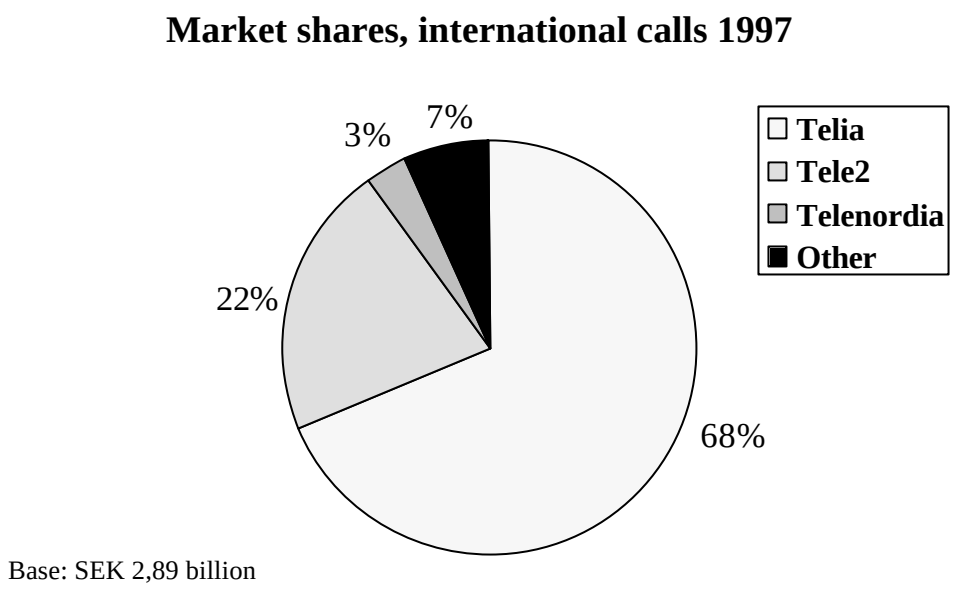
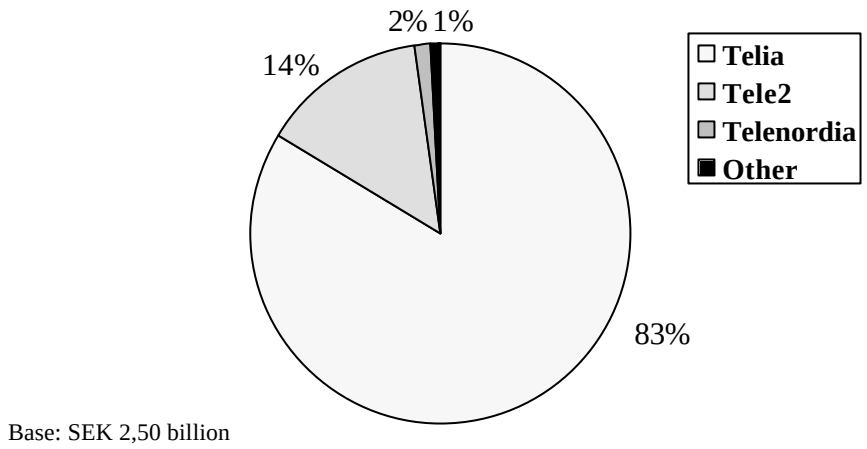


Figure 5: *Market shares for international calls from Sweden, 1997, in value terms. Any interconnection revenue to the telecommunications operators has been excluded.*

Stelacon estimates that the market for international calls, as shown in Figure 5, amounted to about SEK 2.89 billion in 1997. The segment is characterised by keen competition and intense price pressure, leading to a reduction of SEK 289 million (9%) since 1996. Compared with 1996 Telia's share fell from 73% to 68%. Tele2 retained its 22% share. Telenordia experienced the greatest increase during 1997, together with several minor telecommunications operators and telebrokers.

The market for international calls is the segment of the telecommunications market where the capital outlay for a company to get established is lowest, and the margins are still high enough to attract newcomers. Consequently we may expect continued increase in competition in this area. The introduction of preselection during 1999 will probably favour those telecommunications operators who offer a greater range of services than international calls alone. So a likely development would be an eventual weakening of the competitiveness of niche operators who offer only lower rates for international calls.

Market shares, long distance calls, 1997

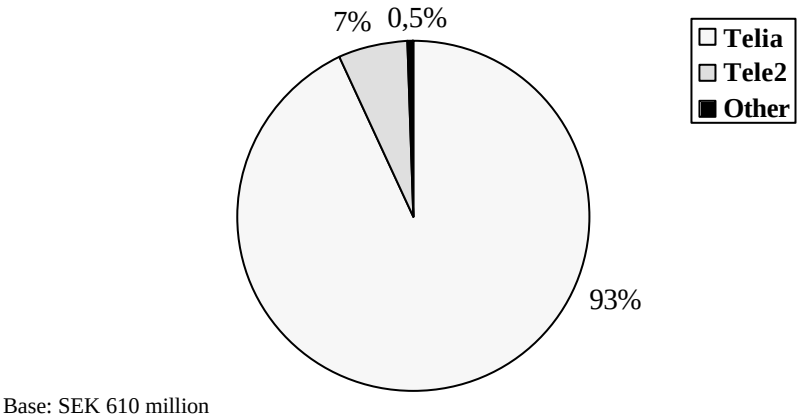


Base: SEK 2,50 billion

Figure 6: *Market shares for long-distance calls in Sweden, 1997, in value terms. Any interconnection revenue to the telecommunications operators has been excluded.*

Stelacon estimates that the market for long-distance calls, as shown in Figure 6, amounted to about SEK 2.50 billion in 1997. Compared with 1996, the value of this market has in principle been unchanged and Telia's share has fallen from 88% to 83%. During the same period, Tele2 and other telecommunications operators have increased from a total share of 12% to 17%. Even though several other telecommunications operators offer lower prices than Telia for long-distance calls, Telia still has a significantly higher market share for long-distance calls than for international calls. The main reason for this is that customers have to dial a prefix to call via an operator other than Telia. Naturally, customers "forget" to do this. In addition, fewer operators offer national telephony, so marketing is less intensive than in the international call market.

Market shares, regional calls, 1997

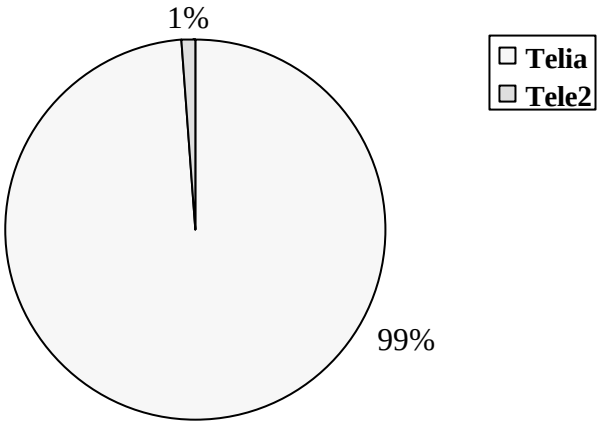


Base: SEK 610 million

Figure 7: *Market shares, regional calls in Sweden, 1997, in value terms. Any interconnection revenue to the telecommunications operators has been excluded.*

Stelacon estimates that the market for regional calls, as shown in Figure 7, amounted to about SEK 610 million in 1997. Compared with 1996, the value of this market was in principle unchanged, as was Telia's share at 98%. There is little real competition for regional calls. This is partly due to the prefix problem of the new telecommunications operators (see above). In addition, customers are not well informed about what calls are regional calls and what are local calls. This makes it difficult for customers to know for which calls it will be worth using an operator other than Telia. Regional calls account for only 3% of the market for telephony services, and Telia abolished the regional call category at the time of the price changes on 7 November 1997. They are now included in what Telia classes as "Sverigesamtal" (national long-distance calls).

Market shares, local calls, 1997



Base: SEK 4,81 billion

Figure 8: *Market shares for local calls in Sweden, 1997, in value terms. Any interconnection revenue to the telecommunications operators has been excluded.*

Stelacon estimates that the market for local calls, as shown in Figure 8, amounted to about SEK 4.81 billion in 1997. Competition in the area of local calls is largely non-existent, and the segment has increased by SEK 719 million (18%) since 1996. During 1997 too, it has been impossible in practice for the new telecommunications operators to compete with Telia's local call rates, except in the case of customers that the new telecommunications operators have connected directly to their networks. However, the local call price rises that Telia brought in during 1998 have given greater scope for competition. As a result, since the spring of 1998, both Tele2 and Telenordia have been offering competitive rates for all types of national call.

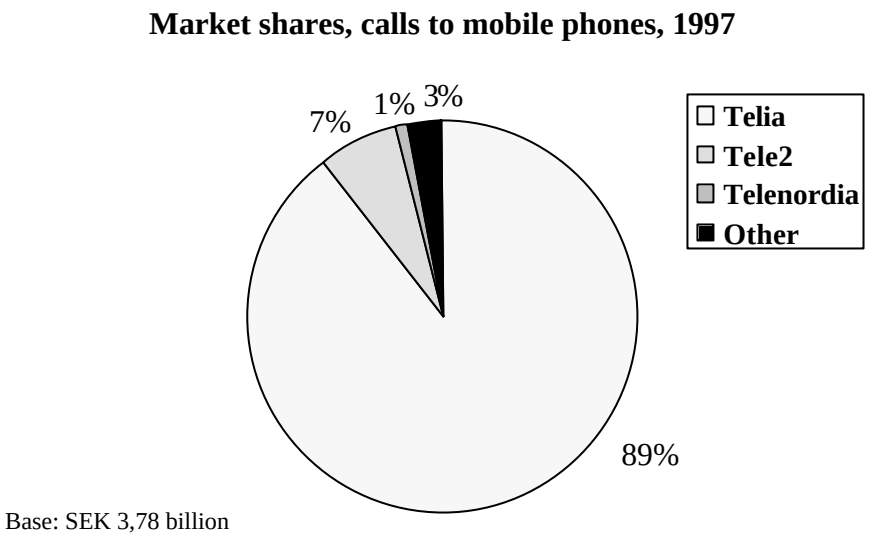


Figure 9: *Market shares for calls to mobile phones in Sweden, 1997, in value terms. Any interconnection revenue to the telecommunications operators has been excluded.*

Stelacon estimates that the market for calls to mobile phones, as shown in Figure 9, amounted to about SEK 3.78 billion during 1997. Since 1996, the market has increased by SEK 1.224 billion (48%) and during 1997 the turnover for calls to mobile phones overtook both international calls and long-distance calls. After local calls, calls to mobile phones are currently the type of call that generates the most revenue.

As in the case of international calls, the high cost of calls to mobile phones is mainly a consequence of interconnection charges. However, by first sending the call to another country and then back to Sweden, the telecommunications operators can achieve lower costs for interconnection with the mobile phone operators in Sweden. This is a fairly common method which is used to allow competitive rates to be offered on calls to mobile phones.

All telecommunications operators who have specialised in offering low rates on international calls also offer competitive rates for calls to mobile phones. Customers which make large numbers of calls to mobile phones can make substantial savings, and this has resulted in Telia losing significant market shares in this segment. The fact that Telia's competitors have not succeeded in gaining market shares as high as those for international telephony is due to the prefix problem (see above), to the fact that customers are not so aware of the cost of calls to mobile phones, and the fact that the telecommunications operators have not marketed these calls to the same extent as international telephony.

In practice, competition on the market for fixed telehony began in 1993 and 1994. During 1993, when Tele2 was allocated the prefix 007, they offered lower prices than Telia for international calls, and ran an extensive marketing campaign based on the theme “James Bond - 007 - licensed to call”. In 1994, Tele2 launched national telephony, with competitive prices for long-distance calls.

Since then, reduced interconnection charges and Telia’s price changes have to some extent improved the market conditions for companies competing with Telia. In practice, these changed conditions were not the most significant factor for the development of competition over the four-year period. Telia’s reduced market shares are mainly a consequence of marketing by the alternative operators and increased customer acceptance of the idea of choosing alternatives to Telia.

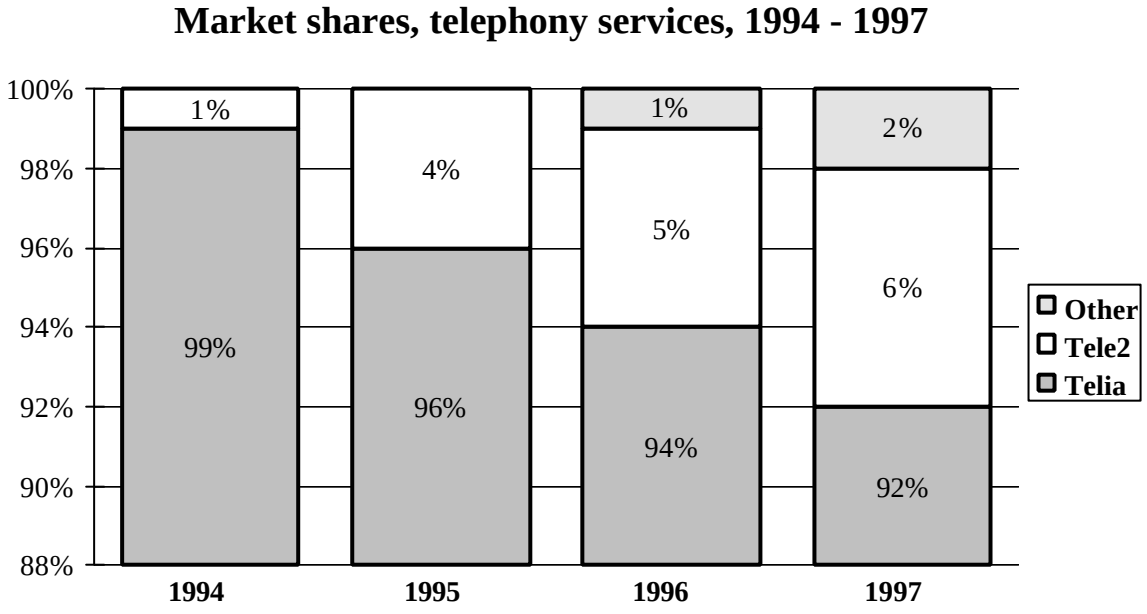


Figure 10: *Market shares for telephony services, 1994 – 1997, in value terms. Any interconnection revenue to the telecommunications operators has been excluded. Note that the y-axis begins at 88%.*

As earlier graphs have shown, the competition differs greatly between the different segments of the market. Despite the fact that competition is keen in most of the segments of the market, Telia dominated the entire market during 1997 as well. Together, other operators have only 8% of the market.

The main reason for Telia’s dominance is that the segments that are most exposed to competition, long-distance calls and international telephony, have decreased both relatively and in real terms. At the same time, the local call market, which is the largest segment and the one with the least competition, has increased. It is worth noting that a proportion of Telia’s revenue from local calls and calls to mobile phones

accrues to Internet operators and mobile operators respectively, in the form of interconnection revenue.

During 1999 there will be several changes in the conditions of the market, among them the introduction of preselection and number portability. In combination with the increased use of alternative local loops, competition in the market is expected to shift into a new dimension. To some extent, the way in which the telecommunications operators have operated during late 1997 and early 1998 has been a consequence of the imminent changes in the market. Apart from this, 1997 was characterised by a temporary equilibrium, where nothing much has happened other than that the telecommunications operators have offered lower and lower rates, primarily on international calls and call to mobile phones.

3.3 ISDN

In practice, Telia is the only telecommunications operator offering a public ISDN network in Sweden. Other telecommunications operators can offer ISDN when they offer customers direct connection to telephony or Internet services. At the turn of the year 1997/98, Telia had 198 000 (100 000 during 1996) installed ISDN B-channels and Stelacon estimates that 120 000 of these channels were ISDN Duo and 80 000 for ISDN Multi. The number of ISDN B-channels doubled during 1997, just as it did in 1996. Our view is that the main reason for the increase in ISDN Multi is that many PABXs are sold with an ISDN interface, and the increase in ISDN Duo is mainly due to increased use of ISDN to access the Internet. Even though solutions with a higher capacity than ISDN will be launched in the next few years, it is Stelacon’s opinion that ISDN will continue to experience positive growth over the next three years. However, the rate of growth will not be 100% as it has been in recent years.

3.4 Effects of competition for telephony services

The main effects of competition are price reductions and changes in the pricing structure. The trend in pricing is for distance to be a decreasingly important factor in the price. This has meant higher local call charges and lower charges for long-distance and international calls. As far as international calls are concerned, the situation is best illustrated by the fact that many operators are offering calls to the USA at less than SEK 2 per minute, compared with a rate of about SEK 10 for calls to countries in Africa, for instance. While distance is becoming a less important factor, traffic volumes and interconnection charges to different countries are becoming all the more significant.

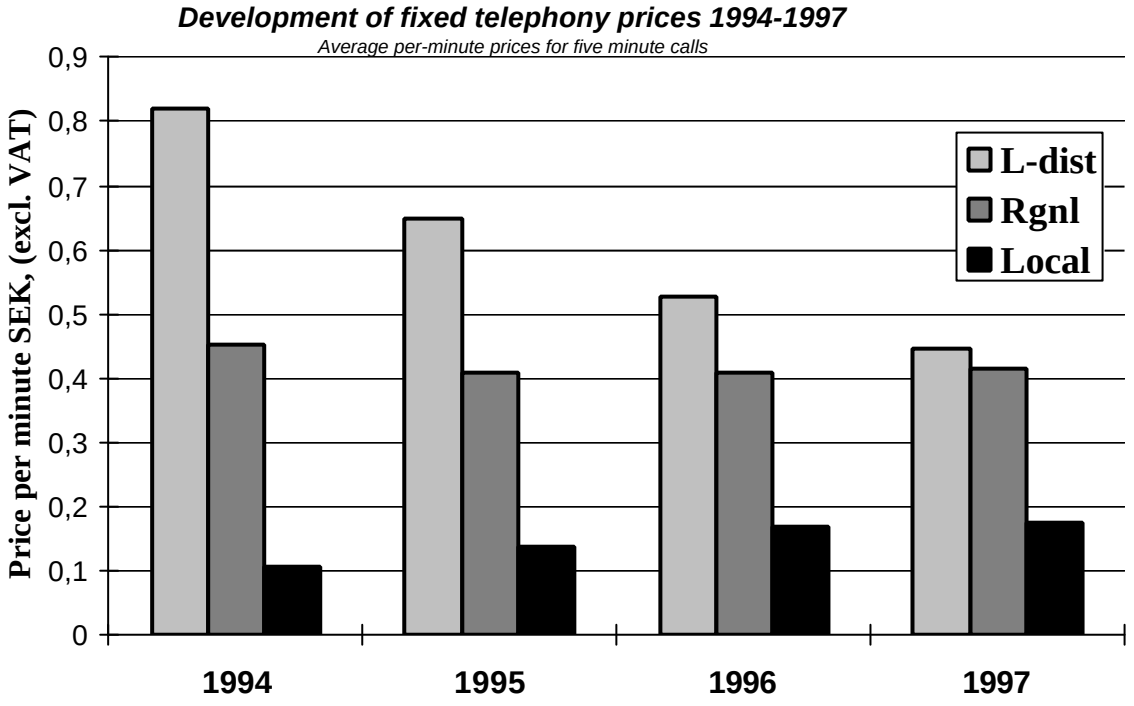


Figure 11: *Average per-minute rates for five-minute calls via Telia, including call setup charge. The rates shown are averages for day and evening calls. In the example above, the call setup charge for 1997 is SEK 0.28.*

According to Figure 11, the average cost of long-distance calls has almost halved since 1994. At the same time, the average cost of local calls has increased by 65%. During the same period, changes for regional calls were marginal.

Apart from 1996, the call setup charge went up every year. In 1994 the call setup charge was SEK 0.12 and currently in 1998 it stands at SEK 0.32, an increase of 167%. Since the call setup charge is the same for all types of call, its percentage effect on cost is greatest for those types of call with the lowest per-minute cost, ie local calls.

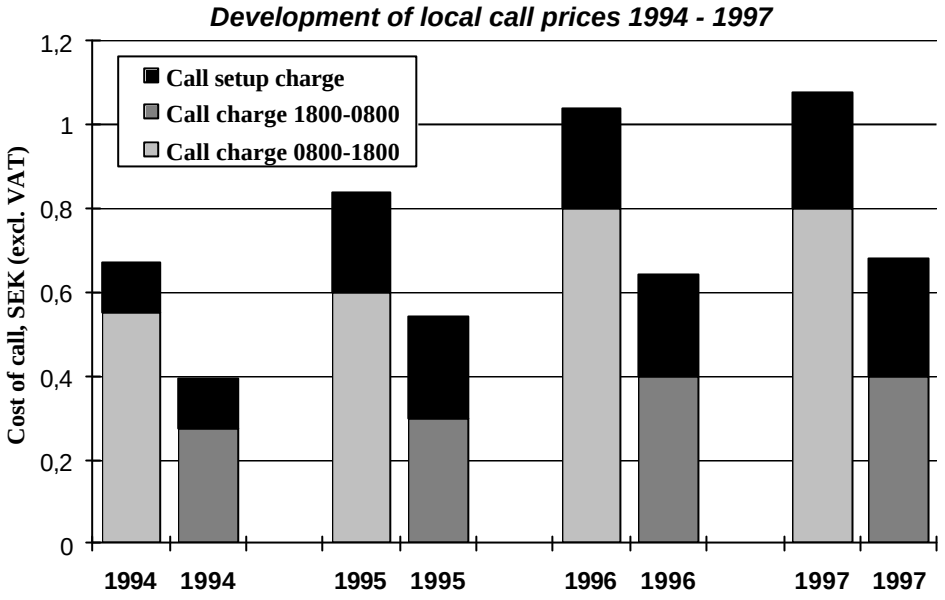


Figure 12: *Cost of a five-minute local call via Telia, 1994 - 1997. In the example above, the call setup charge for 1997 is SEK 0.28.*

Since 1996, the cost of a local call as above, has increased by 4% in the day and 6% in the evening. Compared with 1994 the cost has gone up by 61% in the day and 72% in the evening. Since the call setup charge has risen by more than the per-minute cost of local calls, the call setup charge accounts for an ever greater proportion of the call cost. For an evening local call as above, the call setup charge was 30% of the total call cost in 1994; in 1997 the corresponding figure was 41%.

Telia's 1997 pricing changes

On 7 November 1997, Telia introduced a radical changing in its pricing structure. Telia abolished the concept of the regional call, reduced the geographical area for local calls and increased the geographical area for long-distance calls ("Sweden calls").

Local calls in the same area code remained at SEK 0.16/min.
Local calls to a neighbouring area code went up from SEK 0.16/min to 0.40/min (+150%)
Regional calls were reduced from SEK 0.48/min to SEK 0.40/min (-17%)
Long-distance calls were reduced from SEK 0.64 min to SEK 0.40/min (-38%)

The call setup charge went up twice during the year, from SEK 0.24 to SEK 0.28, and then to SEK 0.32.

The price changes may be seen as particularly radical and gave rise to protests from those who felt disadvantaged. The main reason for this was that, because Telia's area code areas differ in size and population, there were great differences in terms of what a local call covered. The new pricing structure also had certain negative effects for Internet operators. However, it is worth noting that Telia's pricing structure need not

necessarily follow the boundaries of area codes; more than one area can, for instance, be combined to form a charging area.

Competition for different groups of customers

In principle, all business customers have benefited by the competition in the telecommunications market during 1997, even though the difference compared with 1996 is relatively small. However, some companies have been able to benefit by the competition more than others. The size of customers, in terms of their total outlay on telephony services, is a significant factor in determining the prices they are charged by the telecommunications operators. Compared with businesses, homes have relatively small volumes per customer and have therefore not enjoyed such great price reductions or discounts. We have chosen to divide the market into three different customer groups on the basis of their potential for cutting costs for telephony services by exploiting the competition in the telecommunications market.

- **Large companies with 100 or more employees**

In Sweden there are about 3000 companies with 100 or more employees.

In terms of percentage price reduction per customer, it is these companies that gain the most from the competition in the telecommunications market and this will continue to be the case. They have large volumes of both telecommunications and data communication and often possess a high degree of expertise in the telecommunications field. During 1996 these companies actively negotiated advantageous rates from the various telecommunications operators. During 1997, many of them began to shape their telecommunications structure in such a way as to reduce their dependence on a single operator. Their aim is to be able to change operator quickly and so force down rates even more.

- **Small and medium-sized enterprises with 1 to 99 employees**

In Sweden there are about 200 000 businesses with 1 to 99 employees.

During 1997, several different telecommunications operators ran intensive marketing campaigns aimed specifically at this target group. Competition for medium-sized enterprises is very keen at present, above all competition via indirect access, with lower rates for international calls and from some operators for long-distance calls as well. In favourable conditions, businesses whose offices are centrally located in major cities have been able to have direct access to one of the alternative telecommunications operators. They have then been able to benefit by lower rates on all types of call and lower fixed charges.

- **Residential customers and one-man businesses**

In Sweden there are about 4 million homes and about 600 000 businesses with no employees.

The situation for the residential market[8] has not changed significantly during 1997. Residential customers who use a telecommunications operator other than Telia are those who make large numbers of long-distance and/or international calls. Tele2 has held a small but significant share of this market for some time. For those telecommunications operators who entered the telecommunications market at a later stage, it has in practice been unprofitable to address residential customers and they have instead focused on small and medium-sized enterprises. To gain a customer on the residential market costs an estimated SEK 500, and this needs to be recouped within a year. Companies who can only compete for international calls from homes find it difficult to balance this equation, especially since the prices of and margins on international calls are falling.

The above is also backed up by the market survey arranged by Stelacon in April 1998, "The Internet bus". According to its findings, 8% of Swedish homes used a telecommunications operator other than Telia, equivalent to just over 300 000 of a total of 4.1 million homes. Of these 300 000 homes, 77% used Tele2. The most common reasons for the remainder not using an operator other than Telia were a) that they had not given the matter any thought, and b) that they did not think they would benefit financially from it. The survey also revealed that 6% of homes were unaware that fixed telephony was available from any operator other than Telia.

3.5 Other fixed telephony

During 1997 as well, all fixed telephony has in principle gone via Telia or other traditional telecommunications operators such as Tele2 and Telenordia. However, there are other options which offer customers competitive rates. Examples of these options are call-back, telebrokers, private networks and IP telephony. Call-back underwent a decline over the year; telebrokers increased their market share; and telephony in private networks was unchanged. IP telephony attracted much attention but has an insignificant share of the market. Even though turnover in the above services was small during 1997, they are worth noting, especially telebrokers and various forms of IP telephony.

3.5.1 Call-back

Call-back is a niche service which offers lower rates for international calls to countries outside Europe, and for calls to mobile phones. It exploits the fact that it is

[8] We have included one-man businesses in the residential market, since these broadly amount to the same target group for telecommunications operators

cheaper to make a call from the USA to Sweden and then from the USA to – for instance – Taiwan, than to call direct from Sweden to Taiwan. The technology is based on "reversing" the phone calls in the USA so as to make the call at the US rate rather than the Swedish rate. Some variants of call-back are simple; others are more complex. But a common feature of all of them is that the customer "dials – hangs up – is called back", hence the name call-back.

Since 1995 we have noted a decline in the number of call-back companies. The reasons for this are the major price reductions made on international calls by the telecommunications operators, and the plans to charge Swedish VAT on the call-back service. Even though the service has been subject to VAT in Sweden since 1 July 1997, the Swedish call-back do not usually charge Swedish VAT. Only a small number of private individuals and very small businesses still use call-back from Sweden. We estimate the number of active call-back companies in Sweden to be less than 10, with a combined turnover of less than SEK 10 million. So call-back is a marginal phenomenon in Sweden and will remain so, with or without Swedish VAT.

3.5.2 Telebrokers

Telebrokers are not telecommunications operators in the conventional sense; they mediate telecommunications traffic from their customers to different telecommunications operators. The business idea of a telebroker is based on the fact that there is a sufficient margin between the rates they get from the telecommunications operators and the rates they offer their customers. The major part of the telebrokers' revenue accrues to the telecommunications operators for whom they do the broking. In order to be able to mediate calls for telecommunications operators, a telebroker must have some form of agreement with one or more telecommunications operators. They must also be able automatically to direct customers' calls to the telecommunications operators they are broking for. The telebroker does this by placing a device called a telerouter on the customer's premises.

No new telebrokers entered the Swedish market during 1997, and the market is dominated by two companies, NETnet and NetSource. These companies established themselves as telebroker in Sweden during 1995. NetSource is a "switchless reseller", meaning that they do not have a switch of their own, but send the traffic directly from their customers to different telecommunications operators. NETnet is a "switch-based reseller", meaning that they have a switch of their own where they collect the traffic before they send it to the telecommunications operators they are broking for. Just as in 1996, during 1997 NETnet and NetSource could only offer competitive rates on international telecommunications services, and on calls to mobile phones.

During 1996, telebrokers were still regarded as something new and different which many customers found it difficult to understand and accept. This was a severe inhibiting factor for the telebrokers. During 1997 these companies came to be more

widely accepted in the market, and this has had a positive effect on their sales. The two telebrokers have broking agreements with a number of telecommunications operators and send each call to the one that offers the lowest rate. Among the telecommunications operators that use telebrokers are WorldCom and RSLCOM, both of which are companies with a distinctly international focus and which therefore do not see telebrokers as direct competitors.

The telebrokers encounter the stiffest competition from the telecommunications operators who address the small and medium-sized enterprises segment, such as Telia, Tele2 and Telenordia. The telecommunications operators have competitive rates for both national and international telephony and by offering a discount on the total telephony costs of their customers they make the telebrokers' offer less attractive. To survive in the long term the telebrokers must be able to compete with low rates for both national and international telephony. However, the telebrokers offering is never better than that of the companies they provide broking for, and these are operators with a firm focus on international telephony. As long as they are not used as telebroker by Telia, Tele2 or Telenordia they have little scope to offer competitive rates for national telephony. If the telebrokers' offering continues to be limited to international telephony and calls to mobile phones, they will find it increasingly difficult to compete on the Swedish market as well.

The telebrokers in Sweden are in a race against time. Their main strength is in the customer base they have created, which they must increase still further to become attractive as telebrokers to Telia, Tele2 or Telenordia. If they succeed in this they will, for the customers, be a positive aspect of the market in the future as well. If not, their significance will rapidly decline.

3.5.3 Private networks

A private network is created when a company interconnects its PABXs via leased lines. By passing all calls between the connected sites via the leased lines instead of via the PSTN[9], the company can reduce its telephony costs. The expansion of private networks depends on the price relationship between leased lines and telephony services. In practice, therefore, private networks are only worth while for large companies and organisations with several sites and a significant proportion of telephone traffic between them. There has been no significant growth in this area during 1997, possibly a slight increase as a result of local authorities building their own networks. Stelacon's view is that, if all telephone traffic carried by private networks during 1997 was transferred to the PSTN, the traffic would amount to about 1% of the turnover of the total market.

If the costs of leased lines fall by more than the cost of telephone calls, this will lead to an increase in the number of private networks. However, in view of the relatively keen competition for telephony services this is not a probable development. The use

[9] Public Switched Telephone Network

of IP technology to carry both speech and data on private networks may mean a reduction in the costs and may therefore encourage the use of private networks. However, the most probable outcome is that the use of private networks based on leased lines will decline in the long term.

An alternative solution with the same effect as private networks is VPN-networks[10], but these have not found much favour in Sweden. The main reason for this is the low cost of network capacity in Sweden compared with many countries in Europe.

3.5.4 Virtual moves to the competition

A trend that is related to some extent to private networks is the idea of moving from a geographical area with little competition on the telecommunications area to a location where competition is keener, such as Stockholm. Companies and organisations that are not satisfied with the local situation move "virtually" to a location where the competition is keener and prices are lower. The only thing that needs to be moved is the point at which the company's telecommunications traffic is handed over to the telecommunications operator. In purely practical terms, a company in a rural area leases a connection to an urban area and delegates its traffic there. The company then negotiates with several different telecommunications providers for the lowest price. Consequently, larger companies and organisations can make investments which eliminate the disadvantages of being located in a rural area.

Another similar solution for companies and organisations in rural areas is to sign a contract with the telecommunications operator with a "lowest price guarantee"; this means that the company does not pay more for telephony services than companies located in urban areas where competition exists. For natural reasons, only major customers can persuade the telecommunications provided to oblige them with contracts of this type.

3.5.5 IP telephony and telephony over the Internet

The telephony service as we know it today is circuit-switched and offers high-quality calls. However, circuit-switched technology is a relatively inefficient way of exploiting bandwidth. Briefly, with IP[11]-based telephony, the speech is carried in IP packets, and this helps make more efficient use of the existing network capacity. IP telephony is not directly associated with the Internet, but the technology can be used to enhance the efficiency of both private company networks and sector networks, as well as the networks of the telecommunications operators themselves.

IP telephony is still in its infancy and its present shortcomings include both low quality and lack of standards. One of the greatest problems of IP-based telephony is

[10] Virtual Private Network
[11] Internet protocol

the delay in communication. For telephony, the delay should not exceed 150 milliseconds, and it is not a straightforward matter to achieve this in an IP network. There are new technologies for solving these problems, and even if not all of them have been sold, it is abundantly clear that IP technology is a realistic alternative to today's circuit-switched technology. Both manufacturers and telecommunications operators agreed that IP is a technology that may well have a steadily increasing influence on the telephony market. The greatest influence of the technology will be in the long term, and will basically involve increased integration of data and telecommunications, with IP as the common denominator. The most important reason for this is not that IP is the most suitable technology but that it is a widespread and open standard in both the telecommunications and the data industries. It is worth noting that this is the first time that both the telecommunications industry and the data industry have agreed to back the same communications technology on a large scale. This in turn will mean that the technical obstacles which exist today will be overcome in the years ahead.

Stelacon's view is that IP will eventually have a very great influence on telephony, but that the penetration of the technology will differ considerably depending on its fields of application. An analysis of what we consider to be the most interesting areas follows.

Telephony over the Internet

The Internet is a network of many different networks and not a homogeneous network. In practice this means that quality and availability cannot be guaranteed on the Internet. If the Internet is used for telephony, it is therefore impossible in practice to guarantee good call quality without noticeable delay. When the Internet is heavily loaded, the result is a longer delay and poorer speech quality. However, under favourable conditions the quality of telephony over the Internet can be fully acceptable, even if it does not reach the same quality as the public telephone network. To some extent Internet telephony is like booking an unspecified journey - sometimes it is good, sometimes bad.

The advantage of Internet telephony has been that the cost of calls is lower than over the PSTN. With the reduced rates for international calls introduced in Sweden during 1997 and early 1998 this competitive advantage is substantially eliminated. Even so, it can still be worth while using Internet telephony to call such regions as South-East Asia and South America. It is Stelacon's view that international telephony lacks the advantages to outline the shortcomings in its quality and that it will therefore not become more than a marginal service, used by technology enthusiasts.

IP telephony

IP telephony refers to telephony carried via the IP protocol on public or private networks other than the Internet. What the telecommunications operators market as Internet telephony is usually IP telephony. The difference is that they do not use the

Internet, only the same technology, namely IP. The usual approach is for the operator to use IP to carry telephone calls to the USA, for instance. Since the calls are carried as IP packets, each call uses less bandwidth than it would on the PSTN, and can therefore be sold more cheaply. So far, no operator has been able to offer the service more cheaply and with the same quality as conventional telephony. It is our view that IP telephony will achieve a market share of a few percent by the year 2000, but this still amounts to several million Swedish kronor.

Eventually IP will account for an increasing proportion of calls, both on the public networks of the telecommunications operators and on private company networks. IP telephony will probably first be introduced on private company networks and subsequently on the public networks of the telecommunications operators. As regards Internet 2, this may be seen as a private network for the world of universities. On the public network, customers who only want a line for telephony will only use PSTN for the foreseeable future, but the service for customers who want telephony, the Internet, data communications and so on will increasingly be based on IP. The long-term vision is that IP will in this way gradually replace the existing PSTN. The IP protocol that will be used by then will have little in common with the original protocol. Considering that the telecommunications operators lead the market in both telephony and data communication services, as well as Internet access, there is nothing to indicate that this development will lead to their demise. However, it will be harder to distinguish between operators of telephony services, data communication and television. This will lead to more players and increased competition, both nationally and globally.

4. MOBILE TELEPHONY SERVICES

At present there are four operators licensed to offer mobile telephony services. We have excluded companies licensed for paging (ERMES) and terrestrial flight telecommunication systems (TFTS).

- Telia AB (GSM 900/GSM 1800[12]/NMT 900/NMT 450)
- Europolitan AB (GSM 900)[13]
- Europolitan PCN AB (GSM 1800)
- Tele2 AB (GSM 900)[14]
- Netcom Systems AB (GSM 1800)
- Tele8 Kontakt AB (GSM 1800)

4.1 Descriptions of the companies

During 1997 there were, as in 1996, only three active mobile telecommunications operators in Sweden: Telia AB, Comviq GSM AB and Europolitan AB.

Telia AB: Telia is by far the largest telecommunications operator on the market and is licensed in all areas for mobile telecommunications services, such as mobile telephony, paging and TFTS. Telia is also the only mobile operator to offer services based on NMT (an analog network). Telia offers services to the entire market and aims to be able to provide comprehensive solutions. During 1997, Telia launched services such as Unified Messaging and developed facilities for voice-controlled dialling. During 1996, Telia was granted a licence for GSM 1800 as an independent network and in November 1997 became the first operator in Sweden to put this frequency band into service. After a reorganisation of Telia at the beginning of 1998, the mobile services are now operated by Telia Mobile AB.

Comviq GSM AB: Until 1997, Comviq GSM AB was a wholly-owned subsidiary of NetCom Systems AB. During 1997, organisational changes within NetCom resulted in the major company market for mobile telephony being transferred from Comviq to Tele2. At the beginning of 1998, Comviq's activity was integrated with that of Tele2 and Kabelvision, and now comes under the subsidiary company Tele2. However, in the section on mobile telephony services we have chosen to describe this activity under the name Comviq AB. Comviq has offered mobile telecommunications services in Sweden since 1981. On 1 September 1992 they launched one of the first privately-owned GSM networks in the world. Comviq's strategy states that they should offer customers the lowest price. In practice, Comviq is not cheapest for every customer, but their prices are relatively low and they are the mobile operator that offers the greatest variations in rates over the day and the greatest geographical differences in

[12] GSM 1800 is the same as the previously used designation DCS 1800.
[13] Europolitan AB and Europolitan PCN AB are counted as one company.
[14] Tele2 and NetCom are counted as one company.

pricing. During 1997, Comviq became the first operator in Sweden to launch the prepaid card. They focus on good indoor coverage and coverage in urban areas, and expand their network accordingly. Comviq has also been granted a licence for GSM 1800, combined with GSM 900.

Europolitan AB: Europolitan AB is a wholly-owned subsidiary of Europolitan Holdings AB. In 1991, the company was granted a licence to offer GSM-based mobile telephone services and they have also been given a licence for GSM 1800, combined with GSM. Europolitan concentrate on high-usage customers and consequently aim mainly at the business market, and to residential market individuals who generate high volumes of traffic. Over the past year, Europolitan has focused its efforts more on this sector. An example of this is the launch of the prepaid card at the end of 1997. Europolitan's aim is to be early on the market with new GSM-based value-added services and to broaden the fields of application of the technology, for example in the form of wireless access to the fixed network. Europolitan Holdings AB has a subsidiary company Europolitan Stores AB, which sells mobile telephones. Currently they have 21 outlets.

Tele8 Kontakt AB: Tele8 Kontakt AB is licensed to offer services based on GSM 1800, and the company has a licence to offer these services on an independent network. In December 1997, the company was bought by telecommunications operator Telenordia. It is not yet known how Telenordia will use the licence**.**

4.2 Development of the market

In recent years the Swedish mobile telephony market has seen very rapid growth, with the result that Sweden has retained its position as one of the countries with the highest density of mobile phones in the world. At the beginning of 1998 there were 3.17 million subscriptions for mobile telephony services in Sweden, based on NMT and GSM, including prepaid cards. This corresponds to a market penetration of 36% of the population of Sweden. According to Stelacon's survey "The Internet bus", 55% of homes had access to at least one mobile phone in April 1998.

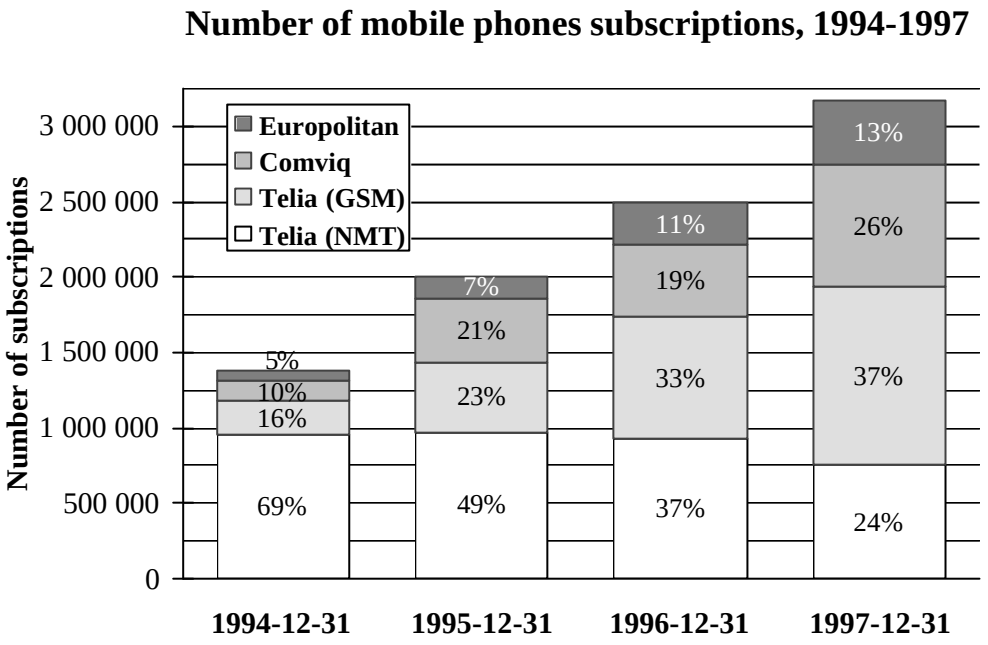


Figure 13: *Number of mobile telephone subscriptions in Sweden during the period 1994-12-31 – 1997-12-31, broken down by NMT and GSM.*

The diagram above illustrates how the number of NMT and GSM subscriptions developed during the period 1994-12-31 to 1997-12-31. Between the beginning of 1994 to the end of 1997, the total number of subscriptions increased by 129% (1.8 million). At the end of 1994, the proportion of NMT subscriptions was 69%; this had fallen to 24% at the end of 1997. The increase is in the GSM market, which grew by about 472% (some 2 million subscriptions) between 1994 and 1997.

The greatest increase in the total number of new subscriptions took place over the past year, but the relative increase was greatest during 1995, when the growth rate was 45%. As for the GSM market, the greatest growth took place during the past year, when the number of subscriptions increased by 843 000. The fastest growth rate in percentage terms was in 1995, when the market grew 145% (just over 600 000 GSM subscriptions).

The total reported revenue of the mobile telecommunications operators for mobile telephony services was SEK 12,2 billion for 1997. This revenue includes interconnection charges[15], which account for about 30% of the total revenue of the operators. So for 1997 the total interconnection traffic revenue amounts to about SEK 3.8 billion. In order to illustrate the value of the sales to the final customer, we have chosen to exclude this revenue. For Europolitan, when calculating the value we only included revenue relating to Europolitan AB, not the proportion relating to Europolitan Stores AB. For Telia, we have excluded the portion that relates to revenue from other activities such as paging. So the diagram below includes only revenue from public mobile telephony services and subscription revenue.

Value of mobile telephony broken down into NMT and GSM 1994 -1997

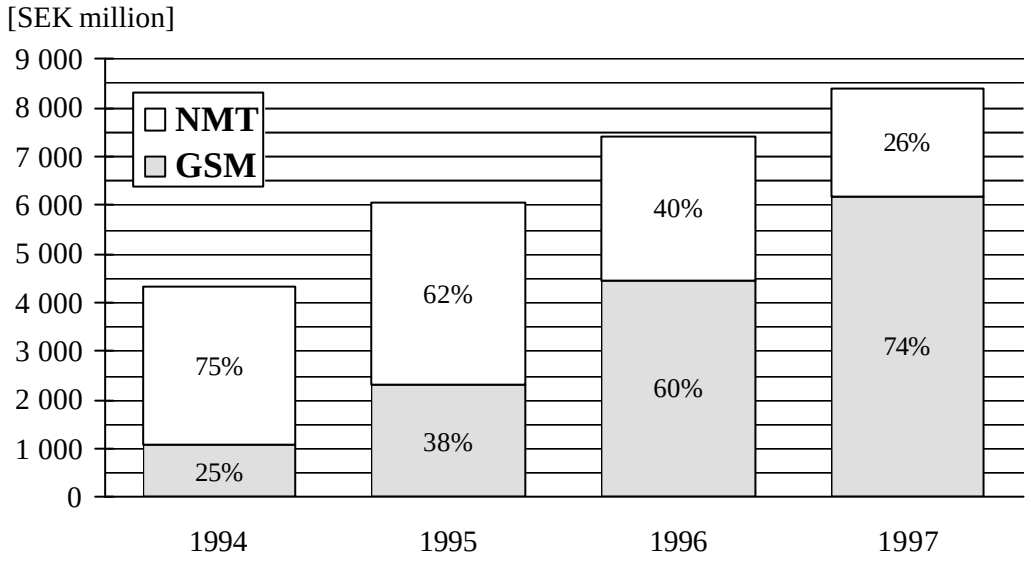


Figure 14: *Value of mobile telephony broken down into NMT and GSM for the period 1994 - 1997. The mobile telecommunications operators' revenue from interconnection traffic is not included.*

As the diagram above shows, in 1997 the revenue from mobile telephony services amounted to SEK 8.42 billion, compared with SEK 4.34 billion in 1994. This is almost a doubling (94%) of the value of the market over the period. The greatest increase in revenue, in both real and percentage terms, occurred during 1995.

Over the last four years, the NMT market has fallen by 32% and both the number of subscriptions and the revenue per subscription have successively fallen. During 1994, NMT accounted for 69% of the number of subscriptions, whilst revenue amounted to 75%. During 1997, these figures were significantly more equal, since the subscription proportion was 24% and the revenue proportion 26%.

[15] The interconnection charge includes a charge for handing a call from the fixed network to the mobile network. At the time of writing, the interconnection charge for a call handed over from the fixed network to the mobile network is SEK 2.74 per minute.

On the GSM market, revenue increased by 479% over the last four years. The GSM market increased most in value during 1996, but the percentage increase was greatest during 1995. So we can state that the market for GSM has grown at an unprecedented rate, whilst the market for NMT has fallen since 1995.

Number of subscriptions broken down by mobile telecommunications operator

The diagram below illustrates how the number of subscriptions for each operator developed during the period 1994-12-31 – 1997-12-31.

Number of subscriptions, broken down by operator, 1994-1997

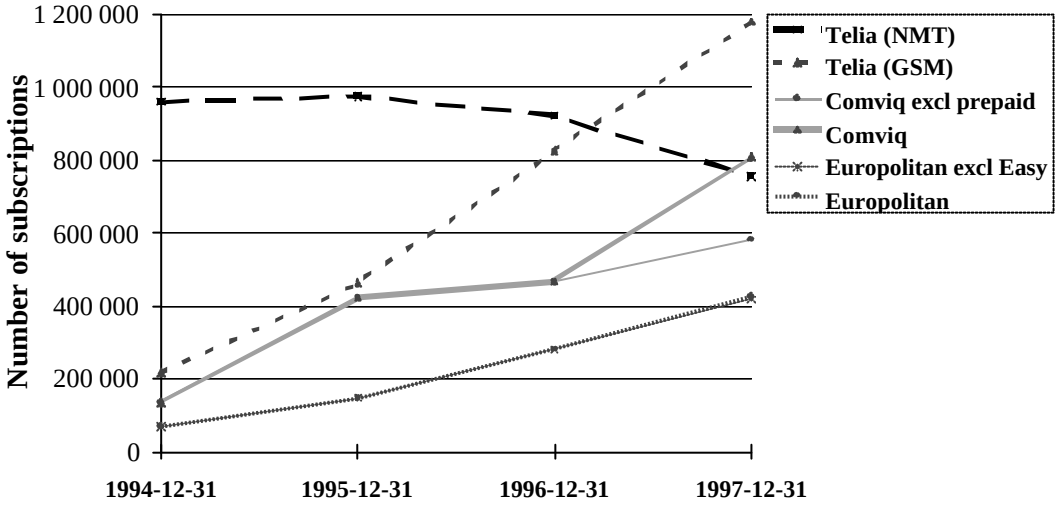


Figure 15: *Number of subscriptions for mobile telephony in Sweden during the period 1994-12-31 – 1997-12-31, NMT and GSM, broken down by mobile operator*

All mobile telecommunications operators have experienced growth in the number of GSM subscriptions. Over the three-year period in question, Europolitan and Comviq have increased the number of subscriptions, including prepaid cards, by about 500%. Telia's increase on the GSM market amounts to 446%. In total, ie both GSM and NMT, Telia's subscriber stock increased by 65%. In the diagram above we have assumed that the growth rate is constant over a year. This is a simplification, since sales are subject to seasonal variations.

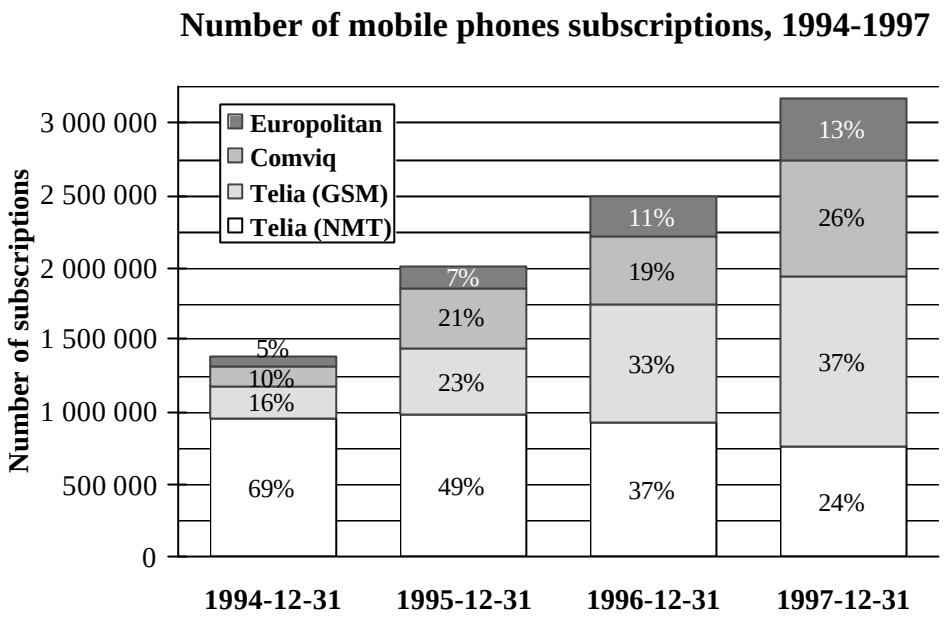


Figure 16: *Number of mobile telephone subscriptions during the period 1994-12-31 – 1997-12-31, broken down by operator. Prepaid cards are included*
.

Telia is clearly the largest mobile telecommunications operator, with a 61% share of subscriptions. However, since 1994 they have lost market share to the other operators, since Telia's share was then 85%. Comviq and Europolitan have increased their market shares during the period in question. At the end of 1994, their shares were 10% and 5% respectively, compared with 26% and 13% respectively at the end of 1997.

However, since there is no competition for NMT, the development of the GSM market gives a truer picture. The proportion of the number of subscriptions between the operators is significantly more constant if only the GSM market is considered. During the past four years, Telia has had a share of around 50%. Comviq experienced the greatest changes. At the end of 1995, they achieved their highest share at 41%; the next year was their worst, with 30%. Europolitan, on the other hand, had their lowest share in 1995 at 14%. Currently it is 18% of the GSM market.

Market shares

To some extent, the distribution of revenue between the mobile telecommunications operators follows the development of the number of subscriptions, but there are differences between the operators' customer types and consequently between their average revenue per customer. It is worth noting that all mobile telecommunications operators report positive results for the second year running.

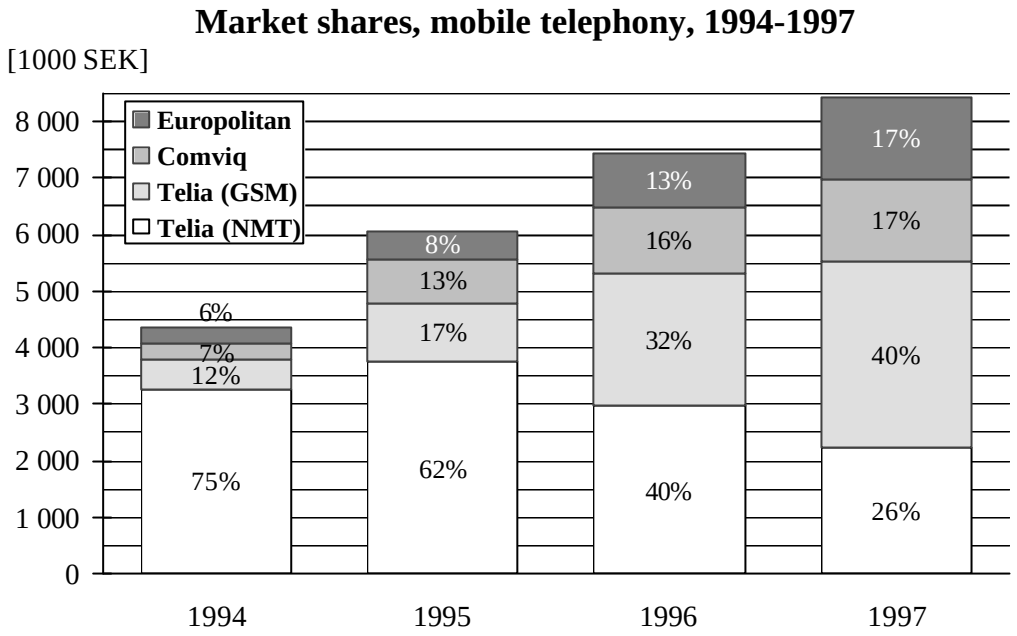


Figure 17: *Market shares broken down by mobile operator for the period 1994 - 1997. The operators' revenue from prepaid cards is included; interconnection revenue is not included.*

During the entire period under review, Telia has been the major player, and this is also the case if we consider only the GSM market. Europolitan and Comviq were broadly equal in both 1994 and 1997, but there were some differences in 1995 and 1996. On the GSM market, Telia has increased its revenue per customer and during 1997 Telia had, for the first time, a higher share of the revenue (40%) than of subscriptions (37%). The highest average revenue per customer is reported by Europolitan, whilst Comviq reports the lowest figure.

Table 2: *Shares of the GSM market for the period 1994 - 1997. The revenue of the mobile telecommunications operators from interconnection traffic is not included.*

Value of the GSM market [SEK billion]	1994	1995	1996	1997
Total	1.07	2.31	4.46	6.19
Telia AB	48%	45%	52%	54%
Comviq GSM AB	28%	34%	26%	23%
Europolitan	24%	21%	21%	23%

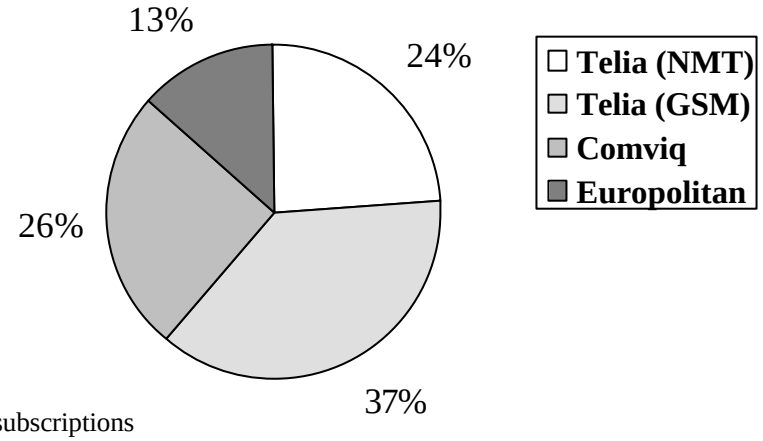
If the value of the NMT market is excluded, the market shares are as shown in the table above. Telia has increased its market share over the years and currently has more than half the market. Europolitan and Comviq have reduced their market shares by one and five percentage points respectively over the period.

4.2.1 Development during 1997

During 1997, the number of subscriptions grew by almost 700 000 (27%) and the total number reached almost 3.2 million subscriptions. At the beginning of 1998, the number of GSM subscriptions was 2 414 000 and the number of NMT subscriptions 755 000. The NMT subscriptions break down into 542 000 for NMT 900 and 213 000 subscriptions for NMT 450, which, at the end of 1996 broke down into 681 000 NMT 900 subscriptions and 240 000 NMT 450 subscriptions.

According to MobilTeleBranschen (the sector organisation of the Swedish mobile telephone industry), sales of new mobile phones during 1997 amounted to about 1.25 million units. The figures for new sales do not agree with the number of new subscriptions, since a large proportion of the sales simply involves a change of telephone and does not result in a net increase in the number of subscriptions. The churn level[16] during 1997 is estimated by all operators to be 20%

Share of number of mobile telephony subscriptions, 1997



Base: 3,17 million subscriptions

Figure 18: *Number of mobile telephone subscriptions in Sweden at the beginning of 1997/98, NMT and GSM, broken down by operator*

At the end of 1996, Telia had a 70% share; during 1997 this fell to 61%. Note, however, that Telia's GSM market share increased by four percentage points over the past year. The operator with the greatest increase in market share is Comviq. During 1997, Comviq's share increased from 19% at the beginning of 1996 to 26%. Much of Comviq's increase results from the start of sales of prepaid cards; see below. Europolitan has also increased its share, from 11% to 13%.

[16] Measure of customer moves, in this case changes of form of contract, regardless of whether or not a new operator is used.

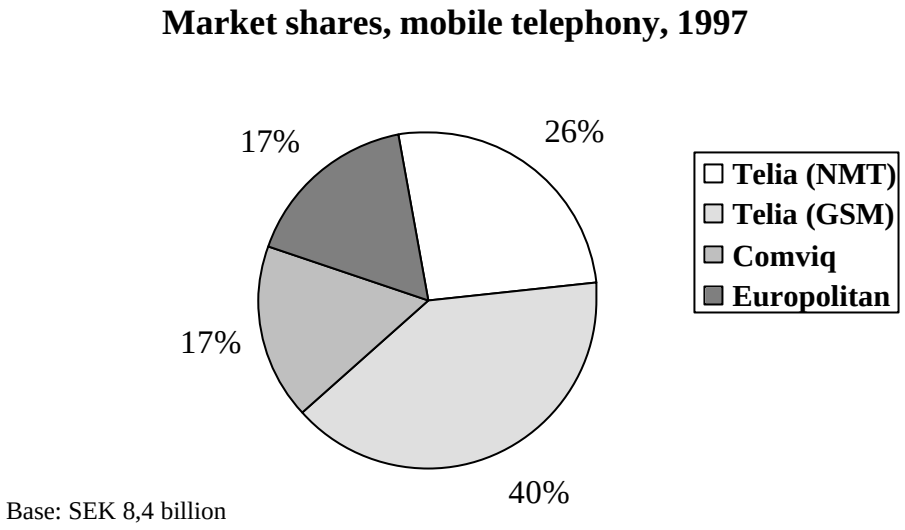


Figure 19: *Market shares broken down by mobile operator, 1997. The operators' revenue from interconnection traffic is not included.*

1997 saw certain changes in the market shares of the mobile operators. Telia lost shares to its competitors. At the end of 1996, Telia's market share was about 71%; during 1997 this fell to 66%. Comviq and Europolitan increased their market shares. At the end of 1996 their respective shares were 16% and 13%; during 1997, these figures rose to 17% each.

Proportions of business and residential subscriptions

It is estimated that just under 60% of the 700 000 new subscriptions during 1997 were residential subscriptions. Of the total of 3.2 million, at the end of 1997, the market was made up of 1.9 million (60%) residential subscriptions and 1.3 million (40%) business subscriptions. This is based on the type of subscription chosen, but this does not always coincide with the way the subscription is used. Businesses sometimes take out residential subscriptions when it is financially advantageous. Stelacon is of the opinion that, from the point of view of payment recipients, the residential and business market proportions are approximately equal.

4.3 Prepaid cards

Prepaid cards for mobile telephone use were launched during 1997. A mobile telephone prepaid card works like a conventional phonecard: the customer purchases a card which enables calls to be made until the prepaid sum stored on the card has been used up. The card can be re-charged when the money runs out. The customer is given a telephone number so that calls can be received. These cards do not admit roaming, so they cannot be used on foreign networks. In addition, there are limits on the services offered, such as sending SMS messages etc. The subscription does not include a mobile phone, but the card can be used in any GSM phone. Prepaid cards enable

mobile telecommunications operators to reach new customer groups and to create a second-hand market for “old” telephones.

On 21 March 1997, Comviq launched its “Comviq Kontant” prepaid card and on 24 November the same year Europolitan launched its “Easy” card. So far, Telia does not offer this mobile telephony service but they plan to launch it during the first half of 1998. By the end of 1997, Comviq had sold 228 000 prepaid cards and Europolitan had sold 7000.

4.4 GSM 1800

GSM 1800 is a standard based on the same technology as GSM 900. The difference is that GSM 1800 uses a higher and wider frequency band, 1800 MHz, and this in turn means that the output power is lower and base stations must be closer together.

Telia is the only mobile telecommunications operator to start operating on the new frequency band, so far to a limited extent. Comviq and Europolitan plan to start using the new frequency around mid-1998. As already mentioned, the fourth licence, which was held by Tele8 Kontakt AB until December 1997, remains unused. The new owners, Telenordia, have not yet stated how they will use the licence. We are of the opinion that Telenordia will not launch a conventional mobile telephony service; instead they will use GSM technology in combination with the fixed telephony services that they offer.

The licences for the use of the new frequency band differ between operators. Europolitan and NetCom Systems (Comviq) have licences to combine their existing GSM networks with GSM 1800. This means that they can use their existing infrastructure and add new frequency receivers to the base stations. Telia and Tele8, on the other hand, have chosen to fulfil the coverage requirement by developing independent networks based on GSM 1800. Regardless of the underlying infrastructure, the frequency space will initially form a complement to the GSM 900 network, and no special services based on GSM 1800 will be launched in the near future. The greatest advantage of the new frequency space is the increased potential for the mobile telecommunications operators to improve GSM availability. This means that the number of customers can be increased and more services can be developed. The coverage requirement[17] for GSM 1800 is not as strict as for the GSM 900 network; the focus is on urban areas.

To use the frequency band, customers need new mobile phones known as dual-band phones which can handle both the GSM 900 and the GSM1800 frequencies. The first dual-band phones were launched in November 1997 and suppliers will in future

[17] The coverage requirement for GSM 1800 is that at least 50% of the population of Sweden and all towns with at least 50 000 inhabitants must be covered by 1999. The coverage requirement for GSM 900 is that all E-roads and towns with over 10 000 inhabitants must be covered.

concentrate increasingly on developing them. Both suppliers and operators confirm that eventually only dual-band telephones will be made.

4.5 Types of subscription and services

Competition between mobile telecommunications operators is still keen, and in order to tailor services to the needs of different customers, the number of types of subscription and the range of services on offer have increased during 1997 as well. With the number of customers constantly increasing while the number of operators is unchanged, the operators are increasingly developing into mass market suppliers. The battle for customers means that, apart from a slight delay due to development and implementation times, the services offered by the operators are the same. Examples of new types of subscription are the prepaid card mentioned above. In addition there are offers such as family/friend subscriptions, special campaign offers and so on. Common supplementary services are voice mail on the network, calling line identification presentation, SMS[18]-based value-added services etc. Data communication and information services are also being developed as part of the mobile concept, as well as message handling, known as unified messaging, additional information services such as news headlines in the form of SMS text messages to the mobile phone, and Internet access. Up to now, it is the low transmission speeds which limit the ability of mobile operators to offer more interesting services in these areas. Another new service introduced during 1997 is that Comviq and Europolitan customers can now rent mobile phones which can be used in the USA, (the customer uses his/her own SIM card).

4.6 Development of prices

The pricing of mobile telephone services has been broadly unchanged over the past three years. However, prices do vary between different types of subscription. Because the number of types of subscription has increased, the price structures are varying more and more. Several subscriptions with very favourable pricing have been launched during the year. The opportunity to sign up for these has been time-limited, indicating that they are more in the nature of campaign offers to win new customers than a channel price reduction. In mobile telephony there is a broad range of value-added services, and the charges for these services differ between operators and from one type of subscription to another.

Instead of reducing prices, the mobile telecommunications operators have chosen to introduce volume discounts, favouring customers who have high volumes of traffic. The business market is also favoured, since special volume agreements are signed. These agreements may give price reductions of as much as 50% compared with published scales of charges. Geographical price variations occur to a limited extent;

[18] Short Message Services

for example, Comviq offers a significantly lower call charge for business customers north of Gävle.

In addition to different types of subscription, the mobile operators also have different charging intervals. Comviq charges calls in intervals of 10 seconds, whilst Telia and Europolitan base their charges on one-second intervals. Telia introduced a call setup fee of SEK 0.32 per call during the spring of 1998. The table below shows examples of Telia's GSM pricing. We chose Telia as an example because it is the company with the broadest market focus

	Business subscription SEK (kronor)	**Residential subscription SEK (kronor)**
Subscription fee	300	0
Monthly rental	100	120*
Call charge within Sweden		
- weekdays 08:00 - 18:00	2.90/min	4.80/min
- at other times	2.90/min	1.60/min

* The fixed rental includes calls to the value of SEK 120.

The prices are exactly the same as for the previous year. The costs of the mobile operators in terms of subsidising mobile phones, investment in network expansion and costly marketing have meant that their scope for price reductions has been limited. The main reason why the prices have not been reduced is that sufficient numbers of new customers have been joining to fill the available frequency space of the operators. A reduction of the call charges would mean more customers wanting mobile phones and increased call volumes per customer, and this would increase the demand for available frequency space. Now that there is more space on the GSM 900 network and now that the GSM 1800 band is being expanded, this should no longer be a problem, at least not for the next few years. The campaign offers that the operators have launched have mainly been aimed at the residential market, with the result that the operators have been able to increase the volume of traffic during the part of the day when traffic volume is relatively low. We can state that, with regard to revenue and the loading of the mobile networks, the mobile operators' pricing has been optimal. However, from the point of view of consumers, the way in which prices for mobile telephony have developed in Sweden has not been satisfactory.

4.7 Subsidies

The mobile telecommunications operators have continued to subsidise mobile phones during 1997 as well. Since this is one of the major costs of the operators they obviously want to reduce it. However, the manufacturers of mobile phones will continue to develop new models and, as with all other capital goods, customers will want to switch to the latest model, with increased functionality and performance. Now

that customers have become used to the present price level for mobile phones, it will not be possible for the operators to remove all subsidies. More and more often, they tie the customer in to a 24-month subscription as a way of reducing subsidies and the high churn rate. When, in the spring of 1998, they gave customers the option of buying a subsidised telephone, even if they only extended the term of the existing subscription, they reduced the cost marginally, but retained the potential to reduce the churn rate.

Over the next few years, the operators will be wanting to increase the utilisation of the new 1800 MHz frequency band. The dual-band telephones required to use both the GSM 900 and the GSM 1800 network will therefore be subsidised, at least initially.

The most probable development is that subsidies on simpler phones will fall as the cost of these phones falls. As for new dual-band phones, they will continue to be heavily subsidised. Over the next two years these phones will probably be linked to types of subscription intended for major users, with a term of at least two years. In total, this will mean a reduction in the cost of subsidies to the mobile telecommunications operators. In combination with the likely fall in average prices from the mobile phone manufacturers and the continued increase in sales of prepaid cards, the effect will be even more advantageous for the operators.

4.8 Mobile telephone networks and coverage

Each of the three mobile operators has its own digital network for mobile telephony. The base stations are linked together either via radio link or fibre, either owned by the operator or as leased capacity from Banverket (The National Rail Administration) or Teracom, for example. Already by 1996 the operators were meeting the PTS coverage requirements for GSM 900 in Sweden, and the coverage of the three operators is more or less the same. During 1997 they continued to extend the GSM 900 networks, partly to cover new areas and partly to increase coverage in areas of highest demand. All the mobile phone operators have started extending the GSM 1800 network, mainly in cities, where the demand for increased frequency space is great.

During 1997, as during 1996, radio frequencies were transferred from the dialog NMT 900 system to the GSM networks of the three operators. Further frequencies were transferred at the beginning of 1998 and this will in all probability continue as the volume of traffic on the NMT 900 system decreases.

4.9 The market players

The situation on the mobile telecommunications market in Sweden is broadly an oligopoly in which the three active mobile telecommunications operators have a firm grip on the market both as network operators and as service providers. Their well-

established positions and the high degree of penetration lead Stelacon to conclude that scope for further operators on this market is practically non-existent.

No significant new players in the form of service providers emerged during 1997. The market is based on companies developing services that are made available via the GSM network. So this is a type of premium-rate calls, with the difference that the services can only be accessed via the GSM network and only by the network to which the customer subscribes. Currently there are, for example, information services such as directory enquiries, stock exchange information etc. The mobile phone user is charged by the mobile operator for the use of the service, and the service provider receives a portion of the revenue from the mobile operator. This is a relatively new market which has not yet reached a significant size and in which there are still few players. If the service providers succeed in developing their products, this market may grow in the future, especially at the time when the growth in the number of subscribers declines.

4.10 The future development of mobile telephony services

During 1998, competition in mobile telephony services will continue to be keen. The number of GSM subscribers will continue to increase for the following reasons:

- there is still potential for growth in new customer groups
- more users are switching from NMT to GSM
- continued subsidies on mobile phones
- increased range of new and used phones at low prices
- subscribers will include machines controlled by GSM technology.

It is extremely important for mobile telecommunications operators to achieve profitability with existing customers, ie to increase the revenue per customer, in order to have the financial resources to fund continued development of services and expansion of the infrastructure. This will bring about a change in the competition, with the operators concentrating more on increasing the volume of traffic, with new services for example, rather than primarily increasing the number of subscribers.

The expansion of GSM 1800 has given the mobile telecommunications operators far greater opportunities to expand both through the number of subscribers and through new services. However, it is not just the frequency space that influences the operators' potential for growth, but also the availability of new technology which exploits the existing frequency space more efficiently, and makes it possible to use more channels at a time for one subscriber.

The technology on which the mobile networks are based is constantly being developed. The main reasons for this are the need to make more efficient use of the frequency space and the need to satisfy ever increasing capacity requirements both for existing and future services such as the Internet, PC-to-LAN, video communication,

etc. Although the introduction of GSM 1800 has overcome any shortage of frequencies for the time being, the operators are highly conscious of the fact that radio frequencies are a limited natural resource. It is therefore highly important for them to exploit these resources in the most efficient and profitable way at any given time, and this in turn influences the rate of development of new services.

According to several estimations, one-third of the revenue from the mobile telephone networks will come from data communication. Considering that, according to some players on the market, only 3% of today's GSM subscribers use GSM data, the mobile telecommunications operators have a long way to go as things stand today.

The providers of mobile networks are working to increase the bandwidth and raise network quality. They state that, during the autumn of 1998, technology will be available to allow a user access to more than one channel. The technology is called HSCSD[19] and is based on circuit-switched technology. The capacity is expected to be 14.4 kbit/s, but one user can have access to as much as 57.6 kbit/s (four channels). 1999 will see the arrival of packet-switched technology, GPRS[20], which allows an effective bandwidth of more than 100 kbit/s. The providers are also preparing for the third-generation mobile network, UMTS, and as a step in this direction, GPRS is being developed further with the EDGE[21] technology, which will allow a capacity of 384 kbit/s. As UMTS[22] comes in, mobile telephony will become even more global. At the same time, new international standards have been developed to achieve call qualities comparable with fixed telephony.

4.10.1 The mobile and the fixed telecoms network

So far, mobile telephony has mainly been complementary to fixed telephony. Integration between fixed and mobile networks has primarily been limited to company solutions based on DECT and GSM, and, to a small extent, on GSM only. On the residential market, very small numbers of younger people have chosen to have only a mobile subscription.

As described earlier, the future development of the mobile telephony networks will mean that more services can be offered, services which used not to be competitive with solutions based on the fixed network. One drawback with this development is that customers' bandwidth demand increases, and the bandwidth of the fixed network is superior to that of the mobile network. The mobile network will probably only be able to take over certain services, predominantly voice and basic data communication services such as Internet access. Even if the bandwidth demand of some customers can be met, the quality of calls on the mobile network must be equal to that of the fixed network.

[19] High Speed Circuit Switched Data
[20] General Packet Radio Service
[21] Enhanced Data rates for GSM Evolution
[22] Universal Mobile Telephone System

Stelacon regards it as highly improbable that the fixed network might be replaced by the mobile network, but future developments will improve the scope for increased volume on the mobile network. This can be done either by offering fixed access via GSM or offering different types of combinations of fixed and mobile GSM. During 1997 the focus has mainly been on developing the technology for this, and up to now there are few examples of application of this technology.

With today's price level for mobile telecommunication services, GSM is not sufficiently competitive with the fixed network to be accepted by a broad market. However, a unique added value could be achieved by offering different types of combinations of fixed and mobile GSM.

In the opinion of AB Stelacon, the solution below is the one that will lead to broad market acceptance:

The customer is offered a subscription which includes a fixed access for the home, based on GSM, and a subscription for mobile telephony. The customers perceive the fixed access more or less as a fixed PSTN access offering data communication at 57.6 kbit/s or 100 kbit/s. Calls to and from the home are charged at the normal rate for PSTN; calls made with the GSM phone in the "home cell" are charged at a reduced GSM rate and outside the home cell at the normal GSM rate. Technically, the base stations and other components used for GSM fixed access are more or less the same as for mobile GSM. This gives economies of scale and lower costs. Since each customer connects both the home phones and the PC (for the Internet), and the mobile phone, the operator's revenue per customer increases considerably.

Further development of this concept might involve using GSM technology for cordless telephones in the home. This gives customers a personal telephone service with a GSM telephone, which is charged at different rates depending on whether the phone is used in the home, within the home cell, or further afield. If this phone is combined with the unit for GSM fixed radio access, customers can also be offered a movable fixed access.

With the convergence of the mobile and the fixed telephony services, there will be a need for co-operation between mobile and fixed telecommunications operators. Operators who offer both fixed and mobile telephony will be well placed to offer new, competitive services based on combinations of fixed and mobile technology.

The effect of the development on pricing

Up to now, the prices of mobile services have been considerably higher than those of fixed telephony. The relatively high prices have been possible because the technology is used to provide mobility, giving customers an added value that they have been prepared to pay extra for. Only a marginal fraction of customers have so far chosen to

replace the fixed subscription with a mobile subscription. These customers are mainly young people who move house often and who have been prepared to pay the higher call charges instead of the fixed charges associated with a conventional telephone line.

It is in the interest of the mobile telecommunications operators to keep the prices at the present levels for as long as possible. In our view, market conditions must change for the prices of the present services to fall. This could happen if, for instance, growth in subscriber numbers declines and competition for existing customers gets keener, if interconnection charges between operators fall or if the debate about the static call charges becomes more intense. It is Stelacon's opinion that the last two factors will cause reductions in all charges to begin during 1999.

The situation will be different for those services that the mobile telecommunications operators have begun to develop in order to compete with fixed telephony. If solutions based on the mobile networks are to be able to compete with the market for fixed telephony, the price differences that exist today cannot be maintained. New technology and combinations of local and national solutions based on mobile network technologies or in combinations with fixed networks, will mean that pricing will have to be significantly more differentiated. The mobile phone charges for national calls have so far been independent of distance; this may well shift towards a pricing structure similar to that currently used for the fixed network.

5. NETWORK CAPACITY

The term “network capacity” covers all forms of transmission capacity on telecommunications networks: anything from large interconnected systems to single connections and black fibre[23]. In January 1997, nine companies held PTS licences to supply network capacity. During 1997, the number of licensees has fallen by one, the company Enator Networks. However, they are among the notified companies through Enator Dotcom. In addition to these eight companies with licences, there are a further 24 companies who have notified PTS during 1997 that they are doing business in the area

The players on the market for network capacity can be grouped on the basis of their access to infrastructure, refinement capability and sales organisation. We have chosen to describe them on the basis of their access to infrastructure, refinement capability and sales organisation. Choosing to describe them on the basis of infrastructure results in two main categories: companies that own network infrastructure and companies that lease it. The expression “own infrastructure” refers only to the infrastructure that the company owns in the legal sense.

Main category 1: Companies that own network infrastructure

Table 3: *Companies or organisations that own network capacity in the form of copper, fibre, radio link networks or satellite. The turnover figures do not include any internal invoicing.*

Company	**Type of network capacity for sale**		**Turnover 1997, SEK million**	**Type of network**
	Black fibre	**Other capacity**		
Telia	YES	YES	>1500	All types
Banverket	NO	YES	105	Fibre
STOKAB	YES	NO	50	Fibre
Svenska Kraftnät	YES	NO	30	Fibre
Teracom	NO	YES	20	Radio link
Rymdbolaget	YES	YES	15	Satellite
Municipalities (10)	YES - partly	YES - partly	<15	Fibre
Sydkraft	YES - partly	YES	<10	Fibre
Vattenfall	YES	NO	<5	Fibre

[23] Optic fibre cable with no transmission equipment connected to it

Main category 2: Companies that lease network infrastructure

Table 4: *A selection of the companies that offer leased connections at speeds below 2 Mbit/s but which do not have their own infrastructure. The turnover figures do not include any internal invoicing.*

Company	Type of network capacity for sale		Turnover 1997, SEK million	Type of network
	Black fibre	Other network capacity		
Tele2	NO	YES	<15	Leased
Telecom Finland	NO	YES	<10	Leased
MFS Worldcom	NO	YES	<5	Leased
Global One	NO	YES	<5	Leased
Telenordia	NO	YES	<5	Leased

Of the players who offer leased connections at speeds below 2 Mbit/s, only Telia has its own network infrastructure. Other companies lease network capacity from other players on the market, primarily from Telia. The companies we consider to be the most important where network capacity is concerned are described briefly below. Tele2 and other telecommunications operators are described in earlier chapters about telephony services.

5.1 Descriptions of the companies

Telia: Telia is the company that has by far the most extensive national network infrastructure in Sweden. Telia leases capacity on this network in the form of analog and digital leased lines, and now black fibre as well. The other telecommunications operators are among Telia's major customers. For natural reasons, Telia's competitors prefer if possible to lease or purchase network capacity from other suppliers. During 1997, Telia's network capacity turnover was just over SEK 1.4 billion. Stelacon is of the opinion that at most SEK 1.1 billion was from sales to external customers. Compared with 1996, Telia has changed the price structure slightly, but in general terms actual price level has neither risen nor fallen.

Banverket (The National Rail Administration): Banverket has a trackside fibre network with 10 000 km of fibre cable and very good geographical coverage in Sweden. The majority of the fibre network uses SDH[24] technology and has capacity for between 2.5 and 10.0 Gbit/s (depending on location) and terminates in railway stations at 800 locations. The network is used mainly for Banverket's own purposes, but it has considerable overcapacity, and Banverket therefore leases out capacity at speeds of 2 Mbit/s and above, but not black fibre. They also rent out for space for customers who

[24] Synchronous Digital Hierarchy

wish to site their own equipment in Banverket's premises. All companies may lease capacity on Banverket network. Customers include Telenordia, Tele2, Comviq, Global One, Telecom Finland, Telia and MFS. The 1997 turnover was just over SEK 100 million, not including the telecommunications services that Banverket sells to Swedish Railways (SJ). In the years ahead, Banverket will also build a GSM-R network (876 and 880 MHz) for its own use.

STOKAB: In Greater Stockholm, STOKAB has a 750 km regional fibre network with up to 70 parallel fibre cables. STOKAB leases black fibre from this network to telecommunications operators and other companies. During 1997, STOKAB increased the geographical coverage of the network to the majority of Stockholm districts where there are significant numbers of companies, and to neighbouring municipalities. During 1998, the network will be extended to the central town of every municipality in the County of Stockholm. In practice, STOKAB has a monopoly of fibre in Stockholm. The monopoly does not extend to Telia, which can still expand its own network. The STOKAB monopoly is an obstacle to operators who prefer to own their network resources. However, the operators' attitude to STOKAB is generally positive and their view is that STOKAB's activity has a positive effect on the development of competition. The majority of telecommunications operators are customers of STOKAB. During 1997 the total turnover from this activity was about SEK 50 million. This does not include rental revenue from Stjärn TV for the use of ducting, nor revenue from municipality or County Council customers.

Sydkraft: Through the company Sydkraft TeleCom, Sydkraft has established a regional network infrastructure in the Malmö region. The network is used mainly for the company's own purposes, but it also leases capacity at speeds above 2 Mbit/s, and in certain cases black fibre as well. In Malmö, Sydkraft TeleCom is building a regional SDH network which will have quite good local coverage. One way of accessing the network is by radio link, using a Nokia system for which Sydkraft TeleCom acts as a reseller. Customers of the network are the municipality and the County Council. AB Stelacon is of the opinion that Sydkraft TeleCom's turnover on network capacity leasing during 1997 was less than SEK 10 million, excluding intra-group revenue. During 1998, similar networks will be established in Örebro. Sydkraft TeleCom is also investigating the future potential of using the electricity network as a local loop for telephony services.

Svenska Kraftnät: Svenska Kraftnät has run a fibre network on its power transmission lines between Stockholm, Gothenburg and Malmö. Svenska Kraftnät only builds fibre networks if it has an external customer who enters into a long-term contract to lease the network capacity that Svenska Kraftnät cannot use for its own purposes. At present their only customer is Tele2, which is leasing all available over-capacity on the fibre network for the next 20 years or so. For its own use, Svenska Kraftnät has an SDH network, but their contract with Tele2 prevents them leasing SDH connections to companies outside the energy sector. Svenska Kraftnät does not possess the local network and cannot therefore establish itself as an access provider.

They do not intend to extend the fibre network on a speculative basis, and extension of the network is therefore entirely dependent on the interest of external companies in black fibre. During 1997, it was extended only marginally. However, Svenska Kraftnät's own data communication needs are steadily increasing and they therefore take a positive approach to gaining more customers to finance further extension of the network. In our opinion, Svenska Kraftnät's turnover during 1997 for the leasing of black fibre was about SEK 30 million. This does not include the leasing of SDH connections to Vattenfall, Sydkraft and other power companies.

Vattenfall: Vattenfall has installed about 250 km of fibre along its power transmission lines. Unlike Svenska Kraftnät's national infrastructure, Vattenfall's is more regional and local. Currently, Vattenfall's fibre network is regional and is complementary to Svenska Kraftnät's fibre network, which usually terminates some way away from urban areas. Vattenfall has installed fibre for its own use, and is gradually extending the network. They also lease black fibre to telecommunications operators such as Tele2. The 1997 turnover was less than SEK 10 million.

Teracom: Teracom has a radio-link-based network with very good geographical coverage. The network is based on SDH technology and has a capacity of at least 155 Mbit/s. Teracom rents mast sites to mobile telephone operators etc, and these companies are also their main external customers for network capacity at speeds from 2 Mbit/s and upwards. Other telecommunications operators and data companies also purchase connections from Teracom. Examples of customers who lease network capacity are Comviq, Europolitan, Telecom Finland and The Swedish Post Office (Posten). The turnover from this activity during 1997 was about SEK 20 million. Teracom is building a terrestrial network for the transmission of digital TV, which is expected to make a breakthrough on the market in the years ahead. In combination with the telephone network, this network will also be able to offer interactive services.

Rymdbolaget: Among the services offered by the Telecom Division of Rymdbolaget are satellite-based telecommunications services. Rymdbolaget has 26 TV transponders on the Sirius 2 digital satellite, as well as six transponders which can be used for telecommunications, for instance. The bandwidth of a transponder is equivalent to 36 Mbit/s. Rymdbolaget's satellites are used mainly for TV, and the turnover for telecommunications services is about SEK 15 million. Rymdbolaget has also played an active part in the development of Internet access involving a combination of communication via satellite and via the telephone network. During 1998, Tele2 launched a service of this type, using Sirius 2.

Municipalities: According to the quantitative study of network capacity in Sweden's municipalities undertaken by Stelacon in April 1997, 210 of Sweden's 288 municipalities had some form of private network. Just over 100 of these municipalities have based the network wholly or partly on their own network capacity, using fibre cable or radio links, for example. Almost one-third of these 100 municipalities had built their networks during 1996. With a few exceptions, the

networks of the municipalities are of limited extent. Only 25% of them had 7.5 km or more of fibre cable and only about 10 municipalities offered leasing of network capacity to external companies. We estimate that approximately a further 10 municipalities have established urban networks since April 1997, and that a large number of the existing networks have been further extended. According to Stelacon's study, Stockholm (STOKAB), Linköping, Ängelholm and Gothenburg are the municipalities with the highest network capacity of their own. Apart from these, the size of municipal fibre networks is not yet sufficient for them to be a significant resource for the telecommunications operators. However, the networks have a major effect on the telecommunications of the municipalities and on their telecommunication costs. Note that these networks are usually owned by power companies, which are in turn owned by the municipality.

Others: The other companies licensed to lease network capacity are Tele2, WorldCom, Global One, Telecom Finland and Telenordia. They lease out network capacity at speeds between 64 kbit/s and 2 Mbit/s directly to the final customer, ie companies in Sweden. During 1997, none of these operators sold significant amounts of network capacity.

5.2 Services offered

The players in the network capacity market therefore differ in terms of access to network infrastructure, and this has led to differences in the services offered by the companies. There is a clear correlation between the network resources of the companies and the degree of refinement of their services. One exception is Telia, which is present in all areas. Stelacon's view is that the services comprise three main groups, two being network providers and one being a service provider.

- The network providers (the first group) are those who sell unrefined network capacity, black fibre for example. This is the simplest form of network capacity. Companies who offer these services are companies that have their own network infrastructure, such as STOKAB and Svenska Kraftnät. They view the network infrastructure as an important resource of their own company or the parent company, and sell over-capacity as a way of financing the network. In principle, no knowledge of telecommunications is required to supply unrefined network capacity, and this suits companies when their core activity is in other areas. Their main customers are service providers who in turn take the initiative to exploit the infrastructure in various ways.
- The network providers in the second group are those who sell refined network capacity in the form of leased lines, usually at speeds of 2 Mbit/s and above. Compared with unrefined network capacity, refined services can provide a better return on the investment. Despite the higher degree of refinement, these services still require only a minimum of knowledge of telecommunications. This may be seen as a first step for these providers towards becoming a telecommunications operator offering additional services with an even higher degree of refinement.

Examples of companies in this group are Banverket (The National Rail Administration) and Sydkraft. Because of the relatively high bandwidth offered, it is mainly service providers, not final customers, who purchase capacity from companies in this group.

- The third group comprises service providers who sell leased lines, usually between 64 kbit/s and 2Mbit/s. Compared with the network providers, they offer network capacity with greater bandwidth flexibility and accept greater responsibility as regards service, monitoring, etc. For the service providers, the leased lines are complementary to their other telecommunications services such as telephony and the Internet. Unlike the companies in the two groups above, and with the exception of Telia, they have no network capacity of their own. To establish yourself as a service provider requires not only greater knowledge of telecommunications activity but a more comprehensive organisation. Examples of companies in this group are Tele2, Telenordia and WorldCom.

In Sweden it is still unusual for companies in this market to move from one group to another. However, there is clearly an opportunity for a network provider to set up as a service provider. This can be done either by offering more advanced services and expanding the organisation, or by acquiring, or entering into alliances with, conventional telecommunications operators. In Sweden, however, none of the companies that own network infrastructure openly state such ambitions.

5.3 Market shares

The network capacity market is complicated, partly because it is made up of network providers and service providers, and partly because the various sub-markets overlap. The diagram below illustrates the structure and value of the market for 1997.

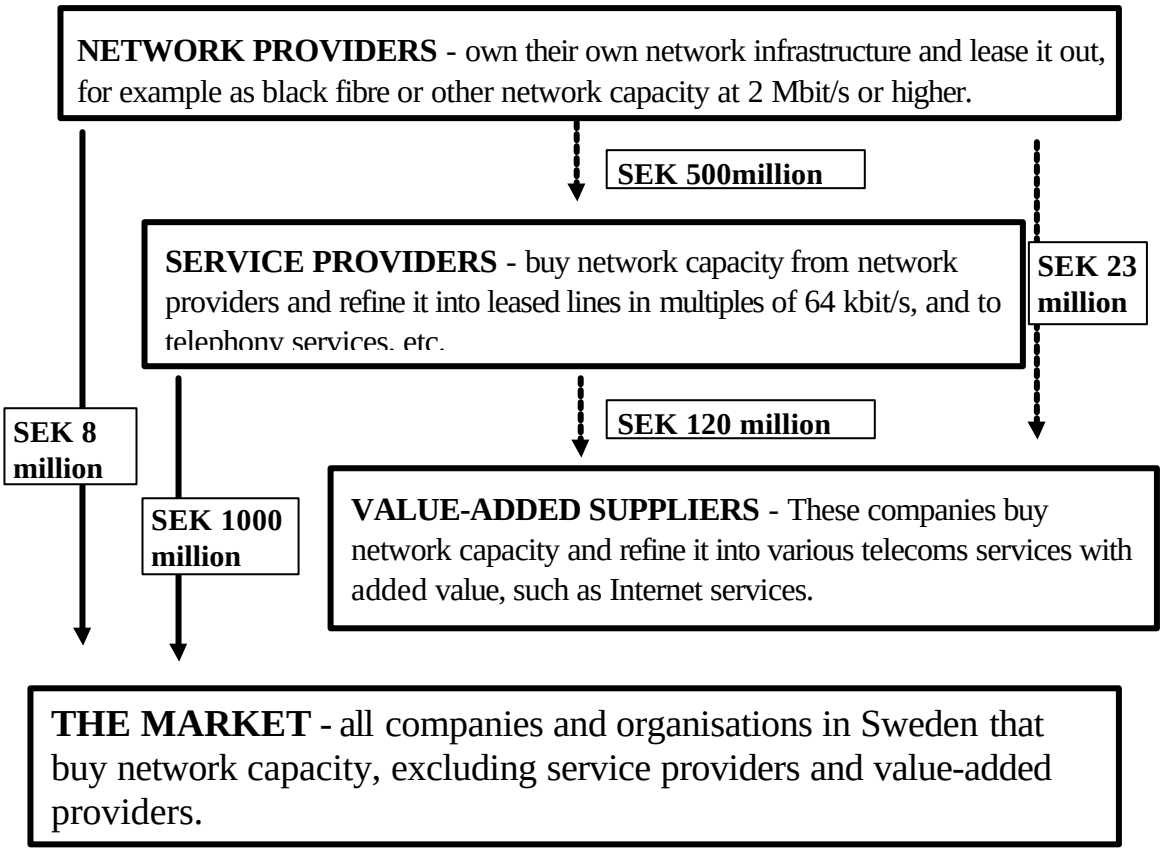


Figure 20: *Schematic description of the network capacity market. The figures do not include internal invoicing.*

Figure 20 shows schematically how the network capacity market is divided into segments. In fact the reality is even more complex, since network capacity is also sold by network providers to other network providers, from service providers to other service providers, and so on.

A significant proportion of all the network capacity produced and sold by network providers and service providers never reaches final customers in the form of leased lines. This is because leased lines are largely used as a raw material by service providers or value-added providers (telecommunications operators). A very common field of application for leased lines is as access lines to data and telecommunication networks. It is therefore incorrect to total the sales figures for the different parts of the market as a way of determining the total size of the market. We have therefore chosen to describe two of the markets, the selling of network capacity by a service

provider and the selling of network capacity by a network provider to a service provider.

1. The selling of network capacity by a service provider

Service providers sell fixed network capacity both to final customers and to other service and value-added providers. As regards the sale of network capacity directly to final customers, Telia has more than 95% of the market, which we estimate to have been worth about SEK 1 billion in 1997. Only a negligible proportion of this figure was for leased lines with a bandwidth above 2 Mbit/s. The figure does not include sales to other service providers or similar, nor internal sales or the lines used to connect PABXs to telephone networks and the like.

The sale of network capacity by one service provider to another service provider or an value-added provider is also a significant market. This market consists largely of Telia's digital leased lines (64 kbit/s to 2 Mbit/s). These lines are leased by companies who in turn use them as access lines to their networks. Lines are then leased in order to be refined and offered to the final customer as some other service set as telephony, Frame Relay or ISDN. In practice this means that Tele2 and Telenordia are among Telia's biggest customers for leased lines. Telia leads the market in this field as well, and faces no significant competition. We estimate that this market is worth about SEK 350 million, of which Telia has a market share of about 98% for 1997.

2. Selling from a network provider to a service provider

Network capacity sold directly from network providers to service providers accounts for a significant market in which network capacity is used among other things for the operators' national or regional trunk networks. This market consists mainly of black fibre or leased lines at more than 2 Mbit/s. Telia is the market leader in this field as well, but faces stiff competition from Banverket, Teracom, Svenska Kraftnät and STOKAB. In principle, companies and organisations owned by the state or the municipalities are all players in this market. We estimate this market to be worth around SEK 500 million, of which Telia had a market share of about 50% in 1997. This segment is the only one in the network capacity field where competition is working well.

5.4 Market conditions

In 1997, as in previous years, Telia has been particularly dominant in the network capacity market. For network capacity with a bandwidth above 2 Mbit/s competition works quite well, but this part of the market is relatively small. In value terms, the major part of the market clearly consists of leased lines at speeds below 2 Mbit/s, which are sold by the service providers. During 1997 the only service providers were the established telecommunications operators, ie Telia, Tele2, Telenordia, WorldCom

and so on. The reasons why these companies find it difficult to get established in this market are:

Compared with most other countries, Telia offers network capacity at very low prices. However, it is Stelacon's opinion that Telia's prices for network capacity cannot be regarded as too low in relation to Telia's production costs for these services. However, the low prices make it difficult for the new telecommunications operators to establish themselves in this market. The main reason for this is the costs these operators incur in producing these services. Since they have no infrastructure of their own, they must lease it from other players on the market such as Banverket and STOKAB. Leasing from the alternative network providers gives regional coverage at best. Network capacity for the local loop cannot be purchased from these suppliers. Since there are in principle no alternative local loops, they are forced to lease them from Telia.

However, Telia does not offer a local loop service; instead, ordinary leased lines are used, such as Telia Link X-Line. In recent years, the charges for Telia Link X-Line have become less and less dependent on distance, and a 100 km line does not cost ten times as much as a 10 km line. In addition, Telia Link X-Line is the Telia service that the alternative service providers must compete with. Consequently it is only possible in exceptional cases for service providers other than Telia to offer leased lines at competitive rates.

So the fundamental reason for the lack of competition is that the service providers have no cost-effective alternatives for the access lines. Competition will therefore not increase significantly until there are alternative access lines at prices lower than Telia's. Another alternative to increased competition is that the companies that own network infrastructure set up as full-scale service providers or form alliances with them. This has happened to some extent in the United Kingdom and Germany, but there are no signs of such alliances in Sweden.
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5.5 The need for an alternative network infrastructure

Access to network capacity, and its cost, are highly important to a telecommunications operator which bases its services on more than just interconnection traffic with others. For the alternative operators to be able to develop into fully-fledged alternatives to Telia they must have access to cost-effective network capacity. None of the alternative operators of telephony services owns significant amounts of network capacity; instead they must lease it from other companies or establish their own solutions.

The companies which own network capacity today set up their networks in order to support their core activity. So the networks were created for different purposes, and this is why the characteristics of the different companies' networks differ. The characteristics of the networks are an important factor in determining the extent to

which they can be used by telecommunications operators and other external customers. The following factors are the most important ones, and this is where the differences between the networks lie: bandwidth, geographical coverage and spread.

Bandwidth

The bandwidth of a network is an indication of its ability to supply different services. The greater the bandwidth, the more services can be supplied and the more capacity-demanding they can be. Some players sell only black fibre, whilst others sell leased lines with a slightly higher degree of refinement. What mainly appears to influence the choice of service is how much fibre they have and the cost of laying more fibre. The bandwidth of a fibre cable is limited by the terminal equipment; in theory a fibre has infinite bandwidth. With the latest technology in the field, WDM[25], a bandwidth of 20 Gbit/s can be achieved, equivalent to 10 000 2 Mbit/s lines. By way of example, Banverket has chosen not to sell black fibre, whereas STOKAB has chosen to sell only black fibre. The table below shows the bandwidths of the various networks on a scale of 1 to 5, where 5 is highest and is equivalent in practice to 20 Gbit/s or black fibre.

Geographical coverage

Networks are generally built on the basis of the geographical areas where the companies conduct their core activity. Obvious examples are Banverket (The National Rail Administration), which runs its fibre cables alongside the tracks, and Svenska Kraftnät, which runs fibre cables along the power transmission lines. As far as geographical coverage is concerned, three different types of network can be identified:

- *Local* networks, connecting together final users within a building or over a small area. These networks are usually built as private networks for internal use and it is unlikely that they will play a significant part in the network capacity market.

- *Regional* networks, the network infrastructure in a town, municipal networks for example. These networks are built for the municipalities' own use and generally have no local infrastructure except to individual workplaces. Examples of infrastructure with both local and regional coverage are cable TV and the networks of the power companies.

- *National* networks, trunk networks used to interconnect local or regional network infrastructures. These networks often have very high bandwidth and a small number of connection points, with the result that service providers are the only target group for these networks. Examples of national trunk networks are those of Banverket, Svenska Kraftnät and Teracom.

[25] Wavelength Division Multiplexing

Spread

Here, we define “spread” as the ability of the infrastructure to reach the final users. This is highly important for the field of application of the network. A company that can only supply network capacity between heavily populated areas can only sell to service providers and other large companies that build private networks. The table below shows the spreads of the various networks on a scale of 1 to 5, where 5 is highest and means that the network has a well developed local loop.

Table 5: *Overview of the characteristics of the alternative network infrastructures*

Company	Coverage	Bandwidth	Spread
Telia	national, regional, local	5	5
Banverket	national	4	1
Svenska Kraftnät	national	3	1
Teracom	national	2	1
Stokab	regional	5	3
Municipalities (10)	regional	3-4	2-4
Sydkraft	regional	4	2
Vattenfall	regional	4	2
Rymdbolaget	satellite coverage	2	5

It is plain from the table above that there is a relatively good supply of national and regional alternative network infrastructure. Within these two areas there are several choices. On a national basis, alternative network capacity can be obtained from companies such as Banverket, Teracom and for those telecommunications operators that have larger volumes it is also worth while leasing black fibre from Svenska Kraftnät. Regionally, capacity can be leased from STOKAB, Sydkraft, Vattenfall or municipal networks. If the municipal networks are to play a more significant part than they do today, it is Stelacon’s opinion that they need a coherent common denominator in the form of a player with a national infrastructure which would be complemented by the municipal networks.

However, none of the alternative networks can be used to connect the final customers, ie as local loops. Satellite reaches the final customers but cannot be used for two-way communication, and this is a major drawback. The alternative service providers badly need alternative local loops and the lack of these has stimulated the development of new alternatives, partly on their own account and partly from other companies that have an infrastructure which could be used for local loops.

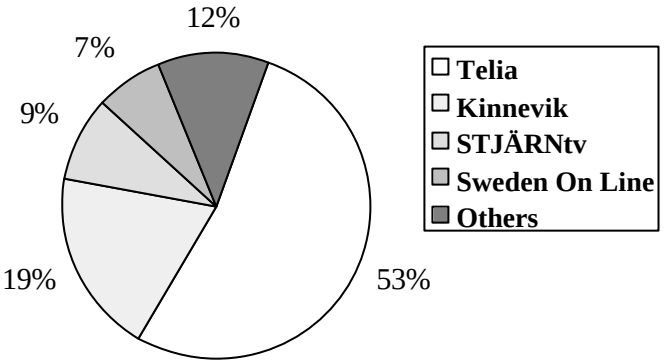
5.6 New alternative local loops

There follows a brief description of the alternative infrastructure and the new technologies that can be used to overcome the local loop problem.

Cable TV

Cable TV is an infrastructure that can be developed into an alternative local loop to supply telecommunications services to homes. AB Stelacon estimates that just over 55% (2.3 million) homes in Sweden are connected to cable TV. Of these 2.3 million subscribers, about 60% pay for a package which provides more than the terrestrially-transmitted channels[26]. During 1997, growth in the number of homes with cable TV has been marginal and the major part of the growth comes from newly-constructed multi-family buildings. There are two main types of cable TV: CATV[27] and SMATV[28]. Since SMATV is unprofitable because of its higher service costs and poorer performance, cable TV operators are attempting to move away from this technology. We estimate that no more than 250 000 homes are connected via SMATV.

Market penetration of cable TV, 1997



Base: 2,3 million homes connected

Figure 21: *Market penetration in number of connected homes with CATV or SMATV. The figure for Kinnevik covers both Kabelvision and Viasat.*

The first cable TV systems were installed in Sweden during 1986, and the major part of today's cable TV networks was built between 1986 and 1990. Most of the networks were built before Sweden had established competition in telecommunication services, and they are therefore not designed with telephony services in mind. The market is dominated by four players who together have 88% of the market, in terms of number of homes connected. Telia has just over 50% of the market for cable TV and it is not clear to what extent Telia intends to use its cable TV network as an alternative to the telephone network. Of the other players only Kinnevik (NetCom) is also a telecommunications operator. Since they can benefit from the effects of synergy with their other activities in the field of telephony, the established telecommunications operators such as Telia and NetCom can reduce the costs of cable TV telephony. In networks that are not owned by telecommunications operators, there is less scope for this. It is therefore Stelacon's opinion that the networks owned by companies other

[26] Terrestrial channels = SVT 1, SVT 2 and TV 4
[27] Cable Television
[28] Satellite Master Antenna Television

than telecommunications operators have very little prospect of offering telecommunication services via the cable TV networks.

Most of the major cable TV operators are currently working on converting their networks to digital operation. The reason for changing to digital is to improve the potential of the core activity, cable TV, but also to be able to offer new services such as Internet access, VoD[29] and telephony. Tests are being conducted to adapt the networks for telecommunication services in the form of, for example, IP traffic and/or with Internet access via the cable TV networks. Before the cable TV networks can be used for interactive telecommunication services, investment will be needed both in the operators' part of the networks and in the networks within the buildings. A cable TV operator may take a positive view of the investments, but the owner of the property must also take a positive view. It is worth noting that a cable TV network must be converted for the entire building, regardless of how many homes want to have telephone and Internet services via the network. This is a major difference from both DSL[30] and radio-based solutions, which only involve a cost to the connected home, not the entire building. In addition interactive communication via cable TV requires a special modem at the final user (the consumer). These modems currently cost about SEK 5000, but it is hoped the cost will soon fall to about SEK 2000 per modem.

At present, cable TV operators see the Internet as the priority additional service, not telephony. Instead of adapting the cable TV network for conventional circuit-switched telephony, it looks at present as if the cable TV operators will choose IP telephony. Whatever technology they choose, Stelacon is of the opinion that telephone services via the existing cable TV networks will not be offered until some time during the year 2000 at the earliest, although some buildings will be offered the service earlier in order to test the market and try out the technology.

Satellite

According to Stelacon's study "The Household Bus '97", which was undertaken in September 1997, there are about 700 000 homes (18%) with a parabolic antenna ("dish"). One possible alternative would be to reach these homes and possibly businesses directly via satellite to a dish at the receiver. At present this is only an option for receiving data/telecommunications, not for sending. This is because the equipment for sending to a satellite, known as an uplink, is costly and requires a licence. However, the solution can be combined with other options such as the telephone network. Jointly with Rymdbolaget, which owns the Sirius 2 Satellite, Tele2 has developed an offer of Internet access via satellite. The solution is based on the customer sending data via the telephone network and receiving data via a satellite dish. The new digital settlements can offer cheaper bandwidth than the analog satellites. The digital satellites cannot be used for two-way communication, and are therefore only complementary to local loops, not an alternative.

[29] Video On Demand
[30] Digital Subscriber Line

Electricity networks

During 1998 there has been great interest in solutions that use the electric power supply network as a local loop for telecommunication services. Subscribers are given an Ethernet connection, which is connected to the electricity network by a coaxial cable. A DPL[31] system can carry a total of 1 Mbit/s, which can be shared by up to 20 subscribers. Behind the new DPL technology are the companies Nortel and Norweb. Vattenfall, Sydkraft and Stockholm Energi have shown great interest in the technology and if these three electric power companies introduce DPL, it will affect more than 2 million customers. The technology will be evaluated during 1998 and will not be introduced on a larger scale in Sweden until 1999 at the earliest. However, if DPL is to become established as an alternative local loop, it is not enough for the technology to work; it must be possible to provide the solutions at low cost. The total costs of DPL are still unclear and they may differ in different countries because of differences in the electricity networks. Since customers will be connected via Ethernet, Internet access will probably be offered first, then, at a later stage, telephony based on IP.

Radio-based local loops

The idea of using radio-based solutions for the direct connection of homes and businesses is currently being looked at closely by many players, both in Sweden and in other countries. Developments in the field are being driven by two main needs: one is to use the technology to connect new customers in areas where there is no existing network infrastructure, for example new buildings in rural areas. In Sweden this need is relatively small, but the need and the market are all the greater in developing countries with no infrastructure at all. The other need, which exists primarily in industrial countries, is for new operators to use the technology for the direct connection of customers without using the network of the dominant operator. In Sweden it is mainly the second application that is the driving force, but globally there is a major need for both applications and this is driving the technology forward and the prices down.

There are three main radio-based access technologies on the market.

- **Fixed point-to-point radio link**

Fixed radio links have been used for many years and may be regarded as both a proven and a reliable technology. The technology is relatively costly and is used above all for connections in the operators' trunk networks and in private networks. However, in line with the rapid increase in the demand for bandwidth in recent years, more and more operators have decided on fibre, and as a result the growth in radio link solutions has been relatively slow.

[31] Digital Power Line

- **Fixed point-to-multipoint**

Unlike fixed radio links, this technology is used to handle all or parts of the local loop. Early in 1998, the NetCom company Interloop launched an ISDN service based on radio access in the 3.4 - 3.6 GHz band. Telia and Telenordia also have licences to use this frequency band. Via radio access at 128 kbit/s, Interloop is offering fixed telephony and Internet access in Stockholm and Gothenburg. The cost of the telephony service is lower than for indirect connection (via Tele2). The Internet service is charged on the basis of traffic volume, not as is normally the case, time. This is because the radio access uses packet-switching technology instead of circuit-switched, so the loading on the network is more in proportion to volume than to time.

Interloop is aimed mainly at small and medium-sized enterprises that need relatively fast Internet access, but do not want to invest in a fixed connection. In the USA, AT&T use the same solution as Interloop, but aim mainly at homes.

- **Fixed/mobile hybrid point-to-multipoint**

It is also possible to use GSM technology for various forms of radio-based local loop. Although there have been ready-made solutions in this field during the year, they have not found commercial application in industrial countries. This is mainly due to the fact that GSM cannot offer data communication at speeds higher than 9600 bit/s and the speech quality is not comparable with fixed telephony.

In the next few years, however, GSM data communication speeds will increase and the technology will soon be able to offer circuit-switched 57.6 kbit/s and in the next stage packet-switched 171.2 kbit/s. The speech quality will also improve, and this will open up potential for local loops based on GSM technology. AB Stelacon is of the opinion that services based on GSM access to the fixed network will be introduced on the Swedish market during 1999 and that they will mainly be aimed at homes. They will therefore be complementary to the Interloop solution described above.

6. FACTORS AFFECTING COMPETITION

One way of achieving the telecommunications policy goals in Sweden is to establish an effective competition situation in the telecommunications market. A number of factors that are highly important for the present competition situation in Sweden are listed below.

To begin with, it can be stated that the competition situation is very different for fixed and mobile telephony. In Stelacon's opinion, these are the most significant differences:

- Unlike fixed telephony, mobile telephony subscribers are directly connected to the mobile telecommunications operator.
- The three mobile telecommunications operators are significantly more vertically integrated, in other words they are both network operators and service providers, compared with the alternative telecommunications operators which offer fixed telephony services.
- The scope for a new mobile telecommunications operator who does not hold a licence to become established is non-existed, since the frequency space will not allow more operators until 2000 at the earliest.
- The mobile operators are more equal in terms of number of subscribers, market shares and services offered than the telecommunications operators who offer fixed telephony services.

Generally, the mobile telecommunications operators are satisfied with the situation on the market for mobile telephony services. At present they operate in an oligopolistic market in which all three active operators are well established and feel no immediate threat from possible newcomers.

However, this view is not shared by the telecommunications operators active in the fixed telephony market. Among these operators there is a widely held opinion that, during 1997, there have been too many companies operating in Sweden for the size of this highly competitive market. Several international telecommunications operators are established in Sweden for reasons other than simply selling telephony services. A presence in the Swedish market is an important "piece of the puzzle" as far as offering global coverage to multinational companies is concerned.

The telecommunications operators maintain that certain changes must be made for competition to be possible in more areas. The changes introduced in the Telecommunications Act of 1 July 97 and the planned changes, such as number portability and preselection, support the view of the telecommunications operators and will therefore be extremely important. These two changes, together with interconnection charges and local loops are factors that are to a large extent

interrelated and which have a major effect on competition. Here are some examples of this:

- Even if it becomes more commercially possible for the alternative telecommunications operators to connect customers directly, their costs are still affected by the charge for interconnection with Telia for the customer's outgoing calls to Telia subscribers.
- Customers who want to be directly connected to a telecommunications operator other than Telia must change their telephone number, and this always costs the customer money. The idea of number portability is to eliminate this problem. However, number portability does not reduce the cost of directly connecting the customers, and until the local loop problem is solved, number is only a problem for a small portion of the market.
- Unduly low interconnection charges in combination with preselection mean that the alternative telecommunications operators will be less interested in connecting customers directly.

6.1 Interconnection charges

Every operator is dependent on interconnection with the Telia network. This is true regardless of whether the customers are connected directly or indirectly, since the traffic must pass through the Telia network in one way or another. This in turn means that the interconnection charges have a significant influence on the ability of the telecommunications operators to compete.

According to the Telecommunications Act, the interconnection charge must be cost-based for telephony service to a fixed network termination point. This has led to prices developing as follows, according to the standard Telia scale of charges:

Table 6: *Telia's interconnection charges for telephony services to a fixed network termination point, 1994 - 1998.*

Year	Charge per minute (SEK/100)	
	Peak Monday-Friday 0800-1800 (with no public holiday)	**Off-peak** Other times
1998	12.6	6.3
1997	16.0	8.0
1996	27.6	13.8
1995	23.5	23.5
1994	27.0	27.0

The above charges are for Telia's Termination and Access service. The charges are based on traffic within a single segment. From 1997 onwards there is an additional call setup charge of SEK 0.07 per call.

As Table 6 shows, the charge per minute has been more than halved during the period 1994-1998. However, the amount and structure of interconnection traffic differs between the telecommunications operators, and this has led to the signing of individual agreements which do not follow the standard scale of charges. These agreements are not made public. Telecommunications operators who receive a relatively large volume of traffic from the Telia network to their own network are in a stronger position in these negotiations and can therefore achieve more advantageous agreements.

Under the new telecommunications legislation, all notified companies have the same opportunity for cost-based interconnection as licensed companies. However, the major telecommunications operators, with the exception of Telia, do not think that there has been an increase in requests for interconnection from new players. "Switchless reseller" telebrokers are not required to notify and are not entitled to interconnection, nor do they need it.

One interesting point is that interconnection charges for calls from the fixed network to the mobile network have remained at the same level in 1997 as in 1996, namely SEK 2.74 per minute. Some telecommunications operators divert traffic (calls from the fixed network to the mobile network) abroad in order to benefit from lower interconnection charges and thus offer customers lower prices. According to the telecommunications legislation, interconnection traffic for telephony service to a mobile network termination point must also be cost-based if it is operated by someone with a significant influence on the interconnection traffic market and who is notified. At present, no operator has been judged to be covered by this rule, and the charge is therefore market-based. However, it is possible that Telia will be covered in the near future, and this may mean a reduction of the present interconnection charges, which may also affect the price to the final customer.

6.2 Preselection

The introduction of operator choice by preselection is planned for 11 September 1999. At present it covers international and national traffic for fixed telecommunication networks.

All alternative telecommunications operators see operator choice by preselection as a very important matter. As mentioned earlier, the alternative operators have the problem that their indirectly connected customers forget to dial the prefix needed to access their network. In some cases the operators have given customers routers which automatically direct calls to their network. This only solves the problem for those customers, ie businesses, and involves a cost. The entire prefix problem could be eliminated by preselection. It is estimated that 30% of competitors' calls go to Telia because of the prefix problem. The alternative telecommunications operators are concerned about how Telia will act when preselection is introduced and what scope

they have to counter Telia's action. One possibility is that Telia might offer pricing models which make it more difficult to distinguish between the call charges and the fixed line rental charges. At present, Telia has little scope for raising the line rental charge because of the price cap that governs the fixed charges. The question the alternative telecommunications operators ask themselves is to what extent Telia can use all or parts of the line rental as a basis for calls. If Telia offers pricing models for fixed telephony that resemble the model commonly used for mobile telephony, ie "make calls for the fixed charge", this might reduce the effect of preselection.

One direct effect of the planned introduction is that several smaller telecommunications operators have moved away from their priority investment in direct connection and are instead focusing on indirect connection, since they are of the opinion that indirect connection will be favoured in the future.

Mobile telecommunication services are currently exempt from the requirements concerning equal access with preselection and telecommunications operator prefix. For natural reasons, the mobile telecommunications operators are not interested in the introduction of preselection either. Since mobile telephony customers always connect directly to an operator at present, they are also tied to the pricing of that operator. This would change if preselection were introduced and would very probably have an effect on the call charging rates, which are static at present.

6.3 Local loops

The question of local loops is very important for the development of competition. Before it is possible to compete for all the telephony of a customer, not just certain types of call, the customer must be directly connected. Those alternative telecommunications operators whose aim is to become a fully-fledged national alternative to Telia are investing huge resources in solving the local loop problem.

The collective opinion in the market is that there are essentially only two solutions to the problem. One is to make Telia's local loop available to the other operators and the other is radio-based access technologies. Since Telia's local loop has not yet been made available, the operators are working with radio-based access technologies. To some extent the operators are also working with solutions via cable TV and satellite, for example, but only for certain niches. However, since 1 July 1997 there has been a change in §20 b of the Telecommunications Act which might mean an opportunity for alternative operators to have access to the local loop. The Act states "that an operator who is liable for licensing or notification is obliged to meet every reasonable request for connection with telecommunication networks for interconnection traffic". The significance of this formulation has not yet been tested, but it might well affect access to the local loop.

6.4 Number portability

The introduction of number portability on change of telecommunications operator is planned for 1 July 1999. In the initial stage, number portability will cover fixed telephony services, freephone services and premium rate services. It will be introduced in major centres of population, with priority for the cities of Stockholm, Gothenburg and Malmö.

The general attitude to number portability is positive. Number portability makes it easier for competing telecommunications operators to win directly-connected customers who currently regard it as inconvenient to have to change telephone number when changing operator. However, in the prevailing circumstances, direct connection will only be available for business customers in the major cities. Number portability alone is not significant with indirect connection; the local loop problem must be solved before it can have positive effects. So the introduction of number portability does not bring with it the advantages of being able to offer services to new sub-markets.

The attitude of the mobile telecommunications operators to number portability is positive if it means for number portability, ie portability of numbers between the fixed and the mobile network. The attitude to number portability limited to the mobile networks is negative. This is because one of the most important factors in retaining existing customers is their resistance to having to change telephone number when they change their mobile operator. If this obstacle is removed, the result will be keener competition with higher churn and consequently higher costs to the operators. This in turn would benefit customers in the form of more attractive offers and lower prices.

7. TRENDS ON THE TELECOMMUNICATIONS MARKET

Some trends which Stelacon believes will be highly important for the development of the telecommunications market in Sweden are described briefly below.

Greater disparity in access to telecommunications services

One effect of competition on the telecommunications market is an increased concentration on the most profitable segments, with the result that the customers who are given the highest priority by the telecommunications operators are the first to have access to new telecommunications services. Developments over the past ten years show that new services are launched first in urban areas. For example, customers in Stockholm had access to both ISDN and ATM services before AXE exchanges had been provided for all customers in rural areas. Up to now, the new telecommunications operators in the market have clearly focused on customers in urban areas, and if Telia is to be able to compete with these operators, Telia must also be quick to launch new services in these areas. Bearing this in mind, it is our opinion that new services will usually first become available in urban areas during the years ahead as well.

In addition, the actual cost of connecting customers to telecommunications or data networks is lower in urban areas than in rural areas. As Telia's market shares decline, Telia's ability to maintain the same prices in rural areas as in urban areas is gradually weakened. The pricing of several of Telia's data network services is already geographically differentiated, with lower prices in urban areas. As far as telephony is concerned, we believe that Telia will put off the introduction of geographically-differentiated prices as long as possible. However, it is Stelacon's opinion that there is a risk that the trend towards differences in prices and services offered between urban and rural areas may affect the telephony service, for instance in the form of different line rentals. It is worth noting that the fixed charges, which include the line rental for fixed telephony services, are subject to a price cap[32].

Players in the Swedish market

In last year's report, Stelacon wrote that deregulation in Europe would lead to less of a focus on Sweden. This has indeed happened, and there is nothing to indicate that the number of telecommunications operators on the Swedish market will increase. However, the currently active operators are well established and will continue to develop. Given the keen competition in Sweden, foreign telecommunications operators will mainly concentrate on markets now undergoing deregulation, such as Germany. In these countries they can be present from the outset, which has proved to

[32] At present, the price cap means that the dominant company in the market must not raise the fixed charges related to a basic subscription by more than the net price index for the previous year. This applies to telephony services between network termination points from a permanent dwelling of fixed place of business with a direct telephone.

be important for achieving the high market penetration that gives a satisfactory return on investment. A company must be present and have its own representation in the Swedish market if it is to be able to offer multinational companies good geographical coverage of Europe. One possible development might be for smaller niche operators in Sweden to be bought up by foreign operators.

Fixed and mobile telephony services

Fixed and mobile services used to operate in fundamentally different ways, but these two markets are becoming increasingly similar. Resellers are being used more for fixed telephony as well, services in which the technologies are combined are being developed, either through various kinds of package solution or the two technologies are used for one solution. Stelacon believes that the pricing structures of the two services will converge further in the future. In mobile telephony, the cost of national calls has been independent of distance. The future introduction of the mobile home zone, company zone etc is an indication of the arrival of more differentiated pricing, similar to that for fixed telephony. Over the same period, the cost of fixed national telephony will become less dependent on distance, and within three years the present differences in price structure between fixed and mobile telephony will no longer exist.

Alternative local loops - alternative network technologies

As already mentioned, the local loop is highly important for the development of the market. Currently it is Telia's local loop (copper) that is almost exclusively used for access to telecommunications and data communication networks in Sweden. However, alternative local loops such as radio, cable TV and satellites have been developed, and during 1998 we have seen that they have begun to be used. The new technologies have mainly been used to access the Internet, but also to some extent for telephony. At the same time, various kinds of DSL technologies give increased bandwidth on the existing copper cables (Telia). It is Stelacon's opinion that none of these technologies will make a breakthrough on the entire market. Each of the new technologies has its own unique strengths and none of them is superior to the others on all relevant criteria. So what will happen is that different technologies will succeed in different geographical segments, and in different customer groups with different needs, etc. The matter of the choices of technology in the area is discussed below.

Technology choices

The past decade has been characterised by digitalisation, which has brought the telecommunications and data sectors closer together. Over the same period there has been a struggle about which technology or technologies will be used. In recent years it has been very evident that there is a trend towards more and more manufacturers preferring open standards. The old idea of locking customers into solutions unique to a given supplier is no longer considered to be a successful strategy. Instead, suppliers are seeking broad solutions with large customer bases, giving high volumes and low

manufacturing costs. This is an argument for the further development of standards that are already widespread, such as IP, GSM and copper cable.

There is also a trend towards different services and offers being fundamentally based on the same technological platform. What are today different technologies and separate networks, for instance the Internet via TCP/IP, fixed telephony via PSTN and mobile telephony via GSM, will be based on the same switches (hardware) but with different software. The aim is to reduce the costs of hardware and servicing and to cut the lead times for the introduction of new services. Using the same technology and the same equipment for different services creates entirely new opportunities to quickly create new services at low cost. In the longer term this contributes to increased convergence of adjacent areas such as sound radio and television, as well as other forms of radio communication and telecommunications activity. However, it should not be forgotten that the global fixed telecommunications network is the world's largest machine, and that both the radio and the television industries are fairly conservative. Even if the will for increased convergence is stronger than before, and the conditions for it are better, it would be unduly optimistic to expect packet changes in the fundamental technology.

Bundling of services

One trend that is growing with increasing strength is the bundling of services, for instance fixed and mobile telephony, the Internet, cable TV, etc. This will also have an effect on competition, since players who used to concentrate on only one of the above markets will suddenly be present in several. So the number of players in each area will increase and competition will be keener. The way in which the players choose to bundle and price their products will be highly important for their competitiveness. This may also need increased collaboration between different players.

Personal telephony

There is increasing discussion of the concept of personal telephony. The term is generally used to describe the ability of a subscriber always to be available at a single telephone number, regardless of their location. This is made possible by transferring/diverting calls to telephones at the locations where the subscriber is usually to be found. Achieving personal telephony by call transfer/diversion is awkward, even if the special services offered in this area, such as Telia Persona or Tele2 Call2One, are used. Personal telephony can also be achieved by using the same telephone network, for example in the car, at work, at college or at home. By combining GSM technology with fixed telephony, as mentioned under "Alternative local loops", it will be possible for the same terminal (telephone) to be used everywhere. In addition, calls made at work will be charged to the employer and calls from home will go on the home phone bill – if that is what the subscriber wishes. Stelacon is of the opinion that personal telephony involving the use of the same telephone everywhere is the alternative that will succeed best in the market. Basing the solution on call transfer/diversion simply makes excessive demands on the user

and limits the market to users who are relatively familiar with telecommunications technology and whose need to be accessible is great.

Beneficial development

The development of telecommunications makes distance less important and the technology can bring new life to rural areas as a result of home-working. But in practice, home-working is less common in the country than in the towns. Global telecommunications at ever lower cost also make possible a multi-cultural offering on services such as the Internet, TV and radio. Nevertheless, in practice we expect the culture and language of the English-speaking world to exert an ever-increasing influence. So it is plain that the “benefits” that developments in telecommunications are predicted to bring do not always come about in reality – for good or ill.

In conclusion, we would like to state in this year’s report as well that increased competition and greater choice will mean that, to a far greater extent than before, it will be what the customers want that determines how the market will develop. This is often overlooked in a market which has traditionally concentrated more on technology than on the actual needs of customers.

Appendix 1

List of companies interviewed

Alcatel Telecom AB
Banverket
Call Media AB
Datateknik
Enator Dotcom AB
Ericsson Radio Systems AB
Europolitan AB
Global One AB
Glocalnet AB
Interloop
Kabelvision
MFS WorldCom AB
MobilTeleBranschen
NetCom Systems AB
Net Master AB
NETnet AB
NetSource Sverige AB
Nokia Telecommunications
Nordiska Tele8 AB
Post & Telestyrelsen
RSLCom AB
Sandviken Energi AB
Stjärn TV AB
AB STOKAB
Stockholm Energi AB
Svenska KabelTV föreningen
Svenska Kraftnät
Svenska Rymdaktiebolag
Svenska Stadsnätsföreningen
Sydkraft AB
Tele 1 Europe AB
Telecom Finland AB
Telenordia AB
Telia AB
Telia Infomedia Television
Telia Mobile AB
Telia TeleCom AB
TELItel AB
Teracom AB
Vallentuna Kommun
Vattenfall AB

Appendix 2

Tables of the figures quoted in the report, broken down by area

FIXED TELEPHONY SERVICES

Table : *The value of fixed telephony broken down by segment, for the period 1994 to 1997 inclusive. Interconnection traffic revenue is not included*

The fixed telephony market (SEK million)	1994	1995	1996	1997
Total	19 597	20 438	21 621	23 586
Fixed charges	7 146	7339	7 639	7 676
Local calls	2 388	3 094	4 093	4 812
Regional calls	662	598	592	610
Long-distance calls	3 903	3 012	2 564	2 505
Calls to mobiles	1 431	2 044	2 555	3 779
International calls	3 138	3 415	3 178	2 889
Other	929	936	1 000	1 315

Table : *The value of fixed telephony broken down by operator, for the period 1994 to 1997 inclusive. Interconnection traffic revenue is not included.*

The fixed telephony market (SEK million)	1994	1995	1996	1997
Total	19 597	20 438	21 621	23 586
Telia	19 100	19 561	20 225	21 656
Tele2	450	800	1 250	1 365
Others	47	77	146	565

MOBILE TELEPHONY SERVICES

Table : *Number of subscriptions for mobile telephony in Sweden for the period 1994-12-31 – 1997-12-31, broken down into NMT and GSM.*

Subscriptions	1994-12-31	1995-12-31	1996-12-31	1997-12-31
Total	1 381 000	2 008 000	2 492 000	3 169 000
GSM market	422 000	1 033 000	1 571 000	2 414 000
NMT market	959 000	975 000	921 000	755 000

***Table** : Number of subscriptions for mobile telephony in Sweden for the period 1994-12-31 – 1997-12-31, NMT and GSM, broken down by mobile operator*

Share of subscriptions	1994-12-31	1995-12-31	1996-12-31	Including prepaid cards 1997-12-31	Excluding prepaid cards 1997-12-31
Total subscriptions	1 381 000	2 008 000	2 492 000	3 169 000	2 934 000
Telia AB (NMT)	69%	49%	37%	24%	26%
Telia AB (GSM)	16%	23%	33%	37%	40%
Comviq GSM AB	10%	21%	19%	26%	20%
Europolitan	5%	7%	11%	13%	14%

***Table:** Number of GSM subscriptions for mobile telephony in Sweden for the period 1994-12-31 – 1997-12-31, broken down by mobile operator*

Share of GSM subscriptions	1994-12-31	1995-12-31	1996-12-31	Including prepaid cards 1997-12-31	Excluding prepaid cards 1997-12-31
Total subscriptions	422 000	1 033 000	1 571 000	2 414 000	2 179 000
Telia AB	51%	45%	52%	49%	54%
Comviq GSM AB	32%	41%	30%	34%	27%
Europolitan	17%	14%	18%	18%	19%

***Table :** Value of mobile telephony broken down into NMT and GSM, for the period 1994 - 1997. The operators' revenue from interconnection traffic is not included.*

The mobile telephony market (SEK billion)	1994	1995	1996	1997
Total	4.34	6.05	7.42	8.42
The GSM market	1.07	2.31	4.46	6.19
The NMT market	3.27	3.74	2.96	2.23

***Table :** Shares of the mobile telephony market, NMT and GSM, for the period 1994 - 1997. The operators' revenue from interconnection traffic is not included.*

The mobile telephony market (SEK billion)	1994	1995	1996	1997
Total	4.34	6.05	7.42	8.42
Telia AB (NMT)	75%	62%	40%	26%
Telia AB (GSM)	12%	17%	32%	40%
Comviq GSM AB	7%	13%	16%	17%
Europolitan AB	6%	8%	13%	17%

***Table :** Shares of the GSM market for the period 1994 -1997. The operators' revenue from interconnection traffic is not included*

Value of the GSM market (SEK billion)	1994	1995	1996	1997
Total	1.07	2.31	4.46	6.19
Telia AB	48%	45%	52%	54%
Comviq GSM AB	28%	34%	26%	23%
Europolitan AB	24%	21%	21%	23%