PTS

June

The Swedish Telecommunications Market 2007

The Swedish Telecommunications Market 2007

Report Number
PTS-ER-2008:15

Reference number
08-159

ISSN
1650-9862

Authors
Ylva Mälarstig, Oscar Holmström och Pamela Davidsson

National Post and Telecom Agency
Box 5398
102 49 Stockholm
08-678 55 00
pts@pts.se
www.pts.se

Foreword

This year's edition of the Swedish Telecommunications Market has now assumed a somewhat new form. The National Post and Telecom Agency (PTS) has published this report since 1994 with a basic format that has remained rather similar over the past few years. Last year we took one step towards making PTS's most important statistics publication more accessible by launching our statistics portal. The statistics portal also gives us the opportunity to present the market shares of individual operators to a greater extent than before, at the same time as these statistics are now searchable and more user-friendly. This year's report shows our next step in this development. Instead of a general analysis encompassing the entire breadth of the market for electronic communications, we now focus on a few interesting areas. It is our hope that the report will become more interesting to read and also arouse curiosity about the statistics presented here and which clearly show how rapidly the market for electronic communications is changing in appearance.

It is clear that 2007 was a year of wireless-based infrastructure. Mobile broadband had an impact, showing growth that was unusually sharp compared with many other new services. Besides this, SMS has taken off again; Swedes send more SMS than ever before. At the same time, we are placing more calls with our mobile telephones, which has for the first time resulted in turnover for mobile telephony services exceeding turnover for fixed telephony services. This year, we also now have a new wireless network in the 450 MHz band, a CDMA 2000 network, which also gives more people the potential to receive broadband than that provided by the traditional metallic telephony network. The wireless-based infrastructures have in other words come to the forefront as bearers of electronic communications services for us all.

The wireless-based solutions also constitute an increasingly important element of the convergence of various services and infrastructures that is taking place. Wireless infrastructure also plays an important role in the shift towards increasingly personal electronic communications. Telephony is already clearly linked to you as a user through mobile telephony. Now the same trend is taking place with broadband, and through this also for services such as access to the Internet and television viewing, since more broadband services are becoming available through the various wireless-based networks, which offer mobility.

The market for electronic communications is a clear example of competition yielding positive effects. There are many things that are promising in the development of the market, many of which can be read about in 'The Swedish Telecommunications Market'. At the same time, a number of problems persist in the Swedish market. For this reason, PTS needs to continue its regulatory and supervisory work. It is a reality for many alternative operators that they often find it difficult to gain access to infrastructure if they do not themselves control their own infrastructure.

Consequently, PTS is continuing its work to promote competition in accordance with the Electronic Communications Act (LEK), and the work related to the second generation SMP decision is currently underway. Developments in several of the emerging markets actually emphasise the need for clear and fair rules to create the preconditions for effective competition. We can see that the market is gradually moving towards increased competition and dynamism, partly underpinned by the decisions made by PTS.

MARIANNE TRESCHOW

Director-General

Contents

List of Tables

Diagrams

Abstract

The retail market for electronic communications in Sweden, measured in total revenues for call services, Internet services and data communications services, increased by 2 per cent during 2007, and had a total turnover of SEK 50bn during 2007. The market value for fixed call services amounted to SEK 18.2bn, which is nearly 1.5 billion less than during the corresponding period in 2006. For the first time, the total revenues from services in mobile networks exceed the total revenues from fixed call services. The turnover for mobile call services, including SMS, increased by 11 per cent to SEK 18.7bn during 2007. The revenues from MMS and data traffic in mobile networks together totalled over one billion SEK. The number of traffic minutes in UMTS networks amounted to more than 18 per cent of the total number of outgoing traffic minutes in mobile networks.

There were 5 506 000 fixed telephone subscriptions in Sweden on 31 December 2007. The number of PSTN telephone subscriptions continued to decrease, and at the same time the number of subscriptions for IP-based telephony increased by 52 per cent to 623 000 subscriptions. The number of pre select customers decreased by 325 000 during 2007.

The number of active customers with broadband access increased from 2 489 000 to 3 131 000 between 31 December 2006 and the corresponding point in time 2007, which corresponds to a growth of approximately 26 per cent. Wired broadband accounted for 56 per cent of the growth and wireless broadband (mobile Internet) accounted for 44 per cent. Dial-up connections continued to decrease at a fast pace.

78 households in 100 had some kind of Internet access on 31 December 2007, compared to 74 households in 100 at the corresponding date the year before. The total share of households with broadband access in Sweden increased from 51 to 62 household of 100 during 2007.

On 31 December 2007, the total number of television subscriptions in the Swedish market was 4 270 000. At the corresponding period the year before, then number of television subscriptions were 3 822 000. The number of IPTV subscriptions has increased the most, followed by terrestrial cable network subscriptions.

Table 1 Key data – the market for electronic communications

	2006	2007	Change
Fixed call services			
Subscriptions for fixed telephony *(thousands)*	**5 551**	**5 506**	**-1%**
of which via WLR *(thousands)*	**1 011**	**1 023**	**1%**
Household	899	873	-3%
Business	112	150	34%
of which via alternative access *(thousands)*	**410**	**623**	**52%**
Household	392	588	50%
Business	17	34	98%
Pre-selection customers *(thousands)*	**850**	**513**	**-40%**
Household	608	337	-44%
Business	243	176	-27%
Revenues from fixed call services *(SEKm)*	**19 615**	**18 221**	**-7%**
Household	12 709	11 852	-7%
Business	6 906	6 369	-8%
Mobile call services			
Mobile subscriptions *(thousands)*	**9 607**	**10 371**	**8%**
Private	7 716	8 216	6%
Business	1 891	2 156	14%
of which active UMTS subscriptions	1 214	2 258	86%
of which via data plug-in cards	92	496	440%
Revenues from mobile subscriptions and SMS *(SEKm)*	**16 839**	**18 652**	**11%**
Private	9 869	11 412	16%
Business	6 970	7 241	4%
Number of SMS sent *(millions)*	**2 857**	**4 843**	**70%**
Number of MMS sent *(millions)*	**70**	**103**	**46%**
Traffic for mobile data services *(Tbyte)*	**203**	**2 191**	**981%**
Data communications services			
Revenues from data communications services to end-user *(SEKm)*	**4 213**	**3 711**	**-12%**
Frame	210	124	-41%
IP-VPN	2 172	2 212	2%
Leased lines	1 387	1 375	-1%
Dark fibre and other raw network capacity	445	342	-23%
Internet services			
Internet-access customers *(thousands)*	**3 595**	**4 054**	**13%**
Dial-up connection	1 105	802	-27%
Broadband connection	2 489	3 252	31%
of which via data plug-in cards	92	496	440%
Revenues from Internet access *(SEKm)*	**8 050**	**8 305**	**3%**
Household	6 100	6 617	8%
Business	1 950	1 688	-13%

Source: National Post and Telecom Agency, 12 june 2008

1 Aim and method

The purpose of this report is to survey and analyse the development of a rather large part of the Swedish market for electronic communications during 2007.

The task of the National Post and Telecom Agency (PTS) is, first, to monitor the development of the market for electronic communications, second, to promote competition within the sector. As part of these tasks, PTS works with market statistics and market analyses. It is also important that the public, operators and other undertakings and organisations gain access to statistics and market analyses, a factor which is also an incentive for PTS to publish market statistics.

This report focuses on the following sub-markets

- Fixed call services, including IP-based telephony
- Mobile services
- Data communications services to operator and end-user
- Internet services
- Television services

This report, 'The Swedish Telecommunications Market', should primarily be viewed as PTS's report on electronic communications market statistics. We therefore focus on reporting market statistics. However, the report also contains a number of more advanced sections with figures and diagrams clarifying the numerical material, describing the prevailing market situation and identifying some underlying factors for the developments taking place within the market.

The Swedish Telecommunications Market has, for the years shown below, been prepared by

1994	PA Consulting Group
1995	Bohlin & Strömberg
1996 – 1997	Stelacon
1998	Öhrlings PriceWaterhouseCoopers
1999 – 2007	The National Post and Telecom Agency

All reports are available on PTS's website (www.pts.se). In addition to these, there are official statistics on the market for electronic communications produced by SIKA. The reports are mainly based on the same primary material.

The gathering of full-year statistics for the years 2000 to 2007 has been undertaken in collaboration with the Swedish Institute for Transport and Communications Analysis (SIKA[1]) and Statistics Sweden (SCB). An important reason for this collaboration is to facilitate matters for information providers as, among other things, this reduces the number of questionnaires distributed. The statistics for 2007 have been gathered by use of a web-based questionnaire.[2]

PTS has access to various details considered to be commercially sensitive according to the Secrecy Act.[3] This is information that has requested from notified operators, for instance in the course of compliance work, and such information is not published in this report. The details that have been requested from notified operators through the questionnaire for this year's gathering of statistics are exclusively used as a basis for:

1. Statistics contained in the report 'The Swedish Telecommunications Market 2007' (PTS).
2. Statistics contained in a public statistics portal.[4]
3. PTS's market analyses and decisions concerning significant market power (SMP).[5]
4. Any PTS decisions concerning universal services.[6]
5. PTS's other operations as a supervisory authority.[7]
6. The official statistics on telecommunications operations in Sweden, contained in the report *Televerksamhet 2007* (Telecom Operations 2007) (SIKA).

[1] SIKA is the authority (reporting to the Ministry of Industry, Employment and Communications) that is responsible for the official statistics on telecommunications operations (see www.sika-institute.se).
[2] The web questionnaire was prepared in collaboration with Unified Dialogs AB, and the information gathering was conducted by Unified Dialogs AB.
[3] Chapter 8, Section 6 of the Secrecy Act.
[4] www.svensktelemarknad.se
[5] The Electronic Communications Act (2003:389) (LEK), Chapter 8, Sections 5 to 7.
[6] The Electronic Communications Act (2003:389) (LEK), Chapter 5.
[7] The material may only be used for these purposes after PTS has informed the operators concerned.

This report is primarily based on the following sources of information:

- Quantitative data collected by PTS from operators.
- Telephone interviews with operators.
- Statistics from previous reports corresponding to the Swedish Telecommunications Market.
- Annual reports.
- Public information.
- Market surveys and analyses conducted by external consultants on the assignment of PTS.

In the questionnaire circulated to notified operators, it is specifically stated which information will be used for each area. A duty to reply was introduced in conjunction with the gathering of information for the year 2003, and a duty to reply has also been introduced for the gathering of half-year information. For details of those operators which have submitted answers, see the chapter 'Schedule of participants'.

The statistics presented in the Swedish Telecommunications Market, which is based on the data received from operators, should be viewed as PTS's assessment of the market. Other public sources have also been used to a certain extent. The questionnaire was distributed to 455 notified operators and to a number of operators which have not been notified to PTS, but which can be assumed to conduct operations within the electronic communications sector. In total, the questionnaire was sent to 558 stakeholders. At the time the report was published, 465 had responded, corresponding to approximately 83 per cent of those asked. However, the gathering of operator data will also continue after publication of the report 'The Swedish Telecommunications Market', which means that PTS's database for operator statistics is being continuously improved and the response frequency is increasing. A certain amount of measurement error naturally occurs, as there are operators in the market that do not respond to the questionnaire. However, the operators which have responded represent a significant proportion of the turnover in the market for electronic communications, and consequently the measurement error should not be particularly large. PTS considers that the information on revenues that has been received for 2007 corresponds to a proportion of at least 99 per cent of the retail revenues in the markets for fixed call services,[8] mobile call services and mobile Internet and also for television services. For

[8] Does not include revenues from dial-up Internet and directory enquiry services.

Internet services, the corresponding level is approximately 80 per cent.[9] Measurement error may also arise if those asked have not answered all of the questions in the questionnaire, if the responses were misleading owing to carelessness, inadequate or misunderstood instructions or if it was not possible to obtain any exact value from the company's accounting. Such attrition and possible inadequacies in the responses received may often be compensated through proceeding on the basis of data collected previously or by making estimates based on related responses in the questionnaire.

Historical statistics are continuously updated whenever further information becomes available to PTS, and for this reason statistics for one and the same year differ in various yearly editions of the report. It is therefore important that those using the Swedish Telecommunications Market have access to the version published most recently.

Market development is reported by statistics, which in some cases stretch back to 1992. As of and including 'The Swedish Telecommunications Market 2006', PTS also shows market shares for the retail markets for each period that information was gathered. However, historical market shares that are older than the full-year 2006 are not published. Market shares for a number of different units are contained in this report, and PTS intends to publish details on market shares in a publicly accessible statistics portal that is available from the PTS Website. This portal shall include market shares for all the retail market variables as of and including the full-year 2006, except as regards the market for television services.[10] However, there are variables which the authority considers to be inadequate or misleading in some other way, and these will not be published in the statistics portal.

In the questionnaire, definitions have been used which also form the basis of the reports, and these definitions are revised and clarified continuously so that they are in phase with developments in the market. Segmentation of individual sub-markets may also change slightly from year to year. Since the questionnaire for 2003, regard is also taken to PTS's need of information for conducting market analyses and making decisions concerning whether any operator has

[9] However, the answers that have been received about the number of customers are considered to correspond to more than 97 per cent of the market value. In other words, some operators have answered the question about the number of customers but not the question about turnover. The estimates that have been made have to a large extent been based on previous answers and on answers about the number of customers. PTS considers that the turnover for the Internet stated in this report lies at a credible level. PTS is also waiting for supplementary answers regarding the operators' turnover.
[10] However, PTS does not exclude the possibility of variables in the retail market for television services being in the future published in a similar way as the variables for the other retail markets.

significant market power. Despite these changes, the information can to a large extent still be compared with previous reports.

One change of a definition worth noting is that 'fixed Internet access' is referred to as 'broadband' in the Swedish Telecommunications Market as of and including the full-year 2007. 'Fixed Internet access' has in previous versions of the Swedish Telecommunications Market been used as the opposite of 'dial-up Internet'. However, such a definition has entailed problems in pace with various kinds of wireless solutions becoming more common, as many people link 'fixed Internet access' either with 'wired Internet access' or view it as the opposite of 'mobile Internet access'. Consequently, as of and including 'The Swedish Telecommunications Market 2007', all Internet subscriptions that are not connected via PSTN or ISDN are categorised as broadband, even if the capacity for some of these subscriptions does not meet up to what many would consider to correspond to a broadband connection.

In numerous cases statistics are reported broken down into private customers or household customers and business customers respectively. The definitions of 'private customer or household customer' and 'business customer' are based on who pays for the service, not who the user is. The criterion for the paying party to be designated as a business customer (including those organisations that are not businesses) is that it has a company/organisation ID number. The others are designated as private customers or household customers. However, this approach means that businesses and organisations registered with personal identity (ID) numbers are included in the category 'private customers and household customers'.

Owing to rounding, the information contained in this report is expressed as per cent and consequently the total of the parts does not always amount to 100 per cent. It should also be observed that the amounts stated for previous periods in the report, for example for revenues, are not adjusted for inflation. In addition, all revenues are reported excluding value added tax (VAT).

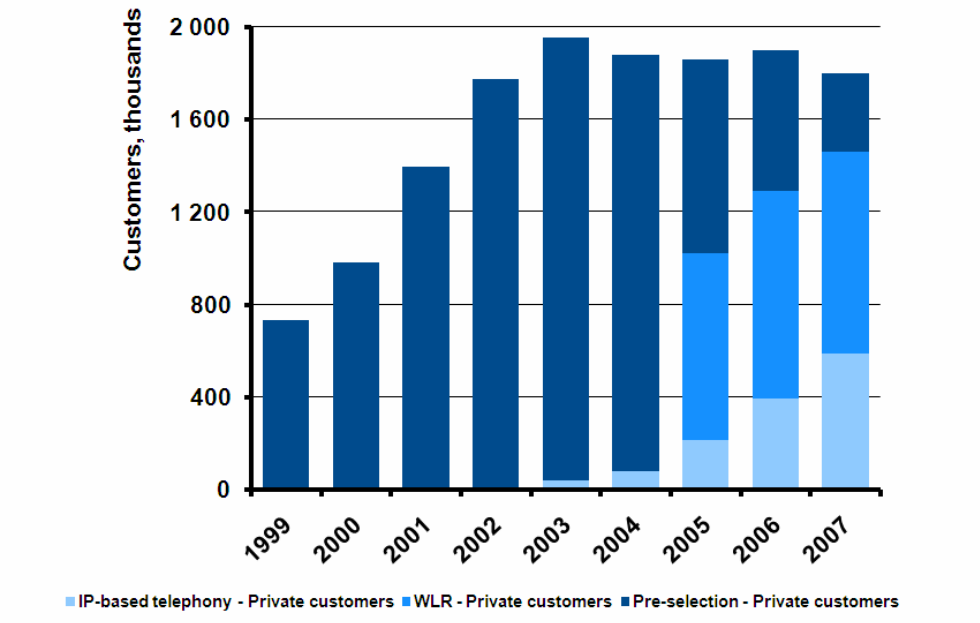
On PTS's website (www.pts.se) it is also possible to download market surveys of the competition situation. PTS has conducted these surveys, either internally, jointly with other authorities or with the assistance of consultants.

2 Market development 2007

2.1 The market for electronic communications

- The market for electronic communications, measured in revenues for telephony, Internet services and data communications, grew by 2 per cent during 2007, and was SEK 50bn on 31 December 2007. The market value of fixed call services amounted to SEK 18.2bn during 2007, which is 1.5 billion less than during the corresponding period in 2006. Total retail revenues for mobile call services including SMS amounted to almost SEK 18.7bn in 2007, which corresponds to an increase of 11 per cent in one year. This means that the total retail revenues for mobile call services are now for the first time higher than the total retail revenues for fixed call services. The total retail revenues for MMS and mobile data traffic were in aggregate just more than one billion kronor during 2007.

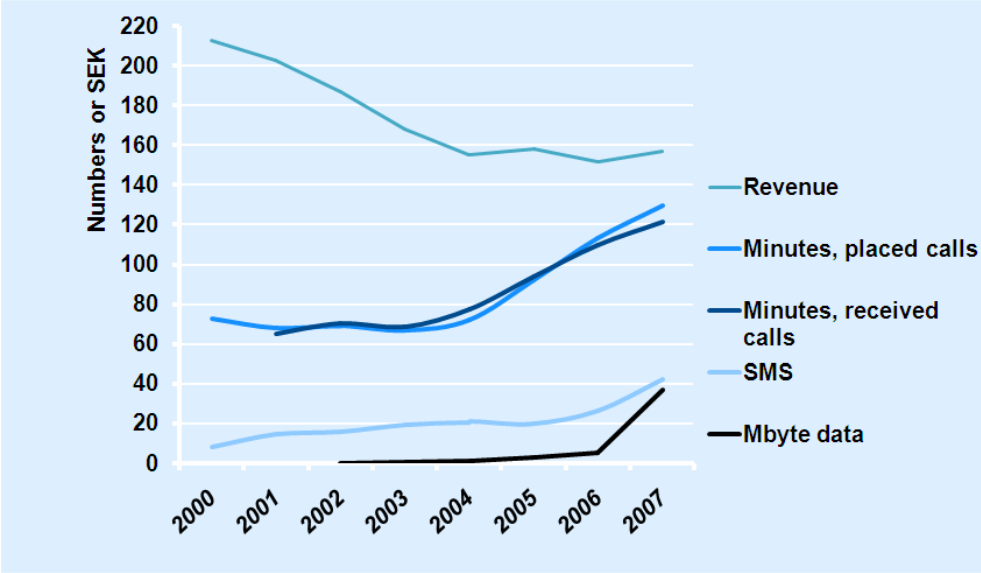
Diagram 1 Number of private customers for pre-selection, WLR (Wholesale Line Rental) and IP-based access



- On 31 December 2007 there were 5 506 000 fixed telephone subscriptions in Sweden. The trends that were clear in 2006 continued during 2007; the number of PSTN subscriptions continued to decrease,

at the same time as the number of subscriptions for IP-based telephony continued to increase. The number of prefix customers and pre-selection customers reduced by 325 000 subscriptions during 2007.

Diagram 2 Average revenue and use of mobile call and data services per month, 2007



- The market for mobile call and data services is continuing to grow; revenues, traffic minutes and the total number of subscriptions have increased in 2007. During 2007 an average mobile customer made two calls of two minutes each per day, which is over two hours per month. This represents an increase of approximately one-fourth during the past year and a doubling in four years. The average customer sent 41 SMS per month, but only 10 MMS the entire year. In addition, a customer received calls for over two hours per month, half of the time from the same network and half the time from some other network. Those customers who also used mobile packet data sent or received on average more than 1 Mbyte per day.

- Just more than 2.2 million subscriptions used services in the UMTS networks during 2007, which represents a two-fold increase compared with the previous year. The total number of traffic minutes that come from the UMTS networks increased by 80 per cent to almost 3 billion minutes during 2007, and comprise just more than 18 per cent of the total number of outgoing traffic minutes.

- The average revenue per traffic minute from an end-user in the mobile networks continued to reduce and was 1.07 kronor in 2007. For contract subscriptions, the average revenue was higher, 1.16 kronor, and for pre-paid cards it was lower, 0.81 kronor.

- The total number of minutes to international networks increased greatly for private customers, and during 2007 this also increased for businesses after having remained static for several years.

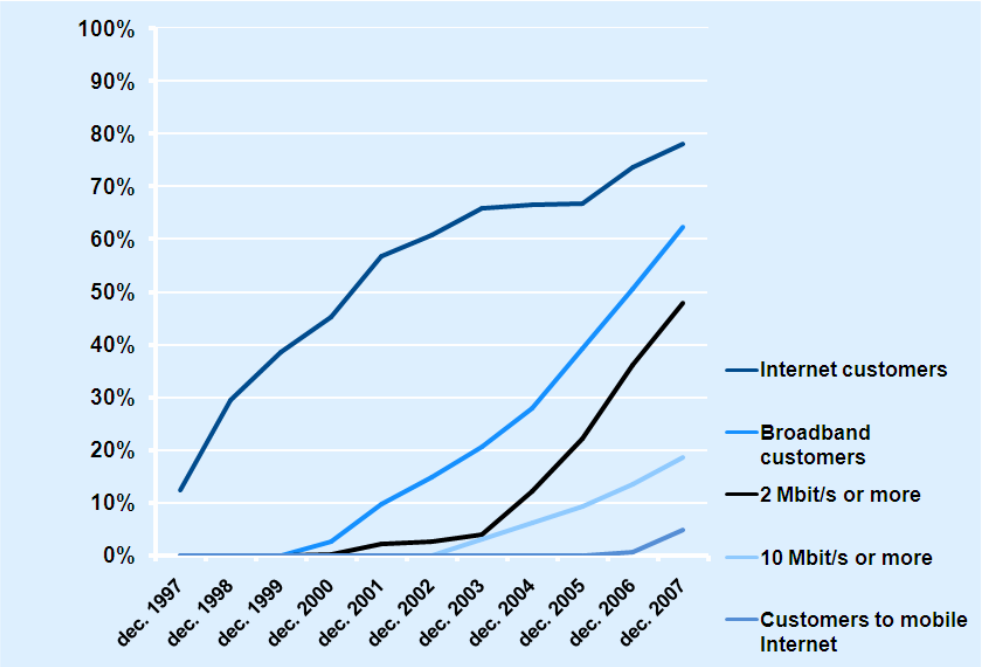
- The total number of SMS sent rose by 70 per cent during 2007, to 4.9 billion SMS sent. Revenues per SMS, which have fallen by one-third in one year and have halved in two years, reduced in pace with an increase in the number of SMS. The average revenue per SMS was 39 öre in 2007. During 2007, 102.5 million MMS were sent, representing an increase of just more than 45 per cent in one year. However, the total revenues for MMS remained unchanged during 2007, though they had previously doubled for two consecutive years. During 2007 the average revenue per MMS was 1.07 kronor.

- Data traffic for mobile packet data continued to increase considerably. This increase was ten-fold in one year and over 200 times as much in three years. There has also been a pronounced increase in mobile data traffic per user. The number of users increased by over 50 per cent and yet the traffic increased from almost five to over 37 Mbytes per person and month. This primarily relates to all mobile data traffic from private individuals. The total revenues from mobile data traffic increased to SEK 965m during 2007, representing an increase of 60 per cent in one year.

- The average revenue per minute for calls made or received abroad sank to 8.70 kronor per minute during 2007. This corresponds to a reduction of just less than 8 per cent compared with the previous year, when the revenue was 9.43 kronor. The decrease is probably a result of the regulation that was introduced on 1 July 2007, and which involved a price cap of 0.45 Euro per minute within the EU. The fact that the average revenue has not decreased more is probably due to the revenues from countries outside the EU being significantly higher. The average revenue per minute for a call made by a visitor to Sweden also reduced, to 5.34 kronor for the full-year of 2007. During the fourth quarter of 2007, the average revenue for a call made by Swedish customers from EU countries was 0.40 Euro, while the corresponding revenue for a call from countries outside the EU was 1.25 Euro.

- Revenues for mobile interconnection amounted to SEK 4.49bn during 2007, which is somewhat lower than the revenues in 2006, which were SEK 4.54bn. During 2007 the number of interconnection minutes was 7.9 billion, which represents an increase of 14 per cent compared with 2006. The average revenue per call minute from national operators' networks (fixed networks and mobile networks) was 56 öre during 2007. New, regulated prices for termination of voice calls in mobile networks are applicable as of 1 July 2007. The prices applicable for the mobile operators Telia Sonera, Tele2, Telenor and Tre are 55 öre per minute. The new price recommendations mean that the transition to cost-orientated prices, according to the hybrid model used by PTS, is implemented in full.

Diagram 2 The number of private customers with Internet access in relation to the number of households



Mobile Internet refers to subscriptions with active users of mobile packet data via data plug-in cards, internal data cards and data cards that connect via USB or the like and is also included under broadband access lines (less than 2 Mbits per second).

- The market for Internet access has for a number of years undergone great changes in conjunction with the transition from dial-up connection to broadband connection. During 2007 the breakthrough for mobile Internet contributed to this market once again facing great changes.

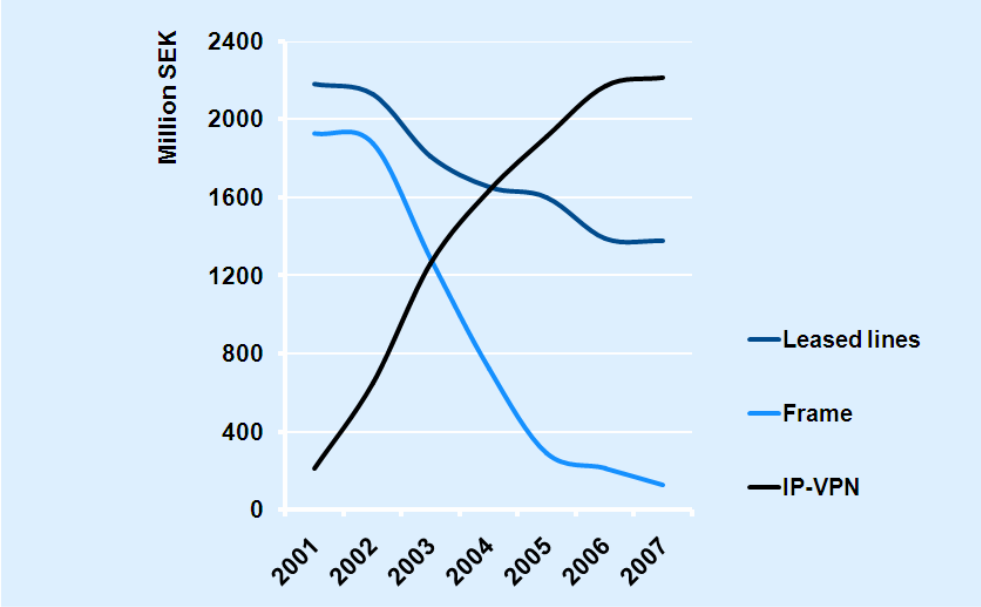
- The number of active customers with broadband increased from 2 489 000 to 3 131 000 between 31 December 2006 and 31 December 2007, corresponding to growth of around 26 per cent. Wired broadband represented 56 per cent of this increase and wireless broadband (mobile Internet) represented 44 per cent. However, dial-up Internet is reducing at a rapid pace. On 31 December 2007, 78 out of 100 households had some kind of Internet access. At the corresponding time in 2006 there were 74 private customers for Internet access per 100 households. The proportion of private customers in relation to the number of households with broadband increased during 2007 from 51 to 62 households out of 100 (see **Fel! Hittar inte referenskälla.**).[11]

- The turnover in the market for Internet access was approximately SEK 8.3bn, which is SEK 200m more than during 2006 when the turnover was SEK 8.1bn. The annual growth of the total revenues from Internet accesses reduced from 11 per cent to 3 per cent during 2007.[12] Revenues for subscriptions for broadband connections to the Internet rose by almost 8 per cent, from SEK 7.4bn to SEK 7.9bn during 2007. During the same period, the revenues from dial-up Internet access reduced by 44 per cent, from SEK 697m to SEK 389m.[13]

- The average revenue per broadband subscription and month from businesses increased during 2007 from 164 to 169 kronor. During the same period, the average revenue per broadband subscription and month from businesses decreased from 542 to 508 kronor.[14]

[11] The fact that one household can have more than one Internet subscription has not been taken into account.
[12] Revenues from subscriptions with active users of mobile packet data via data plug-in cards, internal data cards and data cards connected via USB or the like are not included.
[13] Ibid.
[14] Ibid.

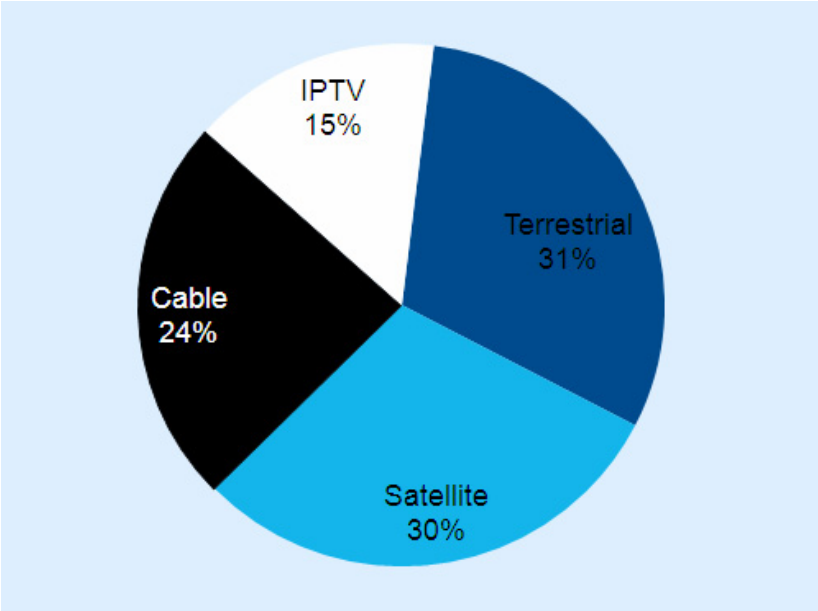
Diagram 3 Data communication to end-user – revenues from IP-VPN, frame and leased lines



- The turnover in the market for data communications services to end-user has decreased by almost 4 per cent during 2007, which indicates a progressive reduction compared with the previous year, when the corresponding reduction was 0.3 per cent. It is primarily the tail-off in revenues from IP-VPN and reduced revenues from dark fibre and other raw network capacity that have accelerated this reduction in turnover.[15]

[15] Assessing the value of the market for data communications services involves certain difficulties, as sales are made at several levels, and the information-base is not always of such a nature that any opinion on the development that is in all respects correct can be provided.

Diagram 4 Breakdown of digital television subscriptions according to different distribution platforms



- On 31 December 2007 the total number of television subscriptions in the Swedish market was 4 270 000. At the same time in 2006 there were 3 822 000 television subscriptions. The number of IPTV subscriptions has increased most, followed by subscriptions via the digital terrestrial network.[16] The estimated around 400 000 households that receive only free television[17] via the digital terrestrial network are not included in the statistics.

- The total revenues for television subscriptions, package options and channel options were SEK 7.3bn for 2007.

2.2 Infrastructure and operators

In addition to the changes described in the sub-chapter regarding market development above, a number of important events that effect the Swedish market for electronic communications have occurred during 2007 and the first half of 2008. A few of these are listed below:

[16] Read more about IPTV in Chapter 7 on new forms of television.
[17] Free television channels are broadcast without encryption and can be received without a pay television subscription.

- On 1 June 2007, Hi3G and Telenor reported to PTS that the respective company's networks covered 8 860 000 people, which was the population coverage that was stated in the licence conditions. On 1 December 2006, SUNAB's (Telia Sonera and Tele 2's joint company for rollout) UMTS network was completed. All three UMTS licence holders have thereby reported that they fulfil the licence conditions.

- Broadband via wireless mobile networks has been launched, referred to as 'Turbo 3G'. The HSPA technology, which allows up to 7.2 Mbits per second downstream and 3.6 Mbits per second upstream, is used in the UMTS networks.

- During 2007 the operator Nordisk Mobiltelefon Sverige started commercial operation of its nation-wide network in the 450 MHz band, based on CDMA 2000. CDMA 2000 allows a rate of 3.1 Mbits per second downstream and 1.8 Mbits per second upstream for data traffic. NMT 450 was the first mobile system in Sweden that reached a large market. The analogue mobile network, NMT 450, which was operated by Telia Sonera, was shut down on 31 December 2007.

- On 14 June 2007, PTS concluded in the report *Improved broadband competition through functional separation*[18] that experiences from PTS's supervision showed that there are structural competition problems that have existed in the broadband market for a long time, and that neither the sector-specific regulation nor general competition law has been able to remedy. PTS concluded that in its regulatory work the authority needs a new regulatory tool to be able to remedy the competition problems and ensure equal treatment of operators that need access to Telia Sonera's metallic access network to be able to offer broadband. PTS was of the opinion that the regulatory tool should provide powers to impose requirements for the vertical separation of a dominant stakeholder. On 18 March 2008, the Government made a decision on the Bill *Improved broadband competition through functional separation*. In this Government Bill, the Government proposed that PTS should receive further powers to intervene in order to increase competition in the broadband market, through a decision on 'functional separation'. The Riksdag (Swedish Parliament) approved the report on 5 June 2008, and it was proposed that the new provisions enter into force on 1 July 2008.

[18] PTS-ER-2007:18

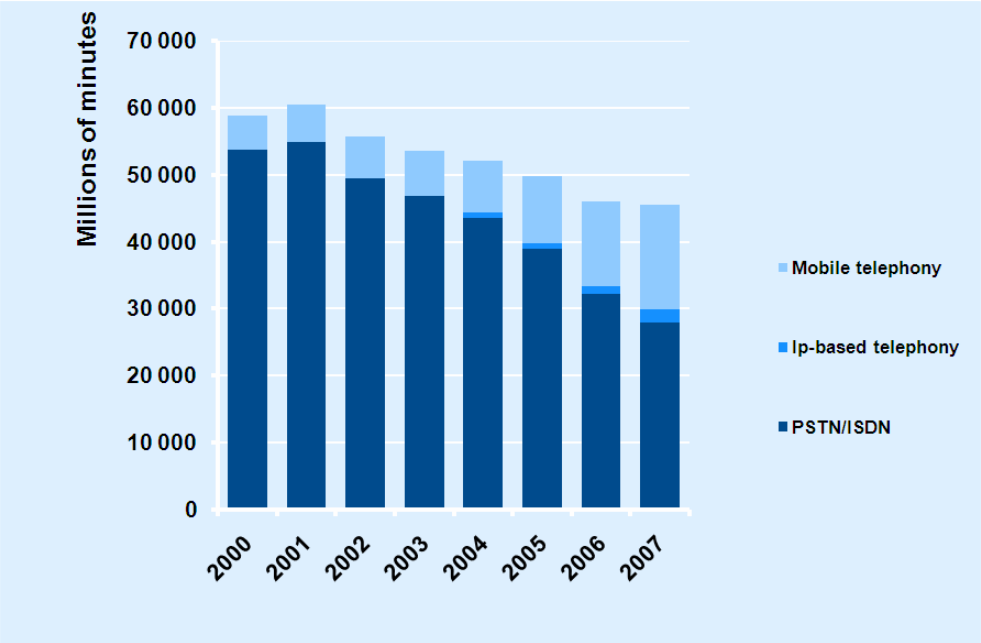
- During 2008, PTS will conduct new analyses of the two wholesale markets for broadband. If PTS considers that the conditions in the market have changed, this may lead to amended regulations.

3 Telephony in transition

Two trends were particularly visible within electronic communications during 2007. The first was a great demand for mobile communications solutions, and the second was the development towards more types of services being transmitted through the same infrastructure to one and the same kind of terminal, in other words, convergence. In this Chapter we look more closely at these two trends.

Traffic minutes in PSTN networks have reduced for just more than a decade in parallel with consumers having assimilated new forms of communication. The use of telephony concerns everything from PSTN and circuit-switched networks to mobile telephony and IP-based telephony. Traffic in the mobile networks is increasing and the proportion of wired IP-based telephony via broadband is increasing greatly, even if this is from a low level. The diagram below clearly shows the change that is underway, reflected by the development of outgoing traffic minutes for the various telephony services. However, minutes for dial-up Internet are included in the traffic minutes for the PSTN/ISDN traffic. The minutes for dial-up Internet have reduced drastically and are not directly related to voice traffic. This constituted approximately 31 per cent of the PSTN/ISDN traffic in 2000, and approximately 8 per cent in 2007.

Diagram 5 Outgoing traffic minutes for PSTN/ISDN, IP-based telephony and mobile telephony



3.1 Convergence

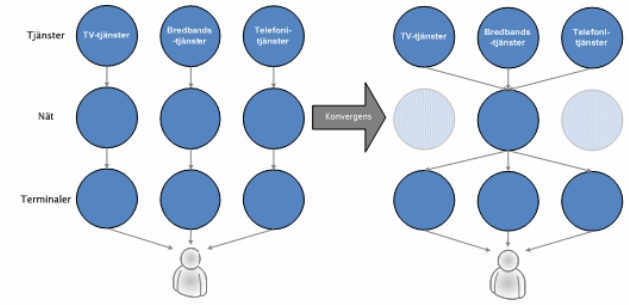
The development towards convergence has been underway for several years. It is not only services and networks that are currently converging, but also technology, markets and terminals.

Behind this convergence lies the fact that one digital bitstream can relay several different communications services, such as voice, data and media, regardless of which network the bitstream is transmitted through. In comparison, it is inflexible and expensive to operate and maintain separate infrastructures for different communications services (television, radio, telephony, etc.) where both equipment and software are specially adapted to just one specific service. Networks using IP (Internet Protocol) in signalling will consequently replace modern circuit-switched networks such as the PSTN networks and the digital service network ISDN. This is usually referred to as the 'Next Generation Network' (NGN). With NGN, services will be able to be offered separated from the underlying transmission network and end-users should be able to use

various forms of connection directly to NGN, such as a wired, mobile or nomadic connection.[19]

One component of NGN is IMS, (Internet Multimedia Subsystem[20]). IMS is a new network architecture for mobile and fixed telephony services and applications that are based entirely on IP and Session Initiation Protocol (SIP)[21]. The principle for IMS is similar to the one for NGN, since IMS is divided up into a control plan for signalling and services and also a media plan for transport. This division makes it easier for operators to rapidly develop and deliver new services. Since IMS is entirely IP-based, computers can easily gain access to the mobile telephony network. Many operators will introduce IMS in conjunction with the transition to NGN. IMS has integral support for multimedia services and facilitates a transparent traffic flow between different types of networks.

Several of the major operators in the EU are already in the process of changing to an entirely IP-based infrastructure, for example Telecom Italia, British Telecom, Telefonica in Spain and KPN in the Netherlands. In Sweden, for instance, Com Hem, Telenor and Telia Sonera put IMS platforms into commercial operation during the autumn of 2007.



Picture 1 Network convergence

3.1.1 Wired IP-based telephony

It has been possible to transmit a voice call as an IP packet all the way to the subscriber since the 1990s, but it is only in recent years that its use has started to gain momentum. IP-based telephony is a comprehensive term for all types of telephony that use IP. However, PTS divides these into different categories

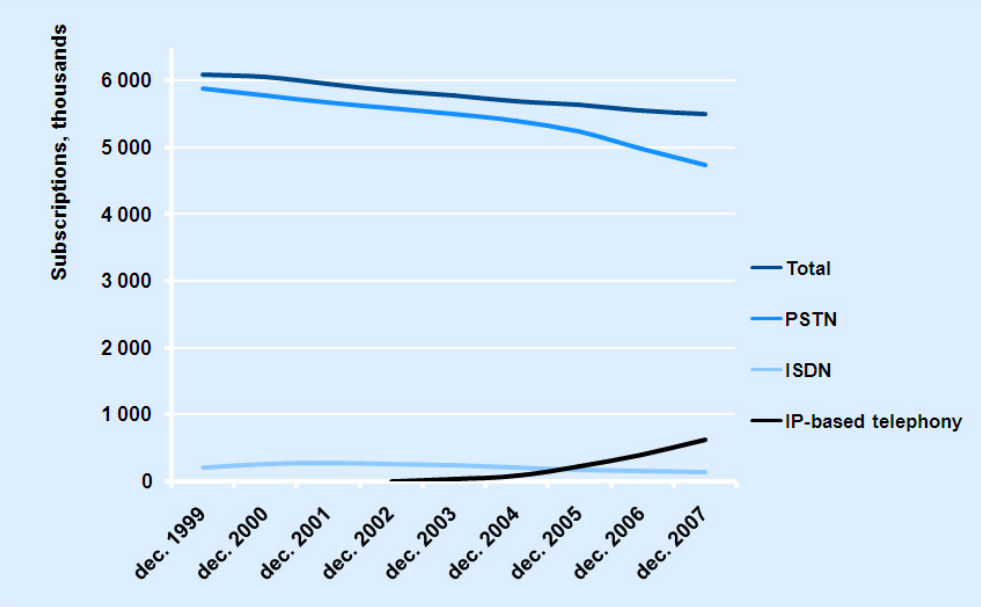
[19] PTS report *Konvergens och utvecklingen mot nästa generations nät* (Convergence and development towards the next generation network), PTS-ER-2008:11.
[20] IMS is a standard that is defined by the project group 3rd Generation Partnership Project (3GPP).
[21] SIP is a signalling protocol that is often used in conjunction with IP-based telephony and multimedia services in mobile telephone networks, where it is used to establish a line between two terminals. SIP is used in IMS and is approved as a standard by 3GPP.

depending on whether the service provider controls its own access, whether end-users can reach telephone numbers from the Swedish numbering plan and also whether the service is fixed or nomadic (that is to say, whether the service is linked to a fixed interconnection point or if the user can take the service with them to another connection).[22] These are the most ordinary forms of IP-based telephony found in Sweden today.

The use of wired IP-based telephony[23] has increased greatly in recent years. On 31 December 2007 there were 623 000 subscriptions for IP-based telephony, corresponding to an increase of 52 per cent since 31 December 2006. IP-based telephony is offered via a number of different access networks, and households are in the majority among customers. Currently, approximately 20 per cent of the population of Sweden use IP-based telephony,[24] and the potential customer base is increasing since increasing numbers of operators offer this service. At the end of 2007, 60 operators offered IP-based telephony to end-users in Sweden.

[22] Compare the PTS report to the Government, 'Investigation of IP based telephony and other electronic communications services and the possibility of reaching the emergency number 112'. PTS-ER-2006:15.
[23] IP-based voice calls over WLAN or intranets are often called 'VoIP' (Voice over IP)
[24] Relates to both Internet telephony and ordinary IP-based telephony. *Individundersökningen 2007 – Svenskarnas användning av Internet och telefoni* (Survey of Individuals 2007 – the use of telephony and Internet by Swedes), Synovate on the assignment of PTS, December 2007

Diagram 6 Number of subscriptions for wired telephony (PSTN, ISDN and IP-based telephony)



The PTS Survey of Individuals 2007 shows that it is primarily the price that motivates customers to change to IP-based telephony. Internet connection is a precondition, and in Sweden almost 70 per cent of the Swedes had a broadband connection in 2007, which means that many Swedes have good opportunities to use IP-based telephony. Another important explanation for the increase is that IP-based telephony is one component of the operators' bundled offers (multiple play), which started being launched during the last quarter of 2005.[25]

However, in the business market, the growth of wired IP-based telephony has not been at the same level. The most pronounced trend in the business market relates instead to the need for mobility, which is the reason that many businesses choose the mobile telephone as their only communications terminal.

There is a lot that indicates that the growth of wired IP-based telephony will continue. The development of IP-based telephony influences competition, results in new business models and will involve challenges for both current and coming legislation in the area of interconnection. The decision by PTS that operators shall have the opportunity for full or shared access to the access

[25] Read more about this in the section about bundling of electronic communications services, Chapter 4.

networks of other stakeholders, the 'LLU Regulation', is an important precondition for more operators being able to offer IP-based telephony on equal terms.[26]

3.1.2 IP-based mobile telephony

IP-based mobile telephony has developed more slowly than wired IP-based telephony, but a number of solutions have now emerged in the market. There are many different variants of IP-based mobile telephony and a great number of possible combinations of software, business models and relay methods. In this connection, one common solution is a 'dual mode mobile', which can be used for making traditional calls over the mobile network through ordinary GSM or UMTS signalling or via WLAN with the aid of IP. Today, a knowledgeable consumer can purchase a mobile telephone that can be configured so that it is possible to make calls with Skype or Google Talk via mobile broadband.

According to some experts, IP-based mobile telephony as a businesses solution has to date been considered to be too expensive for businesses to invest in it to a great extent[27], and the opinion is that falling prices for ordinary mobile telephony may have made businesses less motivated to invest in IP-based mobile telephony. It remains to be seen to what extent and at what rate IP-based mobile telephony will reach the mass market. All evaluators believe that its broad establishment will be delayed until NGN is developed.

Even if entirely IP-based mobile telephony from terminal to terminal is as yet not so common, IP will also play an increasingly greater role in mobile networks. As with wired telephony, IP protocol can be used for transmitting calls in the mobile networks' backbone networks, which reduces the costs for mobile operators in conjunction with, for example, international roaming.

3.1.3 Terminal convergence

One interesting and current example of terminal convergence is fixed-mobile convergence. Fixed-mobile convergence is often referred to as 'FMC' and means that one and the same terminal can be used for several communications services, such as mobile telephony and wired IP-based telephony. The terminal is often called a 'personal base station'. Solutions with personal base stations have had an impact on the business market and it is likely that the demand will also spread to private customers. A femtocell is a small base station that is possible to have at home. This technology has received a lot of attention in recent years, much due to the fact that mobile operators see an opportunity

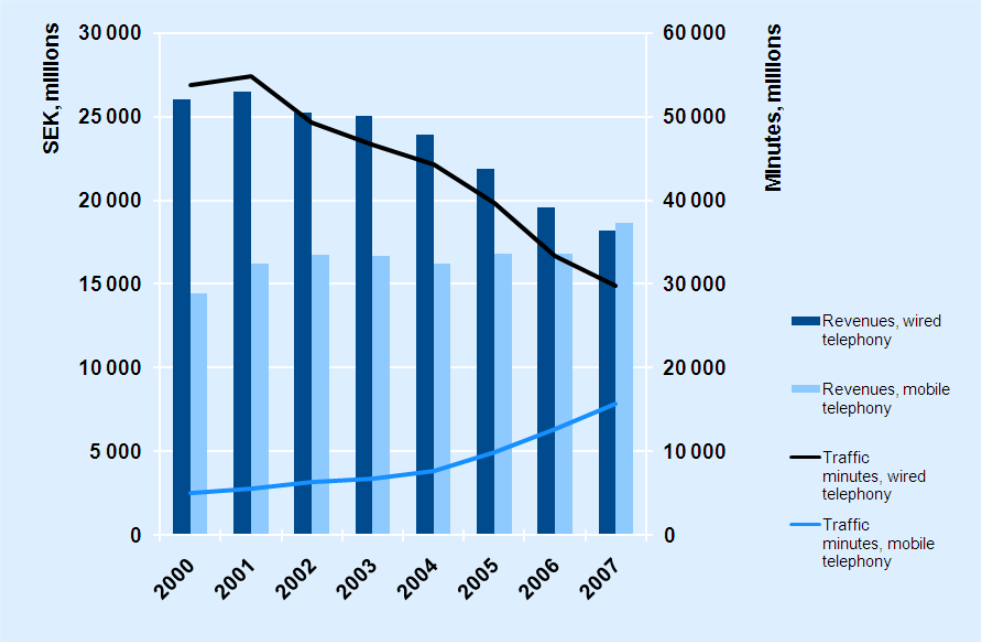
[26] PTS decision of 24 November 2004, File reference 04-6948/23, b
[27] Introduction to mobile Multimedia Communications, Monash University 2008

with the femtocell to enhance their offers to customers in a cost-efficient manner.[28]

3.2 The migration from wired telephony to mobile telephony

There is a strong demand for mobile communications services, and traffic has for several years to some extent migrated from the fixed networks to mobile networks. Since the first half-year of 2004 traffic in the PSTN networks in Sweden has reduced at an increasing rate, while traffic in mobile telephone networks has increased considerably. The diagram below shows how the traffic minutes are broken down between fixed networks (including IP-based telephony) and mobile networks, and the total revenues for wired and mobile telephony respectively. It is worth mentioning that minutes for dial-up Internet, which further accelerated the reduction in traffic minutes for PSTN/ISDN, are included.

Diagram 7 Revenues and traffic minutes for wired telephony and mobile telephony



The size of the market calculated in revenues for mobile call services exceeded the size of the market for fixed[29] call services for the first time in 2007. Traffic

[28] Femtocells: definition, issues and market potential, LSI Corporation & Ericsson 2008
[29] Including wired IP-telephony.

in the fixed networks has almost halved in six years, and there is no doubt that part of the voice calls in the fixed networks have been replaced by voice calls in mobile networks.

In 2006, PTS conducted an analysis of the extent to which mobile telephony could be considred to be a substitute for wired (PSTN) telephony,[30] which does not just mean that the products can be used in a similar way. The analysis at that time showed that there was not sufficiently strong support for mobile telephony being included in the same market as PSTN telephony. In such a substitution analysis, several different criteria are taken into account, for example, how rapidly the migration to the new product is occurring and what competitive pressure the new product exerts on the original in the form of, for instance, price and quality.

It is still a rather limited proportion of the population, seven per cent of Swedes between the ages of 16 and 75 years, who have totally eliminated a PSTN subscription. If there was no difference in price between mobile telephony and wired telephony, 36 per cent could consider having only mobile subscriptions.[31] However, an average user can already save 38 kronor per month by eliminating their fixed telephone subscription and having only a mobile subscription.[32] The fact that more choose to terminate the fixed subscription may partly indicate that consumers are not aware that there is money to be saved. There are also other reasons for wanting to keep their fixed telephone, for example tradition and the family's need of a fixed telephone.

Improved price competition in the mobile market has resulted in mobile prices increasingly moving closer to the fixed prices.[33] However, the price development for PSTN telephony has remained relatively unchanged in recent years, which makes it unlikely that mobile prices have until now exerted any great pressure on the prices for PSTN telephony. There are, though, examples of bundled offers where wired telephony is included at a very low cost.[34]

[30] An analysis of residential customers' substitution of traditional fixed telephony with IP-based and mobile telephony, PTS-ER-2006:38.
[31] When PTS's substitution analysis was conducted in 2006, the corresponding proportion was 40 per cent. The reduction may partly be the result of new reply alternatives being introduced in the PTS Survey of Individuals 2007.
[32]The price development for telecommunications and Internet in Sweden, January 2008.
[33] During the first half-year of 2007 the price reductions stagnated, according to the PTS survey 'The price development for telecommunication and Internet in Sweden – the first half of the year 2007'. A new price analysis has not yet been conducted, but there are indications that the stagnation was temporary.
[34] Read more about bundled offers in Chapter 4.

Market delineations are not static, but can be changed with developments in the market together with new patterns of behaviour, technologies, offers and products. PTS will conduct a new substitution analysis in 2008 in conjunction with the establishment of the second generation SMP decision.

3.3 Market impact

The convergence has obviously increased competition, since telephone operators, cable television companies and Internet providers can offer similar services on the same market. IP-based telephony increases the consumers' opportunities to select the telephone service and the operator that best suit their needs.

Developments towards convergence and NGN involve an increased demand for higher transmission capacity, and PTS expects that this will increase the need of fibre in the wired access networks. The authority is currently working with new market analyses of bitstream and LLU together with supervision of compliance with the existing obligations.

As a result of the increasing demand for mobility, PTS predicts an increased demand for wireless forms of access and the frequencies being managed by PTS. According to PTS's Spectrum Policy from 2006, the objective for frequency administration is technology neutrality and that market stakeholders must increasingly maintain control over the use of spectrum. PTS has recently auctioned out frequencies in the 2.6 GHz band, where several of the winning bidders state that they plan to develop mobile networks med high capacity.

A gradual transition is underway from traditional circuit-switched interconnection to IP-based interconnection, which also affects business models for interconnection. PTS has commenced a new analysis of the markets for fixed and mobile interconnection and is working with revising the calculation models for interconnection-related products.

Developments towards convergence, IP-based communications services and NGN may mean that end-users obtain the opportunity to choose from a broader range of services. However, to be able to gain access to IP-based services it is necessary that users have access to an Internet connection with sufficiently high transmission capacity. Consumers need sufficient information and knowledge in order to make conscious choices, on the basis of both price and quality. It is also important that the range of services does not entail lock-in effects which impede freedom of choice. Other aspects that must be monitored are possible security weaknesses owing to the transfer to the current-dependent IP networks, and how these new technologies affect

emergency services and the possibility of calling to and being positioned by SOS Alarm. PTS is working on several fronts so that as many consumers as possible shall gain access to Internet connections with higher transmission capacity and, in addition, focusing primarily on information to consumers and on monitoring market developments.[35]

[35] PTS-ER-2008:11

4 Bundling of electronic communications services

Technological progress has resulted in a common infrastructure that can be used for supplying different types of communications services such as telephony, data communications and media. Operators can consequently offer more communications services to their customers. For the past several years it has also become more common for operators in Sweden and abroad to broaden their range of services and bundle communications services together in the offer to the end-user. Offers of this kind are often referred to as 'multiple play'.[36]

4.1 Impetus behind multiple play

Swedish operators have in recent years diversified and offer increasingly more types of electronic communications services, in the same way as operators in mature telecom markets in the rest of the world. The impetus behind the operators' horizontal service differentiation can be traced first to a saturation in the operator's original market, second to the operators' reduced profitability in their core operations as a result of competition and market saturation. When stakeholders broaden their range of services in order to compete in new markets, the operators that were originally active in the market must offer corresponding bundles in order to defend their market position in a saturated market. The additional cost for producing a further service will become lower as operators, with the aid of new IP-based technology, can offer more types of services in the same infrastructure. In addition, the operators' administrative routines, customer services and existing networks are used in a more efficient way. New services can be launched without far too much new investment and the operators can seek new customers and higher profit margins within new areas. Such areas are IP-based services such as telephony and television via broadband.

The differentiation and bundling of communications services are closely interrelated. In many cases it is considered that additional sales may be easier and less expensive than new sales, as the supplier already has an established contact with the customer. This applies particularly in those cases when the market has entered into a phase of saturation and where the vast majority of people are already users of a service. The operators, through the lock-in period and discounts for bundled offers, try to tie customers closer to themselves and

[36] Three services that are bundled together are often called 'triple play', where the most common is when television, broadband and telephony are bundled together. Sometimes, 'quadruple play' is also referred to.

reduce the risk of customer defection. Surveys also show that customers who buy more than one service from the same operator are less inclined to change provider. From a European perspective Sweden has, like the rest of the Nordic countries, very extensive broadband coverage, which represents a precondition for some of the components of the package, for example IPTV.

4.2 Multiple play in Sweden

The markets for pay television distribution and fixed telephony are greatly influenced by market saturation and reduced margins. It is therefore natural that network operators such as Com Hem entered the market at an early stage with bundled offers. According to information received from Com Hem, it had approximately 159 000 triple play customers in the fourth quarter of 2007, which represents about 33 per cent of their broadband customers.[37] All the major fixed network operators can today offer households broadband networks with high capacity which can also be used for telephony and television.

Glocalnet and Bredbandsbolaget, which are owned by Telenor, represent other examples of operators who have launched bundled offers at an early stage. Today, among others, Telia Sonera, Tele2, Rix Telecom, Universal Telecom and Vattenfall offer bundled offers, but there are also smaller network owners and urban networks cooperating with broadband and telephony providers.[38] Six operators have registered bundled offers with telephony and fixed broadband on PTS's price information service "Telepriskollen" (Telecom Price Check), of which most are network-owning operators. Cable television companies sometimes offer television and broadband with a bundled price, and sometimes also IP-based telephony.

There are different levels of bundling. Today, most bundled offers in the Swedish market can be likened to discounts applicable if a customer subscribes to a further service. Sometimes a reduced price is offered for a further service for a fixed period, provided the customer ties her- or himself in for a fixed period. In some cases a service must be bought as a bundled offer; this particularly applies for IP-based telephony, which sometimes requires that the customer also has a broadband subscription with the selected operator. This may either result from the technical preconditions or the operator's strategies for pricing. Furthermore, some, even if low, transmission capacity for IP-based telephony is often required; 100 Kbits per second is an ordinary limit for the

[37] Com Hem's Earnings press release 2007.
[38] Rix Telecom has been bought by Phonera, which in its turn has been bought by Alltele. Vattenfall's telecom operations have also been bought by Alltele. It is still possible to subscribe to both of these.

offers in the market.[39] Call quality is comparable with an ordinary PSTN telephone, provided the broadband service guarantees a rate of at least 256 Kbits per second both upstream and downstream.

The components in bundled offers vary, but the most usual bundled offer in the Swedish market is the combination of PSTN telephony and broadband via ADSL. The next most common is IP-based telephony and broadband in combination. Digital television is included in Com Hem's bundle and, during 2007, Telia Sonera launched IPTN and IP-based telephony as a bundled offer. Vattenfall provides a discount of a few per cent on electricity and offers a common invoice for electricity and broadband.[40]

Mobile telephony is as yet not an equally common component of bundled offers, but there are nonetheless some examples. Among others, Optimal Telecom has a combined offer with a very low minute tariff for the mobile subscription, provided that one also has a PSTN telephone subscription with them. Optimal Telecom has a family package with a subscription for fixed telephony and two mobile subscriptions that can call each other free of charge at a low monthly cost. There are also offers where the broadband customer receives a discount for mobile Internet connection.

4.3 Consumer influence

The demand for multiple play is as such not clear, but the customers who wish to take out a bundled subscription are primarily motivated by lower prices. Another incentive is to only receive one invoice for all services and have one and the same customer services. The customer is more inclined to lock more of its communications services with the same operator if they have previously had positive experience of the operator. At the same time, the changed media consumption of households has resulted in a demand for services that form part of certain multiple play offers, for example a more interactive television.[41]

Bundling in its best form assists the customers to discover new services and gain access to them at a reasonable price. In many cases it also means a lower total price for the customer's communications services. Furthermore, it is positive for customers to only receive one invoice and to always be able to contact the same stakeholder in the event of questions and problems.

[39] The ITU standard for coding, G.711, is common for IP-based telephony and provides 64 Kbits per second. Including overhead, both for IP addressing and for frameworks, for example Ethernet, the G.711 system requires a bitstream of just over 80 Kbits per second in the broadband access.
[40] During 2007, Vattenfall offered broadband over cable television networks in certain municipalities through its cooperation with Teracom. During 2008, Vattenfall sold its telecom operations to Alltele.
[41] The Bundle Jungle Europe, Navigating the European multi-play market, Ernst & Young 2007

The network operators are working actively to promote additional sales via telemarketing and there is consequently a risk that customers are persuaded to buy an extra service that they really do not need because it is perceived to be inexpensive. Combined offers can also reduce overall understanding and make it more difficult for customers to compare offers. In certain cases, the services may be less expensive individually than the total cost of the combined offer. In those cases where it is not possible to buy the services separately from the operator, it is not possible to calculate how big the discount really is.

The wording of the contract is particularly important when taking out a bundled subscription, as it may be more difficult for consumers to withdraw from a bundled contract if the consumer is dissatisfied with one of the services. Consumers consequently become more vulnerable if they have all their communications with one operator.

4.4 Competition issues

In other EU countries it is much more common to have bundled offers than in Sweden. For example in Spain, 77 per cent of broadband customers have bought their broadband in a bundle together with another service from their provider.[42] The regulatory authorities within the EU are currently reviewing how an enhanced level of bundling influences competition. There is an opinion that a high level of bundling of communications services creates lock-in effects and provides advantages for the network-owning operators. If these network-owning operators set the retail price too low and the wholesale price too high, it is difficult for the operators who do not have their own infrastructure to be able to offer competitive prices.[43]

Everything suggests that bundled offers will increase in number and that customers will take out bundled offers to a greater extent, in pace with convergence when operators develop their infrastructure for IP-based communications services. PTS is monitoring the area of bundling of electronic communications services and will collect more information about bundled offers from the operators, among other ways through Telepriskollen.

[42] Convergence, Ecta Conference 29 November 2007.
[43] Known as 'margin squeeze'. See for example Ecta comments on ERG Work Programme 2008, November 2007.

5 Mobile Internet

The use of mobile Internet increased greatly during 2007. This development has been pushed on by new technology facilitating higher transmission capacities at access level in the mobile networks in combination with constantly improving coverage and subscription offers with a fixed price. In May 2008 there were sales of subscriptions with mobile Internet having theoretical transmission rates over 3 Mbits per second downstream for 100 to 300 kronor per month via the access technologies HSPA and CDMA 2000,[44] which together cover over 99 per cent of Sweden's night-time population.[45]

The growth of subscriptions for mobile Internet may be viewed as part of general increase in demand for mobility, where the increase in sales of laptop computers and increased areas of use for the mobile telephone represent other components. Mobile Internet with high transmission rates may also be viewed by the end-users as a clear effect of the ongoing convergence of communications networks, services and terminals that create opportunities for new innovative offers and business models. During 2007 the number of mobile subscription with active users of mobile packet data via data plug-in cards or USB modems increased from 92 000 to 376 000. This represents growth of 309 per cent. Details outside the framework of PTS's ordinary gathering of statistics also suggest that the number of users also continued to increase after 31 December 2007. USB modems for mobile Internet have for instance been at the top of the sales figures for mobile terminals in both Telia Sonera and Tre's shops during the first months of 2008.[46]

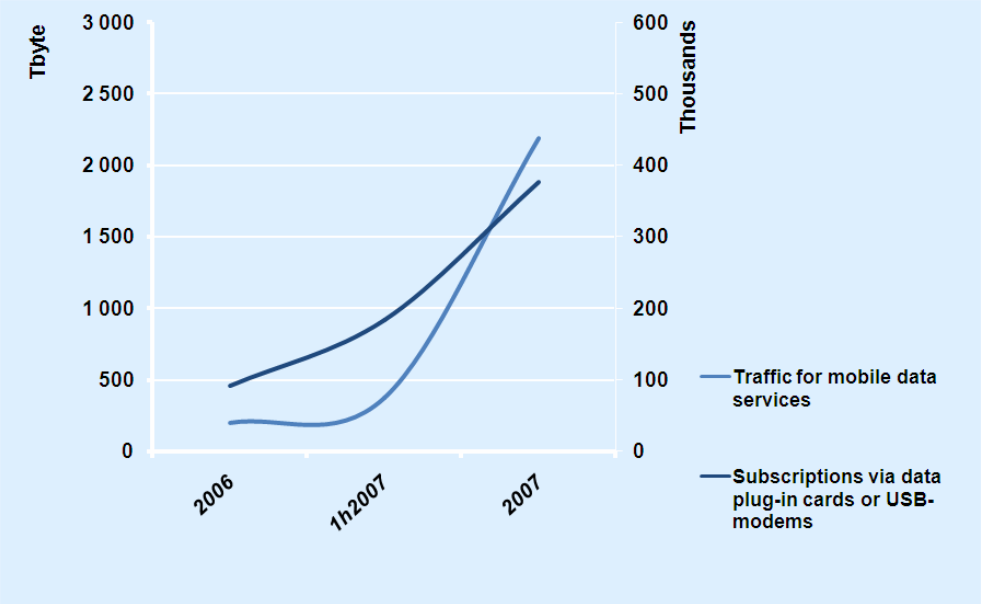
Besides users increasing in number, an average user of mobile Internet generates more traffic now than a year ago. This means that the rapid growth of subscriptions is matched by even more rapid growth of data traffic in the mobile networks (see Diagram 9). The total data traffic in mobile networks increased by 981 per cent during 2007 (from 203 Tbytes to 2 191 Tbytes). However, mobile data traffic is only a fraction of the data traffic transmitted via wired broadband. Higher transmission capacity at access level, changed user patterns and also, not least, new forms of subscription where the price or transmission rate is changed with the amount of data downloaded only after a

[44] www.telepriskollen.se, 14 May 2008
[45] Broadband survey 2007, PTS-ER-2008:5
[46] Other examples are the forecasts of the analysis company IDC, prepared on the assignment of PTS and IT Research, which both forecast further increased sales during 2008. See PTS-ER-2007:25 and http://www.itresearch.se/DocumentArchive/56418.doc.

ceiling has been exceeded (flat rate with a capacity ceiling[47]) may explain the mobile data traffic increasing more rapidly than is the number of subscriptions for mobile Internet. This increased data traffic is imposing greater demands on the mobile networks to be reinforced by more base stations or other capacity-enhancing measures, as large traffic volumes between base stations and users can impair transmission capacity or temporarily impede transmission to individual users. Statistics from PTS's service "Bredbandskollen" (Broadband Check) indicate that the rates 3.2 and 7.2 Mbits per second (which are common for mobile Internet) together with 24 Mbits per second are among the rates that demonstrate the greatest deviations between measured and promised rate.[48] From this perspective, the ceiling in a 'flat rate subscription' can be viewed to be a means of trying to curb the increase of data traffic in the mobile networks. Developments during the next few years will show whether technical and economic preconditions prevail to deal with an increased demand for mobile data services.

[47] There are also variants here. In May 2008, Nordisk Mobiltelefon (ice.net), Glocalnet, TeliaSonera and Tele2 increased the rate to 30 Kbits per second after 5 Gbytes have been downloaded in one month. Tele2's least inexpensive subscription, which provides 7.2 Mbits per second for 99 kronor per month, had a speed limit after 1 Gbyte was downloaded. Subscriptions from the operator Tre did not have any explicit limit value, but Tre reserved the right to limit speeds in the case of extreme usage.
[48] Source: Rickard Dahlstrand, project manager for Bredbandskollen at .SE (The Internet Infrastructure Foundation), to Telekom Online, 11 February 2008.

Diagram 8 Mobile data traffic and the number of mobile subscriptions with active users of mobile packet data via data plug-in card or USB modem



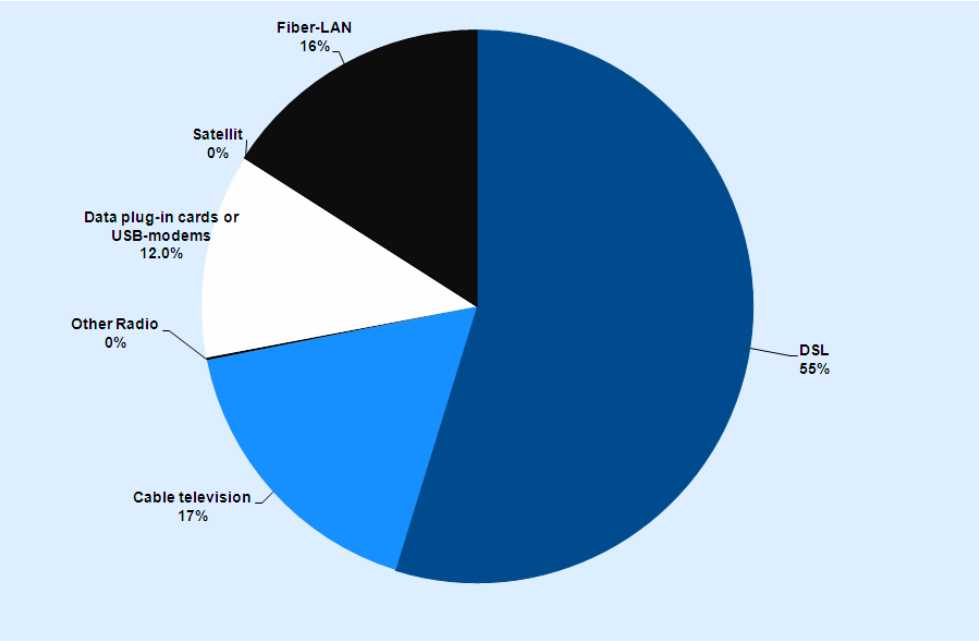
**Mobile data traffic also includes data traffic in mobile networks generated by mobile telephones.*

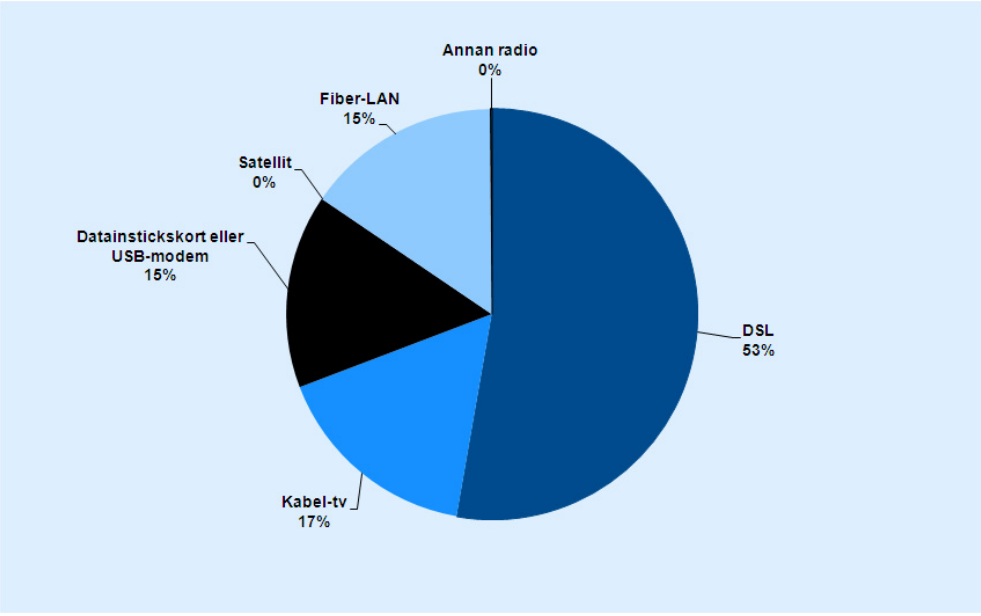
Mobile Internet with high transmission capacity is still a rather new phenomenon in the market for electronic communications. It therefore remains to be seen whether the end-users will use mobile Internet in order to supplement pre-existing broadband subscriptions, or if mobile Internet may in the future be an alternative to traditional forms of broadband. The PTS Survey of Individuals may provide an indication of how the consumers use mobile Internet. However, in the 2007 survey only 60 of almost 2 000 people said that data plug-in cards or USB modems via 3G and Edge were used within the household. Of these, 40 stated that a plug-in card or a USB modem was primarily used as a complement to another connection, while the remaining 20 always connected to the Internet with a plug-in card or USB modem.[49]

Mobile Internet is the form of access that has changed most during the year. On 31 December 2007 subscriptions with active users of mobile packet data via data plug-in cards or USB modems represented 12 per cent of all broadband subscriptions (see Diagram 10). The corresponding proportion on 31 December 2006 was 4 per cent.

[49] *Individundersökningen 2007 – Svenskarnas användning av Internet och telefoni* (Survey of Individuals 2007 – the use of telephony and Internet by Swedes), PTS-ER-2007:26

Diagram 9 Break-down of Internet subscriptions via broadband according to form of access





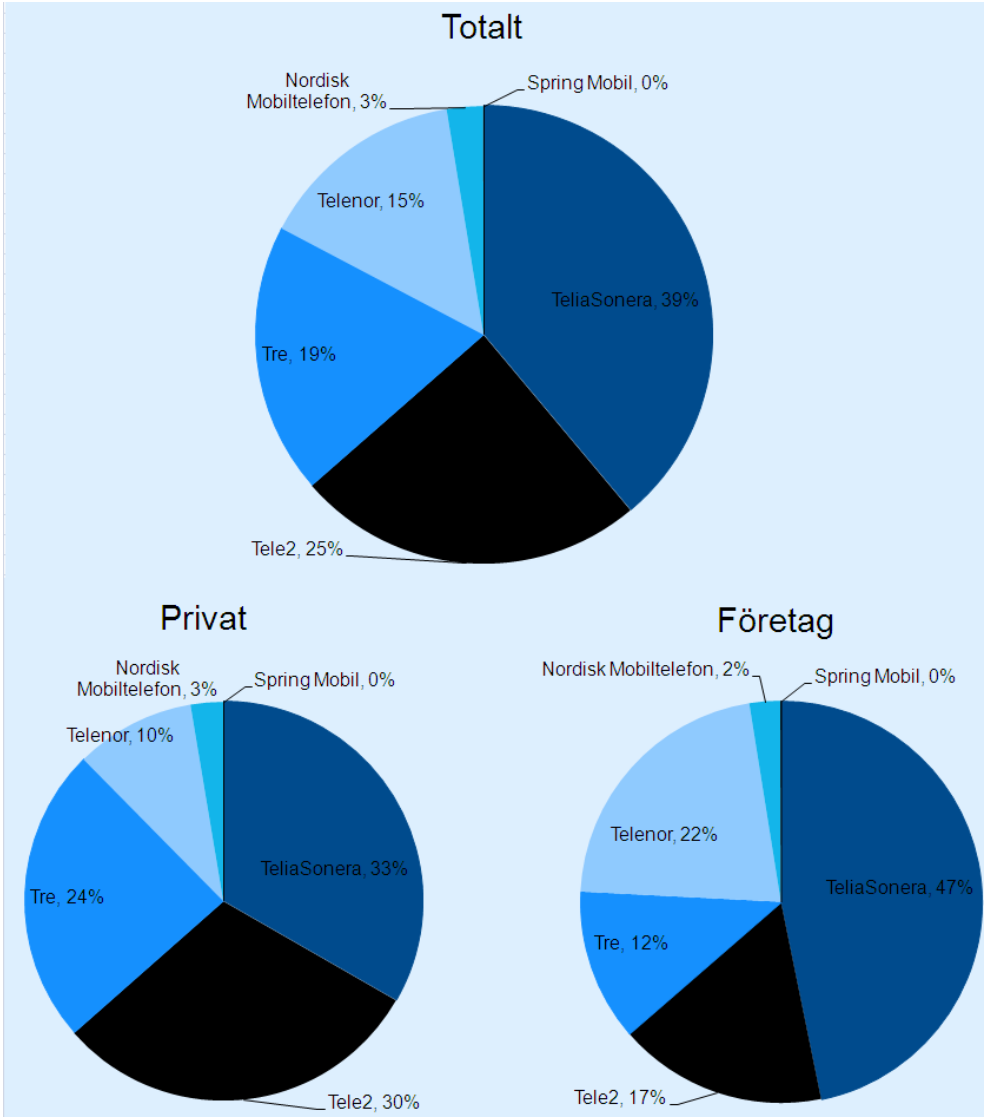
During 2007 subscriptions for mobile Internet were mainly sold by the operators Telia Sonera, Telenor, Tele2, Tre and Nordisk Mobiltelefon

Sverige.[50] At the end of 2007, Telia Sonera was the market leader, with 39 per cent of subscriptions with active users of mobile packet data via data plug-in card or USB modem. The next largest was Tele2, with 25 per cent followed by Tre (19%) and Telenor (15%). The smallest besides Spring Mobil[51] was Nordisk Mobiltelefon with less than 3 per cent of all subscriptions for mobile Internet via data plug-in card or USB modem.

There is also great difference between the operators as regards the break-down between private subscriptions and business subscriptions. Telenor and Telia Sonera have relatively more business subscriptions, while the Tele2 and Tre have relatively more private subscriptions (see Diagram 11).

[50] Nordisk Mobiltelefon Sverige AB changed its brand to ice.net in May 2008.
[51] Spring Mobil only has a few customers with mobile Internet via data plug-in card and USB modem.

Diagram 10 Market shares - number of mobile subscriptions with active users of mobile packet data via data plug-in card or USB modem



6 New access technologies

The strong growth of mobile broadband during 2007 represents one example of how the end-users assimilate new technology. Further new technology and the development of existing networks that allow significantly more rapid transmission rates at access level in both the wireless and the wired networks are also expected in the immediate future, set against the background of the convergence and the increased demand for mobility and higher bandwidths. It is reasonable to assume that this will have a major impact on the area of electronic communications, but it is difficult to specifically forecast how the development of technology will influence different sub-markets. In this section, the new access technologies that PTS considers to be the most relevant today are described. It is not intended to predict which technologies will be generally available and successful in the long term. Instead, PTS wishes to provide an overall picture of the properties of future access technologies and their possible transmission capacity, and in this way shed light on the changes lying ahead in the market for electronic communications.

PTS's role in this is to work to promote the long-term consumer benefit through sustainable competition within and between wired and wireless networks and also through the efficient utilisation of frequency resources with the increased use of wireless forms of access.

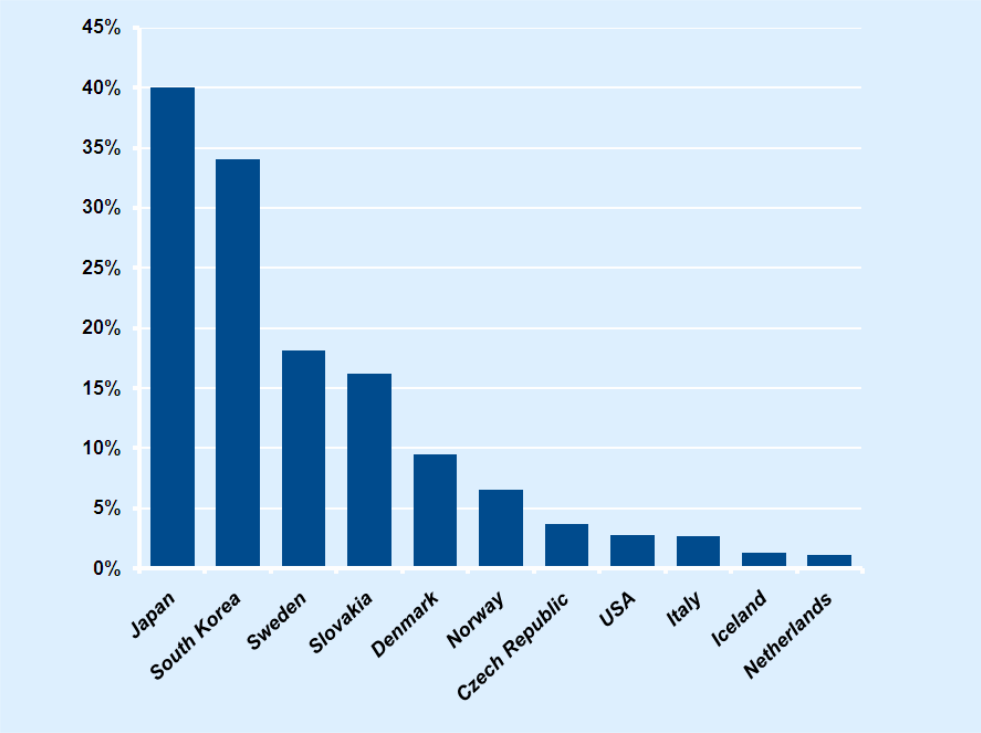
6.1 Wired access technologies

6.1.1 Optic fibre

As optic fibre is the form of access that has by far the highest transmission capacity, demand by end-users for services demanding high capacity will probably result in increased use of fibre in the access network. The number of broadband subscribers who are connected with fibre LAN has increased throughout the 2000s (see **Fel! Hittar inte referenskälla.**) and it is expected this will continue to increase. Viewed from an international perspective, Sweden has a high proportion of broadband subscribers connected with fibre. In a comparison survey conducted by OECD in May 2008, Sweden distinguished itself by having the highest proportion of fibre LAN-connected subscribers for all subscribers with wired broadband, after South Korea and Japan (see Diagram 12).[52]

[52] See http://www.oecd.org/dataoecd/21/58/39574845.xls

Diagram 11 Proportion of subscriptions with fibre LAN of the total number of subscriptions with wired broadband



**Källa: OECD, 19 maj 2008. Abonnemang till mobilt Internet är inte inkluderade.*

Source: OECD, 19 May 2008. Subscriptions for mobile Internet are not included.

6.1.2 xDSL

However, the increased use of optic fibre does not always mean that fibre is run the entire way to the end-user's home (FTTH).[53] Fibre can also be connected to the property network in a multiple occupancy building (FTTB[54]), or to a connection cabinet near the end-user (FTTC[55]), following which the operator uses xDSL technology via the fixed telephone network for the final section up to the end-user.[56] In order to be able to supply rapid transmission rates with xDSL technology, it is actually required that the broadband equipment is placed rather close to the end-user. Recently, an improved version of VDSL (VDSL2) was launched by operators in Sweden[57] and a further VDSL technology (VDSL3) is being developed. VDSL3 technology is

[53] Fibre to the home
[54] Fibre to the building
[55] Fibre to the curb
[56] The upgrading in these respects is often designated 'NGA' (Next Generation Access).
[57] By Bredbandsbolaget. See http://www.nyteknik.se/nyheter/it_telekom/bredband/article74511.ece.

expected to allow rates of up to 170 Mbits per second over a distance of 500 metres and also reduce problems with interference through 'crosstalk'.

The rollout of FTTC in combination with VDSL2 technology, with the subsequent transition to a completely IP-based network, has been commenced in both the Netherlands and Germany. During 2005, KPN in the Netherlands and Deutsche Telekom in Germany announced their plans to transfer to VDSL2 technology. This will in time mean that most of the current telecommunications exchanges will be phased out to instead be replaced by more VDSL nodes closer to the end-users.

In Sweden, no great investment has yet been made to commence a transition to NGA. Strategic planning regarding access network infrastructure is, however, also in progress among operators in Sweden.

6.1.3 Cable television

The cable television networks are currently being upgraded in order to facilitate higher capacity, and today transmission capacities of up to 100 Mbits per second downstream are being tested. In networks offering good quality, it is technically possible to obtain high transmission capacity, although the capacity is limited by the space in the networks being taken up by television distribution.

6.2 Wireless access technologies

6.2.1 UMTS

The continued development of UMTS is proceeding rapidly, among other things through increased bandwidth and improved spectrum efficiency. Certain HSPA networks are for instance already prepared to increase during 2008 the maximum speeds of mobile broadband to 14.4 Mbits per second downstream and 5 Mbits per second upstream. Under the right preconditions, this would provide the end-users with a transmission capacity corresponding to xDSL. The LTE (Long Term Evolution) technology is also being developed, which according to the mobile industry will within a few years, subject to the right preconditions, be expected to provide performance corresponding to xDSL with short distances, that is to say more than 100 Mbits per second downstream and 50 Mbits per second upstream (for each 20 MHz channel).

6.2.2 CDMA 2000

As CDMA 2000 is used in the 450 MHz band, good range is obtained at a rather low investment cost. Considering this range, CDMA 2000 in the 450 MHz band appears to be an alternative for offering broadband to those customers who are currently compelled to use dial-up Internet or who have no

Internet access at all. The frequency space for CDMA 2000 in the 450 MHz band is, however, limited, which means that capacity reduces in areas with many users. In such areas, an enhancement to capacity in the network can be effected, either through increasing the density of the network or through the introduction of a more spectrum efficient version of the CDMA 2000 technology, for example EV-DO Rev B. The maximum transmission capacity for the CDMA 2000 Rev B standard, which can be supplied during 2008, is 14.7 Mbits per second downstream and 5.4 Mbits per second upstream for three 1.25 MHz channels. Nordisk Mobiltelefon Sverige, which is currently the only operator in the network, has formally an allocation of 2x4.5 MHz. This allocation has space for three 2x1.25 MHz CDMA channels. There has, however, been an appeal against the most recent allocation of 2x2.7 MHz, and the determination of the County Administrative Court has not yet been made. During 2010 it is expected that equipment for the standard CDMA 2000 Rev C (UMB) will be supplied. Spectrum space of 2x4.5 MHz would with CDMA 2000 Rev C (UMB) possibly allow just more than 50 Mbits per second downstream. Further spectrum space is required for rates in excess of this.

6.2.3 WiMAX

WiMAX technology has rather broad support in the USA, while European stakeholders are more sceptical. WiMAX as a technology is considered sometimes to be "squeezed in" between UMTS and WLAN (the latter is rather well established as a solution for public places such as airports and hotels). WiMAX has been designed to have a range of up to 50 km and a transmission capacity of up to 70 Mbits per second, but not in combination. As regards Sweden, it is worth noting that WiMAX terminals have entered the market with a start in 2008, that there are WiMAX solutions in, among other places, the Municipality of Västerås and that WiMAX networks are planned for several municipalities in the Stockholm region.[58] In November 2007 and in May 2008, PTS auctioned licences in the 3.6-3.8 GHz band and 2.6 GHz band, and it is possible to use these licences for WiMAX (see more on frequencies under section **Fel! Hittar inte referenskälla.**). Today there are two basically incompatible variants of WiMAX – 'mobile WiMAX', which is currently most discussed, and 'fixed WiMAX', the development of which has progressed further, among other things as regards installations in developing countries.

6.2.4 Other wireless-based technologies

In parallel with the access technologies described above, developments are underway regarding slower mobile technologies that are used in the GSM networks, for example EDGE, which through EDGE Evolution will achieve a theoretical bit rate of 1.4 Mbits per second. As regards the development of

[58] Computer Sweden, 1 October 2007, *Nytt trådless nät i Stockholm* (New wireless network in Stockholm)

mobile broadband, it is also relevant to mention femtocells, that is to say small base stations that via a broadband connection increase mobile coverage at home and make it possible to offer inexpensive calls, and also facilitate the development of various kinds of integrated services. Satellite is mentioned as another technical alternative – in theory. In practice, there are few that believe that anything substantial will occur in the Swedish market within the immediate future. As user-dedicated capacity is a very limited resource, satellite communication is currently a technology that is most appropriate for broadcasting and not for general broadband access. Moreover, satellite communication entails the typical time delay, which may be an inadequacy in certain contexts.

6.2.5 Frequencies in the 2.6 GHz band and frequencies released in the 800 MHz band

Set against the background of the rapid development of wireless access forms, PTS has chosen to allow the stakeholders in the market to control to an increasing extent the use of spectrum, for the reason that it is there that the greatest knowledge of technical and market conditions is found. This is occurring, among other ways, by as far as possible applying technology- and service-neutral licences and auctions as selection procedures when allocating spectrum. During the spring of 2008, PTS auctioned licences for frequencies in the 2.6 GHz band. These frequency licences are technology- and service-neutral, which provides an opportunity both for further development of existing mobile broadband networks and for new networks with new technical solutions. In this spectrum auction, which was concluded on 8 May, Telia Sonera and Telenor won 2x20 MHz FDD each. Telia Sonera and Telenor have through a press release stated that they intend to use these frequencies for the next generation mobile network.[59] In the same spectrum auction, HI3G Access AB won 2x10 MHz FDD, Tele2 Sweden AB won 2x20 MHz FDD and Intel Capital Corporation won 50 MHz TDD.

On 19 December 2007, the Government decided to assign PTS the task of releasing the frequency space between 790-862 MHz which became vacant after the transition from analogue to digital television broadcasts. Thereafter, the released frequency space[60] will be allocated by PTS in accordance with the Electronic Communications Act. When competition for frequencies prevails, it has been the policy of PTS to in the first instance allocate licences by auction in a technology- and service-neutral way, which means that the stakeholder that presents the winning bid controls the use of the frequencies.[61] Mobile

[59] Telenor's press release: http://feed.ne.cision.com/client/Telenor.aspx?id=807527. Telia Sonera's press release: http://feed.ne.cision.com/client/TeliaSoneraAB//Commands/File.aspx?id=807967
[60] Frequency space in the UHF band (790-862 MHz).
[61] http://www.pts.se/upload/Documents/SE/Spektrumpolicy_PTS_VR_2006_2.pdf

broadband services are one example of a conceivable area of use. PTS will conduct a replanning during 2008, and thereafter the authority can proceed with preparing an allocation of frequency licences. It is considered that the allocation will be effected during 2009 or 2010, but the frequency band will not be fully usable before 2012. However, this depends upon coordination with the rest of Europe as regards the shutdown of the analogue television network. The frequency band released will probably be of interest for technologies such as LTE and WiMAX E (mobile WiMAX). Today, there is no technology adapted to this frequency band, but as the demand is expected to be great in both Sweden and the rest of Europe, development by suppliers will be pushed forward.

The advantage of building a wireless network in the 800 MHz band is that good geographical coverage can be achieved with a lower number of masts and base stations than in higher frequency bands, which overall results in lower investment costs.

6.2.6 Conclusion

The report the Swedish Telecommunications Market focuses primarily on the retail market, but in this context PTS nonetheless wishes to emphasise the necessity of the backbone networks and the interurban networks having sufficient capacity for future access technologies to be able to provide the rapid transmission rates mentioned above. An access network is a basic precondition for end-users being able to obtain broadband access, and in the same way there must be a well-developed backbone structure of fibre to link together all the forms of access and provide them with sufficient capacity to enable the supply of rates to meet future demands. In many parts of Sweden the conditions prevail for the operators to build out capacity further back in the network, but at the same time such development cannot be effected on commercial market conditions in all parts of Sweden. This is one of the reasons that PTS in several contexts, most recently in the report Broadband Survey 2007,[62] emphasised that a public initiative is required if everyone in Sweden is to gain access to broadband. The report presented by the Bredband 2013 Commission, *Bredband till hela landet* (Broadband throughout Sweden),[63] it was concluded that further government financial support is required. The Commission proposes in the report that "support is established to build out broadband to neglected areas outside urban areas including small towns, where the municipality considers that a buildout on commercial market terms will not occur within five years".

[62] PTS-ER-2008:5
[63] SOU 2008:40

7 New forms of television

Previously, television has been distributed in infrastructure that was particularly intended for the purpose. The development of broadband means, however, that it is possible to an ever increasing extent to use the same networks to distribute both communications services and media services. IPTV is an example of this. Increased transmission capacity in the mobile networks facilitates both the use of the Internet and other new, capacity-demanding mobile services. One of the most discussed services in recent years is television in the mobile, which is also a good example of how services converge to being distributed in one and the same network, to one and the same terminal. The following section focuses on these emerging forms of television.

Certain surveys suggest that it is primarily younger people who are to some extent abandoning the watching of traditional, scheduled television in favour of interactive experiences, such as for example streamed video clips on the Internet.[64] It is assumed that this will impose demands on new television services to offer a more interactive television experience, where the viewer can personally select the time to view a specific content.

7.1.1 Means of distributing television

The means of distributing television that viewers can choose between are to a large extent determined by where in Sweden they live. Subscriptions via analogue cable networks are the most common of the various means of distribution; there were 1.9 million subscriptions via analogue cable networks as of 31 December 2007. However, there are today in total more customers who view digital television; on 31 December 2007 there were 2.3 million digital television subscriptions in Sweden. There are four digital means of distribution in Sweden: via the terrestrial network, via satellite, via cable television networks or via broadband. In order to be able to watch digital television, it is necessary to have a digital television box[65], alternatively the less common solution with a television with an integral digital television receiver. During 2007 the analogue terrestrial network was shut down, which had the consequence that those who were watching television via the analogue terrestrial network were compelled to buy a digital television box in order to continue to watch television. It is

[64] Television viewing increased during 2007 in all age groups except 15 to 24 years, who watched on average 8 minutes less than according to the survey of 2006. Today, moving images on the web are the most common way of watching moving images, following scheduled television. The proportion of viewers who watch web television (long television programmes from, for instance, SVT.se) has increased during 2007 from 11 per cent to 17 per cent, according to an MMS survey Rörliga Bilder 2008:1 (Moving Images 2008:1).

[65] Also referred to as 'set-top box'.

estimated that 400 000 households do not have a pay television subscription, but receive free television[66] via the digital terrestrial network.

The digital terrestrial network covers up to 99.8 per cent of all households in Sweden (the coverage varies for different channels), but in densely populated areas the reception conditions are often too poor for an individual household in a multiple occupancy building to receive an acceptable television image via the terrestrial network. At the end of 2007 there were 710 000 subscriptions via the digital terrestrial network, which is a slight increase compared with 2006 when there were 650 000 subscriptions.

Satellite broadcasts cover the whole of Sweden, but even these broadcasts may be difficult to receive by an individual household in a multiple occupancy building, as the property owner is often restrictive with permits for satellite dishes. Satellite subscriptions reduced from 720 000 subscriptions on 31 December 2006 to 690 000 subscriptions the corresponding period in 2007.

Cable television networks are most common in densely populated areas, particularly in multiple occupancy buildings but sometimes also in areas with detached houses. On 31 December 2007 there were 550 000 subscriptions via digital cable networks, which represents an increase of almost 30 per cent compared with the same period during the previous year.

7.2 IPTV

Digital television via broadband (IPTV) can finally be selected by those who have access to broadband, provided the broadband connection has sufficiently high capacity. IPTV is digital television relayed via the Internet Protocol (IP). The term 'IPTV' is not absolutely unambiguous. IPTV sometimes means television via broadband, sometimes television via the public Internet, sometimes also television in traditional cable television networks that have been upgraded with IP technology. Other designations used include broadband television (television via broadband networks such as xDSL or LAN) and web television (television via the Internet). In this document, reference to IPTV below designates a digital television service that is relayed via IP over a broadband network to an ordinary television via a set-top box (digital box or television box). The quality should correspond to traditional television. IPTV requires an IP-based connection which today is usually xDSL or LAN, but which could also be a cable television network or a radio access.

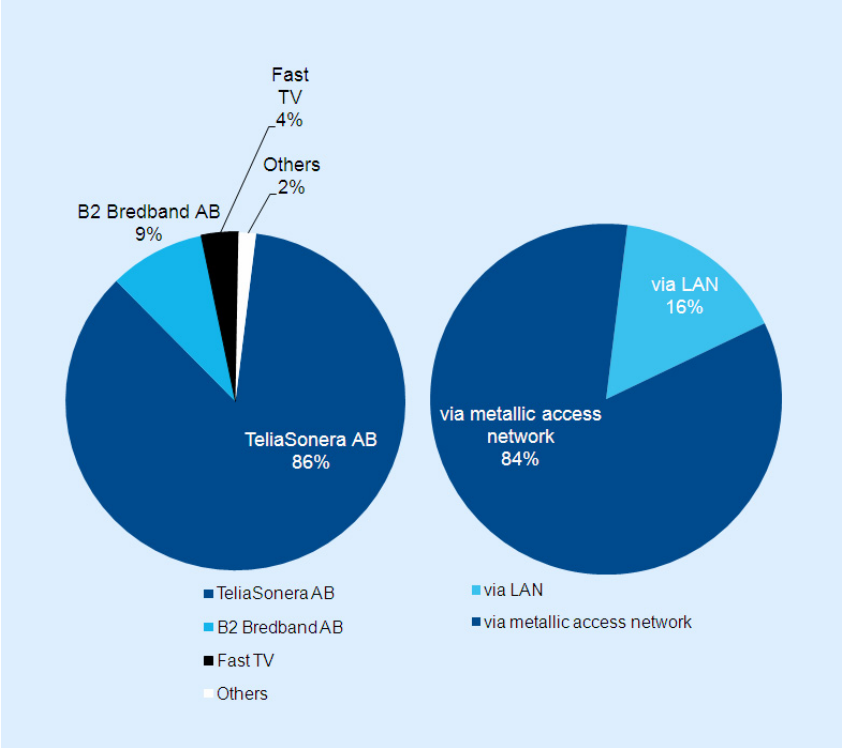
[66] Free television channels are broadcast without encryption and can be received without a pay television subscription.

In addition to linear broadcasts,[67] IPTV affords opportunities for interactive services that provide users with the opportunity to select how and when they wish to watch various television programmes (for instance video on demand).

7.2.1 The IPTV market

The number of IPTV subscriptions increased dramatically during 2007. On 31 December 2006 there were 50 000 IPTV subscriptions, and at the corresponding date one year later there were 355 000 IPTV subscriptions. This corresponds to an increase of 610 per cent, and means that 15 per cent of all digital television subscriptions were IPTV subscriptions. The largest provider of IPTV is Telia Sonera, which has had great success with its service Telia Digital-tv. This service has been provided bundled together with broadband subscriptions and was offered free during a trial period.[68] Other providers of IPTV are Telenor/Bredbandsbolaget, which offers television via broadband from Viasat, and Canal Digital, Fast-TV and a number of urban networks.

Diagram 12 IPTV subscriptions, market shares and means of distribution



[67] Television broadcasts that are provided for all viewing according to a programme schedule.
[68] Free offers were launched in 2007 and initially lasted up to twelve months.

7.2.2 Link to the broadband market

IPTV requirements impose demands on the quality of the broadband connection, and in order to be able to have more than one television receiver even higher transmission capacity is required. This involves limitations for those who have broadband via xDSL. It is not all xDSL customers who can gain access to IPTV via Telia Sonera's access network, as the company has not upgraded its xDSL networks in all areas of Sweden so that they can manage the great load that IPTV involves. However, this development is continuing all the time. At the end of May 2008, 2.5 million households could gain access to Telia Sonera's IPTV solution.[69] IPTV via xDSL increases the customers' opportunities to select television provider.

LAN networks are usually found in multiple occupancy buildings. It is usually the property owner that has arranged the installation of the LAN network, either as an alternative network to the existing cable television network or in conjunction with new building, where there is neither access to a copper-based access network or a cable television network. It is often intended to provide the end-users with an opportunity of choosing between a number of broadband and television operators. However, when concluding contracts for LAN networks in new housing areas there is a risk that operators demand exclusivity, often through contracts lasting several years, and thereby block the property owner's or builder's ambition that the residents of the house should themselves be able to choose provider for telephony, television and broadband. Exclusive contracts risk creating small, local monopolies where the customers in a specific housing area become tied to a provider. Today, several projects aimed at combating this problem have been started, where the property owners, public housing bodies and urban networks are cooperating to create open competition-neutral networks where the viewers themselves can select IPTV provider with the aid of provider-neutral set-top boxes, known as 'base boxes'.

Availability of broadband access is continuously increasing, and thereby the potential customer base for IPTV is also increasing. Technological developments make it possible to distribute several services through the same infrastructure and enable telecom operators throughout the world to broaden their range of services in a cost-efficient manner. There is a clear international trend towards operators wishing to be able to offer both television with as many channels as possible and telephony over their broadband connections, either bundled as triple play or as services sold separately.[70]

[69] According to Telia Sonera's press release, 23 May 2008.
[70] Read more about convergence and bundling in Chapters 3 and 4.

Television can help to fuel the demand for broadband but was as such hardly a profitable service in the Swedish the market during 2007, as IPTV services were offered free or at a low price. Every sixth digital subscription was on 31 December 2007 an IPTV subscription, at the same time as these subscriptions only represented 3 per cent of the revenues for digital subscriptions during 2007. Television is in other words one way of attracting customers to the broadband networks, tying the existing broadband customers more tightly to the operator and reducing their churn.[71] In the five-year forecasts prepared by the analysis company IDC on the assignment of PTS,[72] it was expected that the number of IPTV customers will increase to about 764 000 subscribers during the period up to and including 2011. IPTV may in the future influence competition on the television market positively through IPTV (in those cases where customers are not locked into the local monopoly) being able to offer increased opportunities for customers to select television provider.

7.3 Television in the mobile

Television in the mobile is one of the most topical new phenomena in the television market at the moment. Mobile operators expect that mobile television will help to retain customers and increase revenues, at the same time as the networks are used efficiently. Market surveys in several countries show that there is latent demand to be able to watch television from any location. The demand for television in the mobile is also broadly the same for all customer groups regardless of age and other demographic characteristics. However, being able to receive and watch mobile television does not only involve using a mobile telephone with support for television; it could also be able to involve multimedia terminals or dedicated terminals with large screens that are optimised for mobile television viewing.[73]

7.3.1 Audience perception

The format in a mobile telephone differs greatly from the television experience that viewers are used to, and therefore television in the mobile will probably be used in a different way than an ordinary television receiver. The great gain is in being able to watch television wherever the consumer is located, for example when using public transport. Operators estimate that consumers of television in the mobile telephone would rather watch for short moments than for many hours at a stretch. According to a study by the government television distribution company Teracom conducted after tests of television in the mobile, the test subjects watched television in the mobile while they waited for

[71] 'Churn' is the operators' designation for how many customers end their relationship with the company compared with the company's average customer base.
[72] PTS-ER-2007:25
[73] There are also solutions for forwarding from a television receiver to a mobile telephone.

something and when commuting to their work, and they considered that it functioned well to watch television in the mobile for up to 35 minutes.[74] New television habits thereby impose different demands on the formulation and length of programmes than with ordinary television. There is also a need to be able to pause the programme.

For television in the mobile to have a broader impact, it is necessary to have user-friendly services such as terminals that are 'easy on the wallet'. A user interface that allows interaction imposes demand on both the uplink and downlink.

7.3.2 Television in the mobile in Sweden

In October 2007, two per cent of mobile telephony users answered in the PTS Survey of Individuals that they had watched television in their mobile telephone during the last six months. In Sweden the mobile operators Telia Sonera, Telenor, Tre and Tele2 each launched their television service to mobile telephones during 2007. The offers are very similar, with a monthly subscription including certain channels. The channels are specially adapted for broadcasts to mobile telephones. The cost for a basic package varies between 39 and 69 kronor per month. Tele2 is cooperating with Viasat; they have the broadest range of channels, and in Tele2's offer the customer can also choose to buy individual channels. Viasat launched a television service for mobile telephones in cooperation with Tele2 in June 2008, and this channel package costs between 49 kronor and 89 kronor per month. According to tests, the operator Tre's television service has a better picture quality than the other operators' broadcasts.[75] Tre itself is of the opinion that this results from, among other things, the coding technology.[76]

Broadcasts in Sweden are today made in the 3G networks. All services (voice, data, television broadcasts) compete for capacity in the cell, which means that it is difficult to guarantee the audio and picture quality for television that is transmitted through the mobile telephone networks. In the beginning, television services were really streamed one-to-one broadcasts, which require high capacity in the 3G networks. In order to utilise the available frequencies more efficiently, streamed television services to broadcast or multicast are at this time being developed.

[74] Pilot test of directly transmitted television in the mobile telephone, MMS, 28 March 2007
[75] PC för alla (a popular Swedish home computer magazine), 30 December 2007
[76] The coding technology used is called 'h.264' and is transmitted over the mobile network in 300 Kbits per second, with the aid of DBA technology (dynamic bandwidth adaption) which improves capacity use in the network.

Several broadcasting technologies for television broadcasts to mobile telephones are conceivable. With MBMS[77] technology, the operators can use IP addressing in order to send programmes only to the selected paying users. As the programmes, in contrast to streamed television broadcasts, are only transmitted once from the same base station regardless of how many are watching, this means that the available 3G frequencies are utilised more efficiently. Television can also be distributed through the television network, and Teracom conducted tests during 2006 and 2007 of television broadcasts in a limited part of the Stockholm area to mobile telephones in the digital network for terrestrial television with the aid of DVB-H technology. In Sweden there are also partly built-out networks for distribution of digital radio, which could possibly be used to broadcast television to mobile units, for example with the aid of DMB technology, which is already adapted for television in the mobile.

One future opportunity for television broadcasts to mobile telephones is the frequencies that have previously been used for broadcasts in the analogue terrestrial network. As the analogue terrestrial network has been shut down, the Government decided in December 2007 to give PTS the assignment of releasing the frequency space in the UHF band (790-862 MHz) which was used for broadcasts in the analogue terrestrial network, and at the same time plan a further frequency network for television below 790 MHz.[78] Through this replanning, the terrestrial network gains access to two new transmitter networks, which opens the prospects of new channels and services such as, for example HDTV. When the replanning has been implemented and frequency space released, the frequencies will be allocated by PTS in accordance with the Electronic Communications Act. When competition for frequencies prevails, it has been the policy of PTS to in the first instance allocate licences by auction in a technology- and service-neutral way, which means that the stakeholder that presents the winning bid controls the use of the frequencies.[79] Besides television in the mobile, mobile broadband services are also an example of another conceivable area of use. PTS's Spectrum Policy is based on the decision that the EU's Radio Spectrum Policy Group (RSPG) made in early 2007 for the frequencies in the UHF band to be dealt with in a technology- and service-neutral manner in international regulation.[80]

Besides the said standards, there are a number of other more or less well-advanced technologies for broadcasting of television in the mobile. It is far

[77] Multimedia Broadcast Multicast Service
[78] http://www.regeringen.se/sb/d/9760/a/94782
[79] http://www.pts.se/upload/Documents/SE/Spektrumpolicy_PTS_VR_2006_2.pdf
[80] Radio Spectrum Policy Group Opinion, on the EU Spectrum Policy Implications of the Digital Dividend, 14 February 2007

from clear which technology will prevail in the future. It is likely that television receivers in certain mobile telephone models will be able to cope with receiving broadcasts from more than one technology. The opportunities of operators to offer television in the mobile are dependent upon the broadcasting licences and access to frequencies. It is the Government that decides whether to allocate broadcasting licences for terrestrial television and PTS will thereafter be given the assignment to allocate frequencies.[81]

The same conditions apply for all technologies: there must be efficient ways of controlling access to broadcasts and receiving payment for the services. In those offers available in the Swedish market today, the programme companies and mobile telephone operators cooperate in order to be able to deliver this service. Stakeholders must use commercial models and contracts that are suitable for both the programme companies and the mobile telephone operators. In certain cases the mobile telephone operators have had problems in acquiring the rights to the channels that they wish to be able to offer their customers.

[81] Chapter 2, Section 2 of the Radio and Television Act (RTVL)

Market Data

For market data please see www.svensktelemarknad.se

Table 1 Answers received

2bornot2b AB	Bahnhof AB	BÅLSTA KABEL TV AB	DGC Communications AB
42IT AB	Balder Tech AB	C4 Elnät AB	Direct2Internet AB
AB Borlänge Energi	Bamok Com AB	Cable & Wireless Sweden AB	Djuice Mobile Sweden
AB Hallstahem	Banverket ICT	CampuzMobil AB	Dorotea kommun
AB iP-1 Internet till företag	Barablu Mobile Scandinavia Limited	Canal Digital Sverige AB	driftbolaget i Norden AB
AB Lessebo Fastigheter	BearCom	Canal Digital Sverige AB	Efftel AB
AB PiteEnergi	Belgacom ICS Sweden AB	Canal Digital Sverige AB	Ekhosat Kabel TV AB
AB Stokab	Bengtsfors Energi Nät AB	Carl Lamm AB	Eksjö Energi ELIT AB
AB Svensk Programagentur	Bengtsfors kommun	Carlslids Bredband Ek. förening	Eksjö kommun
AB Svenska Spels Internetservice	Best 4 you AB	Carrot Communications AB	Elektronik ab Radio-Master
AB Tierpsbyggen	Bisnode AB	Cellip AB	Eltel Networks Infranet AB
ABÄlmhults kommunala industrifastigheter	BIVA Bredband i Värend AB	Cepus Internet Solutions AB	Elverket Vallentuna AB
Access IT Sverige HB	Bjurholms kommun	Cheaptel AB	Emmabod Energi & Miljö AB
ACN Communications Sweden AB	Bjäre Kraft ek för	Clue AB	ENGBOMS NETWORK SOLUTION AB
Adamo Europe S.L	Björnekulla IT AB	Colt Telecom AB	Eniro 118 118 AB
Affecta AB	Blixtvik AB	Com Hem AB	Epicom AB
Affärsverken Karlskrona AB	Bodens Energi Nät AB	ComHem Stockholm AB (Gamla UPC)	EPISERVER AB
Affärsverket svenska kraftnät	Borderlight AB	Comtelo AB	EPM Data AB
Alenet Communication	BoreNet AB	CRW Data AB	eskilstuna energi & miljö
ALFA VISION Ekonomisk Förening	Borås Energi Nät AB	C-SAM Kabel TV	Europhone in Sweden AB
Alingsås Energi Nät AB	Boxer TV-Access AB	CSIT AB	Extended partners int. technology in Sto
Amcall Communications Ltd	Bredband i Gislaved Gnosjö AB	Cygate AB	Falbygdens Bredband AB
Arcstel AB	Bredband i Kristianstad AB	Dala Nät AB	Falbygdens Energi AB
Arjeplogs kommun	Bredband i Kristianstad Nät AB	Dals-Eds kommun	Falu Elnät AB
Arvidsjaur Kommun	Bredband Östra Skaraborg AB	Datametrix Outsourcinga AB (f.d. Uni2 AB	Falu Elnät AB
Arvika Elnät AB	Bredbandsteknik 2000 i Karlshamn AB	Dataphone Scandinavia AB	Fastbit Ab
AT&T Global Network Services Sweden AB	Bredbandstelefoni i Sverige AB	David Singleton VD	FastTV Net AB
Avesta kommun	Brinet AB	Degerfors Energi	FCI Telecommunications Corporation Ltd
Axfone Networks AB	BT Nordics Limited UK Filial	Devicom AB (publ)	Fiberstaden AB
B2 Bredband AB	BygdaNet Ekonomisk förening	DGC Access AB	Finarea SA, PoBox 5648 CH-6901 Lugano

Table 1 – continued

Finspång Stadsnät, Finet AB	Helsinge Net AB	IP-Only Telecommunication AB	Landskrona Kommun
FirstNet Solution in Sweden AB	Herjenet AB	IT mästaren Mitt AB	Lebara AB
FLAG Telecom Ireland Limited	Herrljunga Elektriska AB	IT4U Sweden AB	Leissner Data AB
Forest Star AB	Hi3G Access AB	Itesco AB	Level 3 Communications AB
Forshaga kommun	Hjo Energi AB	IT-Hälsingland AB	Le-vonline AB
Fortum Distribution AB	Hofors Elverk AB	Ivar Westberg Elektronikservice (Westél)	Lidén Data Internetwork AB
Fujitsu Services AB	HSB Malmö	Jokkmokks kommun	Lidero Network AB
Gagnefs Elnät AB	Hughes Network Systems	Jämtkraft Telecom AB	Lidköpings Kommun
GC Pan European Crossing Sverige AB	HVE Balt-Com Fiber AB	Jönköping energi AB	Limetransit AB
Generic Mobile Systems Sweden AB	Hylte kommun	Kalix kommun	Ljungby Energi AB
Global Crossing Financial Markets Ltd (I	Håbonet AB	Kalix Tele24 AB	Ljusnet AB
Glocalnet Scandinavia AB	Härjeåns Nät AB	Karlsborgs Energi AB	LNS Kommunikation AB
Glooip S.a.r.l.	Härnösand Energi & Miljö AB	Karlskoga Bredband AB	LTT PLC
Gotlands Energi AB	Höganäs Energi AB	Karlskoga Elnät AB	Ludvika kommun
Grästorp Energi Ek För	Högsbynät AB	Karlstads Elnät AB	Lulebo AB
Gällivare Kommun	IBS Norra Norrland AB	Karlstads kommun	Lunet AB
Gästabudstaden AB	iMEZ AB	Kiruna kommun	Lycksele kommun
Gävle Energi AB	Infogram System AB	Kommunicera i Umeå AB	Lyssna & Njut AB
Gävle kommun	Infonet Broadband Services Corporation	Koppla Skandinavien AB	LäNet Västerbotten Data och Tele AB
Götalandsnätet AB	InformationsTeknik i Norrbotten AB	Kraftringen Service AB	Malmö Stad
Göteborg Energi GothNet AB	Infracom AB	Kramfors Mediateknik AB	Malungs Elnät AB
Habo kommun	Insat Net AB	Kristinehamns kommun	Malå kommun
Habo Kraft AB	Interdirect Tel Limited	Kungsbacka kommun	Mariestad Töreboda Energi AB
Hagfors kommun	Interoute Communication Ltd	Kungsörs Fastighets AB	MEAC
Halmstad Energi och Miljö AB	IntraPhone AB	Kungälv Energi AB	Media Network i Halmstad AB
Halmstadept AB	IPC Network Services Ltd	Kävlinge	Mediateknik i Varberg AB
Halmstads Fastighets AB	IPCell AB	Köpings Kabel-TV AB	Megaphone AB
Haparanda kommun	Ipeer AB	Köpings kommun	MKB Net AB
Hedemora energi It-net AB	iPhone AS	LA Cable AB	Mobile Business Challenger MBC AB
Hedemora Kabel-TV AB	IPnetto	LAN Assistans & Konsulting AB	Mobot AB

Table 1 – continued

Mora kommun	Omninet AB	Rätt Internetkapacitet i Sverige AB	sollentuna kommun
Motala kommun	One Telecom Sverige AB	Salabostäder ab	Sorsele kommun
Mowic AB	Open Broadbandnet Sweden AB	Sala-Heby Energi Bredband AB	Source Mobile AB
Multicom Security AB	Optimal Telecom Sverig AB	Sandviken Energi Elnät AB	sourcecom Svenska AB
MWNet AB	Oskarshamn Energi AB	satellithuset	Spide Rboss AB
Mälardalens Datorförening	Oskarshamns kommun	SavMAN AB	Spinbox AB
Mälarenergi Stadsnät AB	ownit broadband ab	Savvis Europe BV	Spring Mobil AB
Mönsterås Kommun	Pajala kommun	Seanet Maritime Communications AB	Stadsnät i Kumla AB
national Internet Service Provider	Perfect Communication AB	Secure Transmission Sweden AB	Stadsnät i Örebro AB
Net at Once AB	Perspektiv Bredband aB	Seniofon AB (fd Salescom AB)	Statnett SF
Net IT in Sweden AB	Perstorp Näringslivs AB	ServaNet	Sting Networks AB
Netnod Internet Exchange i Sverige Ab	Phonelink Scandinavia AB	Serverhallen I Norden AB	Storumans kommun
Netprovider Nordic AB	Phonera AB	SEVAB Nät AB	Stratos Wireless Inc.
Netsize Sverige AB	Phonera Företag AB	SIHI Scandinavia AB	Straznet AB
Newphone Service Provider	Phonzo AS	Simrishamns Kommun	Streamtel AB
Nitma AB	Piteå kommun	SITA	Stålboga Bruk Förvaltnings AB
Nordanstigs kommun	punkt R AB	Sjöfartsverket	Sundbybergs Bredband AB
Nordisk Mobiltelefon Sverige AB	Qall Telecom AB	Skara Energi AB	Sundbybergs Stadsnätsbolag AB
Nordmalings kommun	QuickNet AB	Skellefteå Kraft AB	Sundebyn Kabel-TV förening
Norrsken AB	Ready AB	Skellefteå Kraft Elnät AB	Supertel
Norrtälje Energi AB	Real Smart Communication Europe KB	Skinnskattebergs kommun	Suravision Ab
Norrtälje Energi Försäljnings AB	Rebtel Networks AB	Skurups Kommun	Svalövs Kommun
Norsjö Kommun	Regionförbundet Gävleborg	SkyCom AB	Svea Billing Systems AB
Nossebro Energi Försäljnings AB	Rix Telecom AB	SkyCom AB	Svea Billing Systems AB
NTT Europe Ltd	Robertsfors kommun	SkyCom Karlstad AB	Svedala kommun
Nynäs Stadsnät AB	Ronneby Miljö och Teknik AB	Skövde kommun Tekniska nämnden	Swedish Radio Supply i Wermland AB
Nässjö Affärsverk AB	Roslagen Broadband Network AB	Smålands Bredband AB	Swefour AB
OKQ8 AB	RSLCOM Business AB	Software Cellular Network Ltd.	Svensk Telerabatt AB
Olofströms Kabel-TV AB	RSLCOM Sweden AB	Sollefteå kommun	Svensk Växeltjänst AB
Olofströms Kraft AB	RTC Factory AB	Sollentuna Energi AB	Svenska Stadsnät AB

Table 1 – continued

Svenska Stadsnät Karlshamn AB	Telogic	Utsikt Katrineholm AB	Värnamo Energi AB
Svenska Stadsnät Laholm AB	Teracom AB	Utsikt Linköping AB	Västerbergslagens Elnät AB
Svenska Stadsnät Svalöv AB	Thalamus Operations AB	Vaggeryds Energi AB	Västerviks Kraft Elnät AB
Svenska UMTS-Nät AB	The Cloud Networks Nordic AB	Vanco Net Direct limited	Växjö Energi AB
SYSteam Nät AB	Tibro Energi Försäljning AB	Varberg Energi	VÖKBY Bredband AB
Säröhus AB	Tibro kommun	Varberg Energimarknad	Yac Ltd
Söderhamn Teknikpark AB	Tidahols Energi AB	Vasa Läns Telefon Ab	YMEX AB
Sölvesborgs Energi och Vatten AB	Tierps kommun / KanalTierp	Wasadata Bredband AB	Ystad Energi AB
TA Teleadress Information AB	Timepiece Services De Consultoria LDA	Vattenfall AB	Zapcell Telecom A/S
TDC Mobil Norden	Tingsryds kommun	Vattenfall Eldistributon AB	Zilikon Traffic Center AB
TDC Song AB	TNT-Elektronik AB	Wayport Norge AS	Ånge kommun
Teknikbyrån i Sverige AB	Torsås kommun	Weblink IP Phone AB	Åre Network AB
Telavox AB	Transcom AB	Venatech AB	Åsele Kommun
Tele Wing AB	Transit Kabel TV AB	Ventelo Sverige AB	Åtvidabergs kommun
Tele2 AB	TransTK (UK) Limited	VenteloPrivat AB	Älvsbyns kommun
Tele2 Sverige AB	Tranås kommun	Verizon Sweden AB	Öresundsbro Konsortiet
Tele2 Syd AB	Triangelbolaget D4 AB	Vetlanda Energi & Teknik AB (VETAB)	Öresundskraft AB
TelecomExpress AB	Trollhättan Energi AB	Viasat AB	Örkelljunga Bredband AB
Teledigit	T-Systems Nordic TC Services, Sverigefil	Viatel Sweden AB	Örnsat AB
Tele-Man Ab	TV-NET	Vilhelmina kommun	Österlens Kraft AB
Telemar Scandinavia AB	Tyfon Svenska AB	Vindelns kommun	Östhammars Kommun
Telenor AB	UDDEVALLA ENERGI AB	Wireless Maingate Nordic AB	Östkraft AB
Telenor Fibre networks AB	Ulricehamns Energi AB	Visionutveckling Internet i Göteborg AB	Överkalix Kommun
Telenor Sverige AB	Umeå Energi Elhandel AB	WM-data Infra Solutions AB	Övertorneå Kommun
TeleProffs Sverige AB	Umeå Energi Umenet AB	WM-data Norr AB	Övik Energi AB
Teleservice Bredband Skåne AB	Umeå kommun	VNHKC Europe AB	
TeliaSonera AB	Unicorn Telecom	Voxbone S.A.	
Teliofoni AB	Uppcom AB	Voxcall AB	
Telitel Sverige AB	Uppsala Stadsnät AB	VSNL International Sweden AB	
Tellax AB	Uppvidinge kommun	Vännäs Kommun	

Table 1 – continued

IPbolaget Skandinavien AB
Equant Sweden AB
PI.SE AB
Teknikmejeriet AB
Interoute Sweden AB
AllTele Allmänna Svenska Telefonaktiebolaget