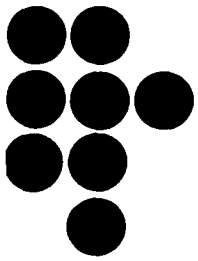

COMMUNICATIONS FORUM

"Personal Communications: What's Going On in Europe?"

April 1, 1993
4:00 to 6:00 p.m.
Bartos Theater
20 Ames Street
Massachusetts Institute of Technology
Cambridge, Massachusetts

MIT COMMUNICATIONS FORUM
ROOM E40-242A
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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
COMMUNICATIONS FORUM

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Speakers:

Christer Odmalm,
Communications Systems
Telia Research
Televerket

Peter Olanders, Ph.D.
Short Range Communications
Telia Research
Televerket

Rapporteur: Kelly M. Greenhill, M.S. candidate
Political Science Department, M.I.T.

Introduction by moderator PROFESSOR HARVEY M. SAPOLSKY [H.S.]: I would like to welcome you to the M.I.T. Communications Forum. Today's topic is *Personal Communications: What's Going On in Europe?* Americans are used to watching the Japanese, and we tend to become knowledgeable about whatever is going on in Japan. In the area of personal communications however, it is also important to know what is going on in Europe. We are fortunate to have two people here who can tell us; they are from Televerket, the Swedish telecommunications company.

Our first speaker is going to be Christer Odmalm. He received a Masters of Science in Electrical Engineering from the University of Lindkjoping before joining Swedish Telecom Radio. Now, he is head of communications systems at Televerket's Telia Research. Our second speaker will be Peter Olanders, who received a Ph.D. from the University of Lund. He first joined Ericsson Radio, and then moved over to Swedish Telecom, where he is manager of short-range communications.

The format will be as follows: the speakers will make their presentations, and then we will open the floor for questions. Mr. Odmalm...

CHRISTER ODMALM [C.O.]: Good afternoon, ladies and gentlemen. My name is Christer Odmalm, and I going to start to give you some background for the main topic today. I will give you some information about our company, and also tell you what is going on in Europe, related to liberalization.

The Swedish Telecom Administration or Televerket, which is what we normally call it, participates in the M.I.T. Industrial Liaison Program. The purpose of this visit is to identify areas of common interest and try also to define where we might cooperate in the future. We also participate in the Communications Forum and in the Universal Personal Communications Symposium, other activities by which we hope to expand our contacts with M.I.T., and hopefully also with other members of the Industrial Liaison Program here.

This presentation will be divided into three parts. Firstly, I will give you some information about our company, as well as give you an overview of what is going on in Europe, especially in relation to the liberalization of telecommunications, which is a very important topic now in Europe. Thirdly, Peter Olanders will give a presentation, which focuses on the main topic, Personal Communications. Of course, there are many other areas which we would like to discuss, such as HDTV and other multimedia-based services, but I don't see this as a starter today.

[Mr. Odmalm presents a transparency of Europe.] You see the first slide, and maybe you can just point out where Sweden is. There is a very good climate there right now, warm compared to Boston. You can also see the other parts of Europe. I am not sure the map is fully correct, as it is taken from a computer, it seems there need to be some changes in the program these days.

Televerket has the same role as PTTs in other countries in Europe, except for the "P" in PTT (the Post part). Televerket offers a number of telecommunications services, such as telephony, data communication, mobile telephony, and cable TV. For the past year, regulatory questions have been handled by a separate organization called the National Telecom Agency, instead of by Televerket. Televerket is currently an administration, but

hopefully by the first of July this year, it will be a company, fully owned by the government. At the same time, Sweden will also get its first law for telecommunication.

Televerket consists of three parts. We have a core business unit, which is a network of radio services and user services. Then we have Megacom regional units, which are the interface to the customers. To support this core business, we have complementary businesses, like cable TV, Telia, which is producing different types of telecommunications equipment, and we have business unit support, where we have Telia Research, which is, for example, the R & D part of Televerket.

Telia Research was formed about a year and a half ago in 1991, and it is the R & D part of Televerket. The number of employees is about seven hundred and twenty, and the budget is about $100 million per year. We are working in different areas, and today we are going to describe one area-Personal Communications and mobility. That will also include existing systems, such as NMT and GSM paging systems, Internet networks, image communication, and HDTV, roadbank communications, and management systems for telecommunications, which is getting more and more important for the operators. We will also discuss some basic technology research in fiber, satellite, and radio technologies. One part that is getting more and more important is human interfaces and usability of services. I think we are very good at designing systems, and providing the business unit with technology. Still, we have a lot of problems with how to use the equipment. I think it is a general problem all over the world.

Telia Research is rather small compared to, for example, British Telecom and France Telecom in Europe, about one-fifth or one-tenth of the size of the other research units. Therefore, it is very important that we focus on the most important R & D areas. Of course, we cannot cover all areas. Some of the areas where we have achieved good results are mobile communications and broadcasting systems.

One example I would like to briefly mention is a project which started in 1991. The task was to show that it is possible to broadcast HDTV via terrestrial transmitters, and we designed a system with 24 or 25 megabits encoding equipment, and we chose a special type of modulation called COFDM to get good performance on the radio channel. This system was demonstrated at the IBC last summer, and it was a great success. There was a lot of interest from other parts of the world. We also managed to change the direction in Europe from analog solutions to digital solutions for HDTV.

We've had some discussion here today about what is going on in the United States, and I know you are also looking at COFDM for modulation. So, it will be very interesting to see what is happening here next time we visit, in six or twelve months. This is just an example of a rather small project that has succeeded very well. The cost of the project was about $2.5 million and the number of project members was about ten. Also we designed the equipment within one year.

So, we now have all the equipment needed for the emission of HDTV. Here you can see the encoding unit for HDTV-two racks with mostly standard circuits and some special circuits. On the receiver side, you have one of these racks for the decoding, and a rather small unit for the modem. So, it is a very compact unit compared with the existing HD Mac system in Europe.

This first part described Televerket and Telia Research. Next, I will give an overview of what is happening in Europe in the telecommunications area. The monopolies are unlikely to survive until the year 2000. Barriers, both national and international, will be lowered. Manufacturers must produce equipment based on standards. Under the

liberalizing influence of the European Community, the roles of the PTTs are changing totally. They have to define new strategies to stay in business of telecommunication. There are a lot of activities in the different PTTs in Europe involving how to proceed in the future. We will have competition in all types of telecommunication, even for voice telephony. EC emphasizes harmonization of national standards and approval of procedures, and the liberalization of the procurement and supply determinants. The EC directives discouraged introduction of national standards. So, although the internal market offers important opportunities for free trade in terminals, the key to liberalization lies in network competition. The instruments are the joint approach to open network provision and the liberalization of services.

In addition to the community initiatives, individual countries, both within and without the community are introducing liberalization measures on the national level. Sweden is one of the most liberalized countries, and regulations have been on a pragmatic and minimal basis.

We have two standardization bodies in Europe. One is ETSI, the European Telecommunications Standards Institute, whose purpose is to produce the technical standards necessary to achieve a large unified European telecommunication market. All other types of standardization is done by CEN/CENELEC.

The EC has taken a number of initiatives for Pan-European services. At the symposium at the beginning of this week, there were a lot of discussions to get agreements on standards here in the United States. I think that, in Europe, we have succeeded at getting agreements on a number of standards and initiatives for Pan-European services, such as mobile standards for GSM, DECT, and in paging, ERMES; there are also plans for the coming broad band networks. So, I think Europe has succeeded at getting these standards. And of course, it is all through discussion in the industry about the usefulness of standards. Some want to introduce their own solutions, but, as the system gets more complicated, it is very important to get these agreements and standards.

We are talking about monopolies, but in Sweden, Televerket has never been a monopoly as defined by law. It is a state-owned public utility open to full competition. But as we can see, until now, Televerket has retained its monopoly position. But now with the liberalization of Europe, we can see a number of new companies on the Swedish market. However, in general, in Europe, the regulations will continue and PTTs need to decide the future strategy. It will not longer be sufficient to set simple transmission connectivity. PTTs will need to compete on cost and quality, in addition to having a number of attractive services.

Televerket's market share is about three percent of the world market. Of course, it is very little. We want to influence the telecommunication market. To get a stronger position on the global market, Televerket has formed a common company together with the Dutch PTT and the Swiss PTT. If we add the three different countries together, the total revenue is quite substantial. There will probably be other such constellations in the future. Many of the companies in Sweden are international companies. About 36 of the world's 500 largest companies are from Sweden. So, it is very important that Televerket can offer them a global telecom service. All telecom operators are looking for the same market, the global companies. So, there will be real competition over these 500 companies.

This overhead will give you some impression of the competition in the different countries. As you can see they have different areas, like public switching, telephone networks, data communication, mobile communication. Then, to the right, you can see an index, which indicates the level of monopoly of competition. You can see, from the top,

Austria with a monopoly on all areas down to New Zealand, with full competition. And you can also see that, for example, the United States and Sweden are on the bottom part of this list.

As I said earlier, we have a number of new companies in Sweden, competitors to Televerket. We have Tele2 and Comvik, which operate both telecom services and mobile telephone services. NordicTel operates mobile telephony, GSM, Regis Telecom, France Telecom, AT&T, and different value added service operators. We also see now a number of national and regional networks. Other government-owned administrations or organizations also provide telecommunications services, for example, to the Swedish railway. So we have internal competition between the government-owned companies.

The question is, why is there such interest for companies to go into Swedish market? What we see is that it is partly because, if we look at the full Nordic market, it is quite large. It is the fourth largest market in Europe. I think also that they are the most liberalized countries in Europe, so it is a very good area to test.

Now, what you can see in, for example, mobile telephony for GSM, we have three operators. In the analog system, we had almost full monopoly from Swedish Telecom Radio, and competition in data communication [international traffic, of course]. So the large companies, and also the triangle between Stockholm, Gothenburg, and Malmö, are very interesting for all of these new telecom operators in Sweden.

Q: In mobile telephony, are there three contending PSF networks with their own base stations?

C.O.: Yes. There are three operators, and they have to share the band width between these three operators in Sweden, with eight million people.

Q: With reference to your previous slide, does Nordic include Finland?

C.O.: No. I think it is Sweden, Norway, and Denmark. Okay, this ends my presentation. What I would like to give you is some information about Televerket, and the idea is that now we have full competition in Sweden in telecommunication. It will be very exciting and interesting in the next couple of years for Televerket, if we can manage to change the direction of Televerket to be a full competitor to these new operators from other countries. I thank you, and I leave the word to Peter Olanders.

PETER OLANDERS [P.O.]: Allow me to present myself, in spite of the excellent introduction I got. *[Here Dr. Olanders displays a copy of his business card with myriad phone numbers].* Looks wonderful, doesn't it? You know, I am going to talk about personal communications, and already here on my business card, we can see some of the reasons why we are working on it. Here we can find one, two, three, four, five, six, *[counting the numbers]*, and actually, they have forgotten my GSM telephone number, my home phone numbers, and the alternative FAX number. The reason is obvious--there is no more space on the card. There are too many telephone numbers.
And if I take it away and ask, what is my phone number, you haven't a chance.

I would like to start by giving you a little bit of background. I think we can find the background of personal communications in the mobile communications. By no means is it anything new. This front page is from 1950 *[shows slide of an old Swedish magazine cover of a couple at the beach with their portable radio].* And here you have it, the thing we all want to have on the beach. Not Einstein on the beach, but a radio.

Actually, in 1950, we also started our first mobile telephone system in Sweden, called MTA. About ten years later, we started MTB [Mobile Telephone A, Mobile Telephone B]. Then we started Mobile Telephone D. Now, we may ask, where is MTC? *[Dr. Olanders displays slide of six generations of mobile telephony].* Well, it is here; it is called NMT. Then, we have NMT at 900, and we can also see GSM here. There are some interesting observations we can make here. For example, what will happen with NMT 900 and GSM, and so on? *[Olanders points to the fifth [NMT 900] and sixth [GSM] generation lines , which extend into the future.]* You see that there is a nice period of about ten years, and one can try to draw some conclusions.

Another way of illustrating the same information, or part of the information, is through this figure here, the MTB system, which was launched in 1971. [*Dr. Olanders now displays a slide with National -MTD[1971], Nordic-NMT [1980] , European-GSM [1991], and Global-FPLMTS, UMTS [2001]categories.].* MTD was a national system. It was actually a rather good system, but it was only national. Then, when we launched NMT in 1981, it was a Nordic system, and that is what "N" in NMT means.

Ten years later, we have attempted to launch GSM. That was a European system, *at least* European. Ten years later, we will launch the next system, we guess. That will be FPLMTS or UMTS, or whatever; that will be global. What will happen in 2011? It must be a universal system.

Now, everybody knows mobile communications have been an extreme success, and especially so in Sweden. This slide should illustrate that. *[Dr. Olanders displays a timeline of the growth of mobile telephones in Sweden ,from about 1.33 per 1000 inhabitants in 1982, to 13.46 in 1986, to 53,.8 in 1990.].* We start with 1982, and see that it has increased to a rather large number. This is per 1000 inhabitants, which means we have a market penetration of about six percent, which is about the highest in the world.

In the Stockholm area, we have the highest density of mobile telephones in the world. As Sweden is a large country, this doesn't mean that just because we have the largest penetration of mobile telephones that we have the highest density, but in the Stockholm area, we do. And I think we now have a penetration now of about 12 percent.

The operator is quite happy about this. But, he is asking, could I penetrate deeper? Maybe this is just for business people as they can afford it. But what about normal people, would they buy it? Everybody said no. Well, well, the operator is saying, we'll see about that. What did they do?*[Dr. Olanders shows a slide of a variety of mobile services].* We had two systems, the NMT 450 *["for those whose car is their workplace"]* and the NMT 900 *["for those who need a telephone after they leave their car"].* Then they launched a new service. They called it NMT 450 RED, and that was the cheap service. If you used it during weekends, during nights, you paid just a third of the normal rate. However, if you used it during busy hours, you paid three times the normal rate. No subscription, and you buy equipment on the second hand market. So, it is more or less free--$100 or $200 for equipment, no subscription, you just send in the forms.

It is too early now to evaluate the effects of this, but it seems to be a fair success. Maybe this is one way to penetrate outside the business people. The operator who thought of this says he has a vision of human communications in the future, which brings us to this next slide. They say there should be integrated standards, one mobile telephone service, one personal mobile telephone, further adaptation to customer needs, and worldwide operation. They also say that 9 out of 10 people will have a personal mobile telephone by the year 2000. This slide is from the Radio division of Swedish Telecom, who claim this system will be around in seven years.

They say there is also some technical development. I will try to explain this in about a minute. I am now pointing at DECT-Digital European Cordless Telecommunication, a wonderful system, I must say. ERMES, the paging system, is also Europe-wide. The DCS 1800 *[Digital Cellular Systems]* is the same as PCN. PCN, which means Personal Communications Network, is now identified with DCS 1800, which is simply GSM on 1.8 GHz.

The FPLMTS, the Future Public Land Mobile Telecommunications Systems, is actually a standard, which is standardized within the global standardization body, CCIR. I won't say much about that because that is not the European business; it is the global business. And well, my topic here is Europe.

UMTS, the Universal Mobile Telephone System, is usually identified as FPLMTS, however, it is the standardization from Europe, but we'll come back to that, too. But, we can already say that UMTS is the third generation system, whereas GSM, DECT, ERMES, as well as DCS 1800 are second generation.

My subject here is Personal Communications, and during the seminars which I attended yesterday, we discussed PCS in the U.S.A. It was quite obvious that most of the speakers focused on some type of radio equipment. That means that Personal Communications is clearly being identified as a radio system. In Europe, we are now trying to broaden this concept to say that it will include other aspects. Now I will try to explain why.

This is a very nice figure; I made it myself. *[Dr. Olanders presents a slide entitled "Today".]* Today, one could say that we have the PSTN, that is the normal fixed network. To that point, we have connected different kinds of mobile or cellular systems. These systems here are independent of each other. And the competitor is, of course, not allowed to share the system with his competitors, and so on. So, we will have many networks covering the same geographical area. The fixed network grids cover most of the country of Sweden, and the different mobile systems have to cover almost the same area. This is an expensive way of doing it, but today it is the only way.

Now we come to another figure, I made this one, too. *[Dr. Olanders presents a slide entitled "Tomorrow."]* What I would like to illustrate here is that I think we can expect to get new fixed networks, such as the ISDN network, which has a special meaning in Europe because this will be the first network with the same interfaces throughout Europe. Open standards for these interfaces, so it will be very easy to move equipment between companies. I can buy it wherever I like. For normal telephones, I usually have no problems, but if I would like to buy more advanced equipment, such as a PABX, today I would have enormous problems in Europe. What I had intended to illustrate with this figure is that we'll have to integrate the different networks at a much deeper level than we have today. If we continue to launch a new mobile system every ten years, then we will end up in some years with a lot more networks. If there was only one operator, one could maybe accept it. But for example, with GSM, we will have three independent operators, which is enormously expensive. So there may have to be a deeper integration: to save money and to save investments, in order to use the investments in fixed networks.

In Europe, we have a lot of bodies and organizations. Here I will highlight some of them. We have the COST Program, meaning European Cooperation in the field of Scientific and Technical Research. This draws participation from all of Europe, where we share our knowledge with each other and exchange information in different ways. There is the RACE Program, which means Research and Development in Advanced Communications Technologies in Europe. Here we are working together. We have many

projects within RACE, two of which I will tell you about: the CODIT project and the Mobilise project. Another interesting organization is EURESCOM, which is the R & D organization for the network operators in Europe. These are 100 percent fixed network operators, so it is the old PTTs. Last, but not least, we have ETSI, the European Telecommunications Standards Institute, where we make up standards. Now, you may understand why I set up the figure this way. ETSI gets input from all of these bodies, and of course, from a number of other bodies.

Now, I will present two projects within the RACE program, both aimed at the growth of Personal Communications. I intend to start to say something about the CODIT project. It is a Code Division Testbed. I must admit that you, in the U.S., are rather ahead of us with regard to code division. You have already launched a system, you have testbeds running, and so on. But, we are going to catch up. For those of you who are not familiar with it, one could describe it in the following way: a normal receiver works according to the FDMA principal, Frequency Division Multiple Access. You just tune in one of the channels. This is, of course, the principle you have in the analog systems today. We have one channel for the up-link, the link between mobile and handheld. And there is another ch

It is time to introduce the TDMA: Time Division Multiple Access. The difference is only that you switch from the frequency plane to the time plane. This system is now used in, for example, GSM, the mobile cellular system in Europe.

Then, finally, we come to CDMA, where we occupy a full area in the frequency/time plane, and you have to have a key of some kind. You can use direct sequence, you can use frequency hopping, whatever, or different combinations of it. You can combine this technology with the others, of course. CDMA has a number of interesting features for mobile communications. I won't go through these features, but CDMA is the access method that we are working on in the CODIT project.

So, for CODIT, what are our goals? Well, it is to demonstrate a flexible radio interface for future mobile communications systems, based on CDMA, and we should have a variable bitrate, integrated speech and data, flexible traffic capacity and cell size, and flexible system architecture. It sounds nice, and it is nice for the operator. The question then is, when can we use it, if we can use it at all? That, of course, is what we are going to investigate. The output from the CODIT project is a testbed demonstration. It should also be validated by simulation. There should also be a full system concept for the radio interface for UMTS, and the output should be able to use as input to standardization [ETSI]. We are slowly coming to what Christer previously called UPT, which means Universal Personal Telecommunications. It is the standard in Europe for mobility within the fixed network, and only within the fixed network. It has nothing to do with the mobile networks. End of chapter.

Let's go into Mobilise, which is a completely different project. Whereas CODIT was a project that worked solely on the radio interface, Mobilise is another approach, one that looks at the services and focuses on the fixed network. One starts with Mobilise by defining Personal Communications. Personal Communication offers to end-users in their different roles [family, work, etc.], the ability to communicate and organizes communication according to their own preferences in such areas as: time, space, medium, cost, integrity, security, accessibility and privacy."

There is a danger always when one discusses services, since it is such a soft area and so difficult to define. The Mobilise project's objective is to specify and define a new service concept that would offer Personal Communications to end users. The service has a

rather interesting name, PSCS. We see that it maintains the main PCS features of personal mobility, organization of communication, and service integration.

Now what is personal mobility? It can be defined as "the possibility to move between different terminals, independent of the kinds of terminals they are." This has nothing to do with cellular systems, though cellular systems may be used. In contrast to this, we have terminal mobility, illustrated by this happy young guy walking around with his handheld. *[Dr. Olanders displays a picture of a young man walking around with a ladder, a can of paint, and his handheld telephone.]*

Next, the integration of services, what will it mean? It is the intention that we should integrate telephony, voice mail, FAX, pager, and e-mail. It is quite difficult to go from FAX to telephony. Or is it more difficult the other way around, to go from voice to FAX?

Let's look at ETSI, the European Telecommunications Standards Institute. We have some goals at ETSI, and they are to facilitate integration of telecommunications infrastructure, to assure interworking, to achieve compatibility of terminal equipment, and to create Pan-European telecommunications networks.

[Now Dr. Olanders displays an organizational chart of ETSI. It has a hierarchical system similar to many firms and bureaucracies.] We have an organization within ETSI. Looks like a normal company, doesn't it?

Here, on the next slide, we find something interesting. There are some technical committees within ETSI, and here the real work is done. There are twelve such committees, and I will say some words about some of these. In NA *[Network Aspects]*, we are standardizing the fixed network. And here, for example, we are working on new standards-standards for mobility within the fixed network. There are, of course, other aspects of the network that are standardized.

BT means Business Telecommunications. We also have SPS, which is Signalling, Protocols, and Switching, TM, which is Transmission and Multiplexing, TE, for Terminal Equipment, and EE, for Equipment Engineering. We also have RES, Radio Equipment and Systems, which is a very interesting committee. Here we standardize, for example, TETRA, that is the PMR system in Europe. We also standardize some cordless systems, for example, DECT and also CT2, which most of you have heard of, and a number of other different standards. Next, is SMG, Special Mobile Group, the committee standardizing GSM. They also handle DCS 1800 and UMTS, so these are the mobile system. There is also PS, which is Paging Systems, SES, for Satellite Earth Stations, and the ATM, Advanced Testing Methods. And then, we come to the committee on Human Factors (HF), which covers all the different questions around usability, MMI, etc.

Now, I promised to say some words about the Smart Cards. In Europe, Smart Cards are standardized by TE. At Terminal Equipment, they are also standardizing a Smart Card. Here we have the new petite card; they just started last week. In RES, we have a Smart Card for DECT. In SMG, we have one for GSM, and for the other systems as well. Besides those, I don't believe we have any more Smart Cards. In that sense, it seems we may be making a mistake here. Maybe we are, but frankly speaking, all of these Smart Cards are alike. Or any rate, very similar, and there is very good reason for that. There are so few people who know this business about Smart Cards, so we have a rather good hope that we would get one Smart Card for all these services. One Smart Card instead of four, five, six, or whatever. These are Smart Cards for different standards, not for different operators, which is quite a difference.

Another aspect, with respect to this figure, is to say something about mobility. Where are we standardizing mobility? Well, in UPT, we have mobility for fixed networks. In BT, we have standards on mobility within the private networks. In SPS, we have standards for mobility within ISDN. Within RES, we have mobility for DECT; it is a mobile standard in itself. In SMG, that is also a mobile standard in itself; it is, of course, cellular. Now, we are coming to the same interesting thesis I said about Smart Cards. We are trying to coordinate all these mobile groups to come out with concepts that we can interlink with different kinds of mobility, and if we achieve that, we will deliver tremendous services to our customers.

Q: Can you say what you mean by mobility in the fixed network?

P.O.: That is what I described with the slide I called personal mobility, when you move between different terminals, and you still get all the services you would like to have. You get your service concept, which you have defined in some way. Maybe you identify yourself to this telephone with a Smart Card. You must have some way of doing it. It could be a badge, or your fingerprint, or you could just use the normal keypad to say "Hello, here I am." There are different ways of doing it, while the last one, of course, is the crudest.

Now, do you think our standards will converge? I don't think it, but I can show it. Today, we have the first generation of mobile systems, and we are now launching the second generation. We have more standards in the second generation than we had in the first generation. That may mean that, in the third generation, we will get only one standard, a global standard that can handle all of the services. It could be like that, though I doubt it. I think that the nature of humanity is the major obstacle towards substantial convergence.

I will say some words about radio in the local loop. Radio in the local loop is to replace the very last pieces of wire that are connecting the subscriber to the network-to replace it with radio connection. Usually, we think of households being connected in this way because companies usually require quite high capacity-two megabits, ten megabits; then it is better to have fiber or coaxial cable. For radio in the local loop, there could be different kinds of radio systems. The operators will maybe get a more flexible network; there are some advantages for the operator. The users may get terminal mobility. Let's have a look at this...

Going back to DECT (which of course is my favorite system), DECT can also be used for replacing the wiring in the local loop. So, it is one of the candidates for radio in the local loop. Here, you can see how this is going to be arranged if one talks about the pure case of radio in the local loop. You have a base station *[with omnidirectional antenna]*, and then inside the different households, you have fixed mounted equipment with a fixed antenna *[with directional antenna]* . (The antennae may, of course, be on the roof top). Then you have a normal telephone *[attached to the customer unit through a socket]*. The subscriber here knows nothing about the fact that we are using a radio instead of wire, and he does not benefit, anyway. It is a tool for the operator, nothing else.

So, the advantage for the operator is, of course, the flexibility, which I mentioned. It will be easier to mount such equipment, you don't have to dig down the wire (which is expensive these days). Also, it is much more flexible. If you get tired of a subscriber, you just take away the antennae. Or more properly, you redirect your antennae from him. It is a very easy and fast way to get a network. Think about the new countries in Europe. You know we doubled Europe some years ago, and Eastern Europe has problems, many

problems. One of their problems is telecommunications. Their network not only stems from the 20's, they are at the level they had in the 20's. It is just impossible to get a new connection for a subscriber; he has to wait ten years. RLL is, then, a very good way of introducing the services to people in such areas. This was the local loop case, the purely local loop case.

Now, assume you have a subscriber who would like to have a cordless telephone. So, he goes to his retailer, buys DECT equipment, and connects it to his socket. Then, he has two sets of DECT equipment in tandem. I don't think he would be very happy if he were informed afterwards that he could just use his normal DECT to connect directly to the base station. In that case, say we give handhelds directly to subscribers, then they will also have some mobility within the house, outside the house, and around the neighborhood. Usually we call that Neighborhood Public Access. Then, of course, there is no limit how many lines you can have. You can give one handheld to each member of the family. This requires, of course, more base stations. Because of the small antennas, you need higher field strength, and the only way to solve this is to have more base stations.

Here is a slide that illustrates how radio in the local loop could be used. This is another way of showing the figure I showed you a minute ago. *[This slide cuts out the middle man, so to speak, by connecting the base station directly to the portable unit.]* A different method of attachments that would also have some very interesting implications. I would say just a few words about it.

There is an enabling possibility here that we can get a new operator structure. *[Dr. Olanders presents another slide showing how network operators will connect to service operators, which will allow connections between neighborhood, shop, and telepoint].* Don't mind about the different words here. It is called Global Network, it doesn't mean anything. Forget about those words for the moment. Let's say that in some area we introduced a neighborhood local loop. The people in this area will be equipped with handhelds, let's say, fixed handhelds. They won't have any fixed normal telephones, only cordless telephones. So, when they are out walking outside the house, they will, of course, bring their telephones. Why not? Even when they go away to the shopping center. When they get there, they realize they have forgotten what they should buy. So then, they want to telephone back home. And the very kind owner of the shopping center has said, okay, I will give you some capacity because I have a DECT system already, and I am willing to sell some of my capacity to you.

This allows you to contact your home with the help of a cordless telephone. Then, when you go out on excursions, you enter public places where you can use your telephone as a telephone, meaning some operator is organizing it. These different kinds of accesses can be repeated over and over again. In this way, we may get a coverage of different places of incoming and outgoing calls, dependent on the access operator. The access operator may then connect to a service operator, who organizes all of the phone calls and the background service. At the highest level, we might have a global network operator, who operates the large background infrastructure that one needs.

In this way that I have described it here, we may get a system that is launched from bottom up, and not as is normal with mobile telephones, which has to be organized from top down. It can also start in the small scale; it doesn't have to start launched out throughout the country. This is, of course, just one scenario, there could be others.

Q: I understand how you get a call out, but how can you get a call in?

PO: That is why you need a service operator, who has information about where you are, Because as soon as you enter the service center, for example, then your handheld will have some communication with the system (if it is turned on). They will exchange identities, etc. Then, in that way, the system will know where you are, just like a mobile telecommunications system.

I would like just to wind up by saying that in Europe we are trying to give telecommunications a rather broad meaning. And we are trying to achieve it by working with different research programs in different ways. In programs where we exchange information, in programs where we are building testbeds, and in research organizations, where we are developing architecture. And finally, we go to the stage of standardization, standardization which aims at programs that can be used throughout Europe. We don't know yet if we can achieve all of these goals, but I think the coming two or three years will show us that this has been a successful way.

H.S.: We'll open it up for general questions.

Q: Have you had some experience yet with propagation at 1.8 GHz and the low power of the handhelds, and do you have any thoughts about how you see the standards for exposure going at that frequency?

P.O.: There were many questions. Let's see if I can answer them. Yes, we have some experiences. We have made a lot of simulations and measurements of frequencies around 1.8 GHz. I cannot say that we know everything...far from it, but we have a lot of experience. Second question, yes, also there, we have put in a lot of effort. You maybe know that the DCS 1800 and DECT are working at about the same frequencies. Therefore, we are studying both high power (that is, one watt) and low power (that is, .1 watt), and we have learned a lot. One has to study this in an open environment, on the street, and indoors (normal office environments).

And your third question was about the health hazards, if I heard you right. Yes, all of us have heard a lot about this through the mass media who are telling us we will get cancer. But we have also made a lot of studies, both for DECT and for DCS 1800, and as far as we know, there are no dangers. The problem is, of course, if there are any real long term effects. Let's say ten generations. We don't see it. Our kids don't recognize it. Not their kids, and so on. After ten generations, they may recognize, okay, it was a mistake. But, we don't have any evidence at all. It is not measurable today.

Q: Just to follow up on the first question, could you describe the range that you are seeing with 100 milliwatts at 1.8 GHz?

P.O.: Oh yes, it is quite interesting. In the case of DECT, which is real low power, we think that in a normal office, we would get a radius of about 20 meters, 50 meters, and that is also the intention because DECT is designed to be a very high capacity system. For example, the cells must be extremely small. In a more open environment, we will easily achieve around 200 meters. And in fact, with equipment we have today, DECT equipment, we have succeeded at getting good connections at even higher ranges: we have got line of sight connections for distances from about 500 up to 800 meters.

The normal antennas are integrated inside the equipment, usually. So, therefore these antennas are, so to speak, lousy. If we replace these antennas with a little bit better antennas, we can get double or triple these distances. Sooner or later, we will have problems with time delay and delay spread, and such things. Let's say maximum distance

is around two or three kilometers. So, now you have got it from 20 meters up to two kilometers.

Q: Well I guess what you just said leads into my question. You seem to hint earlier that DECT might have broader applications than was originally thought, and perhaps overlap with some of the other services and standards that were in the official grand vision of unification. Can you give us an off the cuff guess as to what might happen in terms of competition and market evolution for DECT GSM, CT2, and perhaps a few of the other systems that are out there?

P.O.: It will be DECT only...DECT, DECT, DECT Actually, we are trying to integrate the different systems with each other. We are developing profiles that will keep working with other systems. For example, we are having one GSM profile, giving an interwork between the DECT and GSM. We are not trying to compete with GSM. (That is worthless.) We had these battles some years ago, and now, we are tired of them. We are also developing a profile for DECT for the ISDN.

I think you will see a similar thing with UPT. Where we can really try to interwork together is with the mobility in the fixed network. We can get some industry support from the network, for example, for DECT. But, it also works the other way around. The operators of GSM will enjoy new customers--DECT users. With CT2, for example, we had enormous discussions in Europe. Should it be DECT, should it be CT2, should it be that technology, or should it be another one? The truth is, of course, that the customer doesn't care. He would like to have good equipment, and it is worthless, in that case, to try to battle over the technical features. It is better to look at the service, and the battle will be in the marketplace, not in the standardization organizations.

Q: You emphasized competition, of course, and emphasized how Sweden is probably much more liberal than the U.S., but I can't remember if your index came out that way. But, on the other side, you had at least one transparency in which, your conclusion, to be blunt about it, we see alot of duplication. To read between the lines, and I think necessarily, following your logic, unnecessary, useless duplication. You see the need in the future, I believe your words were, for "greater integration" in the networks, but that is not the direction of competition. You can't have commodity competition, that is very strictly commodity competition, because at some point (if your objective is to do away with duplication), even that commodity competition goes away. Can I ask for your thoughts on how liberalization and competition fit together, with a conclusion about the integration of the network?

P.O.: What have I done? Actually you are quite right. It is a very difficult issue, and we have been discussing it in Europe for some years now. I think one could say that one aspect, we have what is called in Europe, open network provision (ONP), which is a frame of how networks could be shared or how competitors could use each other's networks. Needless to say, we haven't solved it.

But, I think that everyone realizes that we cannot just continue to make new networks, especially us in Sweden. With the exception of Stockholm, it is hard to populate because we have such low density. It will be too expensive for the operators; they will just kill each other. And one operator too many will kill the entire business, and we are trying to avoid that. Then, you will say, ah, but then you don't have free competition. That is correct. At the moment, we don't have free competition, though we are trying to achieve it, and we are coming closer and closer. What I tried to show here was a scenario for the future, where I try to say we have to integrate the different networks more deeply than they

are today. We simply cannot launch new networks every tenth year, with ten different operators for each system; it is not sustainable.

In other words, as for your question, I can't answer it for you, just give you indications.

Q: I think the Clinton Administration would appreciate any answers you get as they too struggle towards managed competition. If I may be permitted another question on an entirely different tack... you quickly made some crucial arguments about potential complementary roles between cable and fiber and radio, when you said that businesses are going to want two or ten megabits, they will go to fiber for that. Can I set this in a context, and ask for your experience on the data you are working on. You have argued that we might replace the residential local loop with radio? I would be interested in the cost comparisons that you see. Quite clearly, we don't have to dig a cable into the ground, which is extraordinarily expensive. The terminal is probably more expensive, and will always be more expensive, but the cost of trenching the cable may dominate.

Here is where I am interested in what your calculations tell you. There is the service quality issue as well. Radio links are more easily dropped. I lose my cellular calls quite regularly. I would ask, therefore, for your assessments, first of all, of the reasonableness of moving to all radio versus some cable. And second, at the business or higher density level, whether indeed it holds that we cannot use radio for the wider band links, or whether there is some possibility out there that radio might serve for both.

P.O.: Well, again, you have spotted some weaknesses. Of course, you are right. There is no reason to say that when we go up to (and beyond) two megabit capacity that we can not provide that with radio. Indeed, we do that. We have the point to multipoint system and the point to point system for radio links.

With respect to your other question, you are asking me to expose some of our deepest information, and that I won't do. I mean, I can't share any calculations here. I can just say that it is common knowledge, or well. . .there is a rumor in Europe saying that you can have service for the same price with radio as you have with wire.

As for your questions about the prices for the terminals and so on...it looks like what you described today, but what we are trying to achieve is a mass market situation, where these are produced in such large numbers that they would be extremely cheap. If we can achieve this, we don't know. We are saying, and hoping, that some day the DECT equipment will be cheaper than the CT0, which is like the cordless you have in the U.S. And that will be pretty soon.

H.S.: We have time for three more questions...

Q: My name is Walter Hodge. I am personally interested in telecommunications applications. A naive question occurred to me, and I would like to see if you, as researchers in Sweden, have looked at this. It looks to me like Sweden is to the mass of Europe as Canada is to the mass of North America. A thinly populated Northern country, with advanced technology and relatively advanced social services, on the north end of an industrialized continent.

Can you tell me if you've done any research on comparisons, and whether you have looked at the Canadian models of telecom, and such things as delivery of social and particularly, educational services, which they have historically done by radio. You also have some indigenous populations, which have historically been migratory, and so forth. Have you found anything interesting in comparisons between your two countries, and is it

reflected in telecom, and in social aspects of telecom development policy? Again, it is a naive question, but I think the analogy is somewhat valid.

P.O.: As far as I now, we have not shared information. However, it is my belief that we have done some studies about how we think the society will develop, what kind of telecommunication is needed, what kind of driving forces will we have in the future. But it is such a soft area, in which it is difficult to get any hard facts, and I myself, have little such knowledge, so I am sorry I cannot answer your question.

Q: When we were talking about provisioning the local loop infrastructure, you said that radio was roughly the same cost, or maybe one-third the cost, of fixed network. Is that for voice only, or is that for the kind of band width we would see for interactive TV or other kinds of services we want to see on ISDN?

P.O.: A very interesting question, I must say. If we now think of DECT for a moment, as we all realize it is my favorite system, it will actually be costly to have it completely ISDN. You have to pay for it. But, you pay only when you would like to use the high capacity. So, it is just a dynamic fluctuation. For example, you could decide now I would like to have a video connection, and then you'd get it, and you would pay for it. I don't think that the capacity that is the real problem in this case. DECT is designed for much, much higher capacity, and we don't have this capacity in our homes. DECT is designed for the office, with FAXs, with video phones, with everything that could be communicated with telecommunications means.

Q: If you had video (unintelligible), maybe?

P.O.: Yes, maybe you have one in your home, or two, or three. But, in the office, you would have one in each corner. And you have a lot of FAXs, and you have radio-based equipment that can also be used for calls. So, all of this is in the scenarios we have created for DECT. Still, I would say the capacity is quite low for these applications.

Q: I guess only this is because some of the things we'd like to see digitized, those applications are not available for all users right now.

P.O.: Yes. If we say that this link should also provide you with television programs and HDTV and all the rest of it-teleportation, or whatever-I am sorry, no sir, we can't do it yet.

Q: You specifically exclude television from this system?

P.O.: No, no, that was not my intention. My intention was to say that DECT is not aimed for television, it is aimed for video phones, for example.

Q: Could you see a visual enhancement on DECT that could economically provision television over such a link in the home?

P.O.: I don't think one should mix systems like that. That is my personal view. I don't see the point really, and DECT is not designed for it. But, of course, it is easy to do it if you would like to. You just need to add more frequencies to increase the capacity.

Q: Can you give us some idea of how you hope to get to zero dB gain at 1.8 GHz?

P.O.: Are you talking about antennas?

Q: Yes, a great antennae question. You mentioned earlier about staying within the box.

P.O.: Oh no...that is not what I meant. Maybe I was not clear there. I don't think that is possible, by no means. It would need to be some way external. Perhaps you have to pull it out in some way.

H.S.: Let me thank our visitors for a very frank, very relaxed, and very informative presentation. We appreciate it.

Telia Research

Communications Systems

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Head of Section
Short Range Communications

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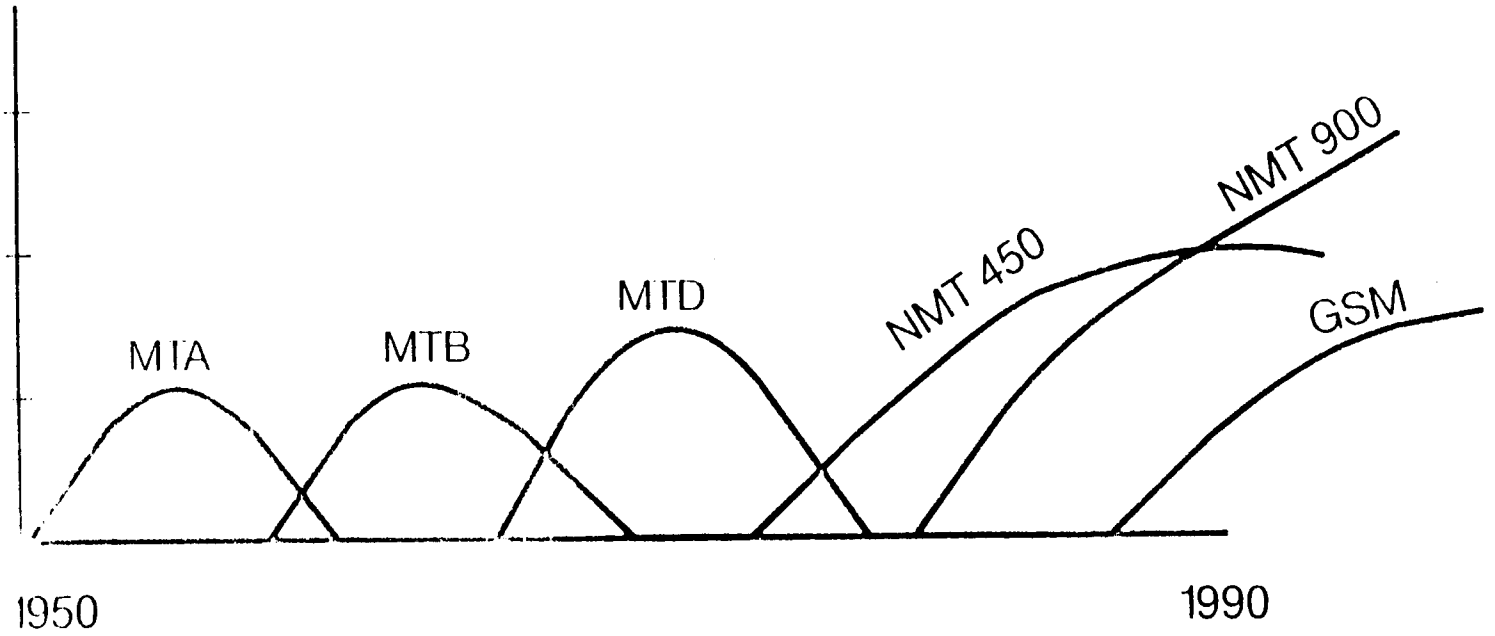
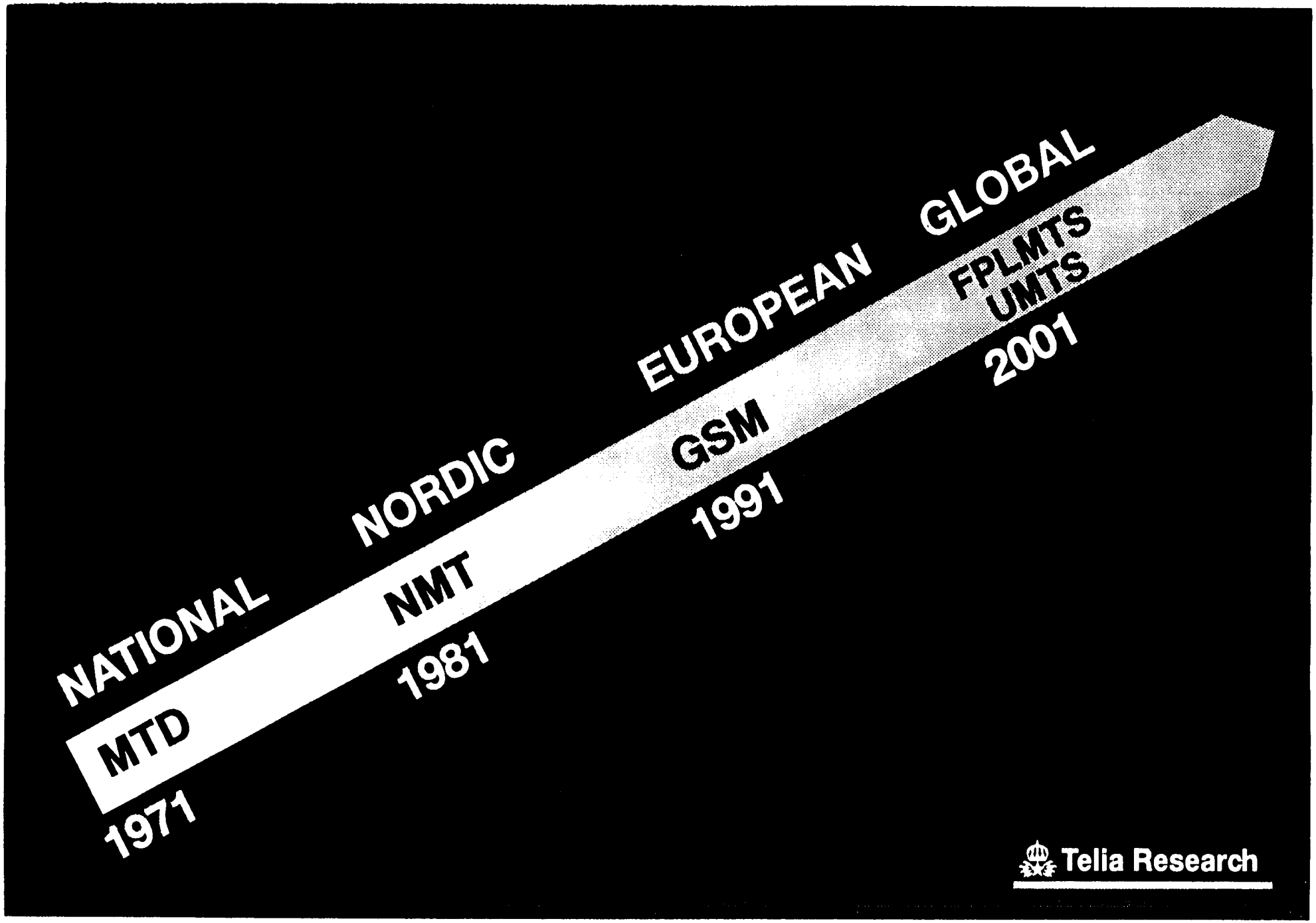
	Minicall text 074-27 14 94	NMT	010-47 06 66

Teknikens Värld

TELEVERKET RADIO
NMT GSM
MOBILTELEFONI

6 generations of mobile telephony

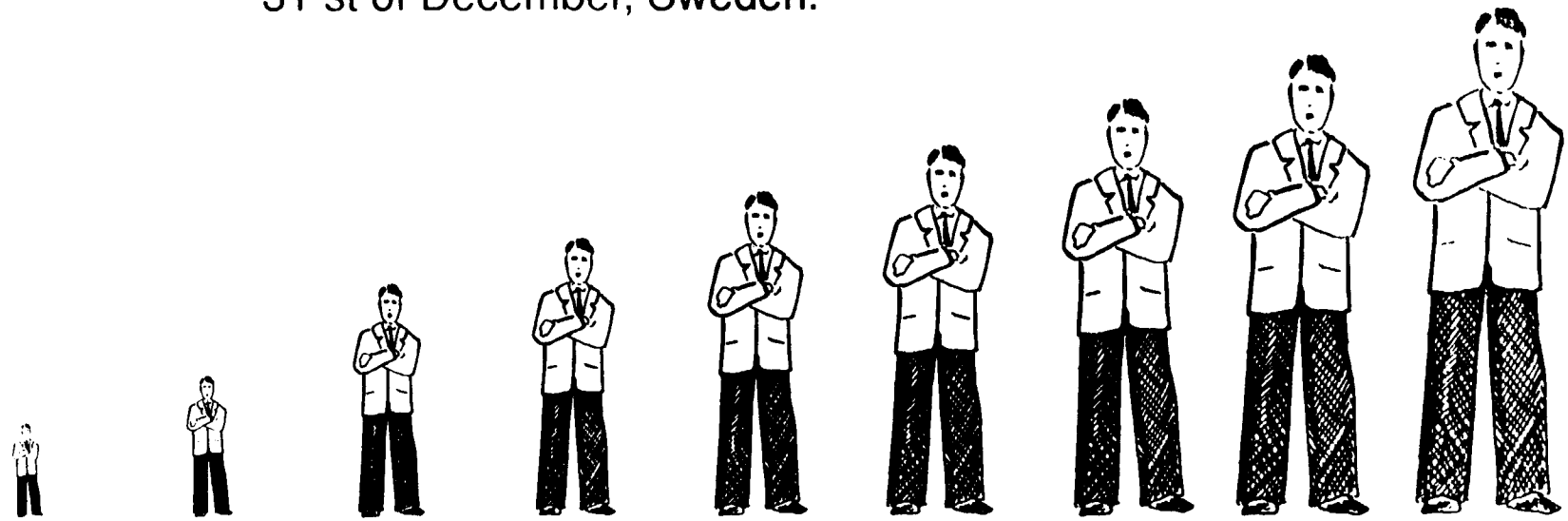



NATIONAL
NORDIC
EUROPEAN
GLOBAL
MTD
NMT
GSM
FPLMTS
UMTS
1971
1981
1991
2001
Telia Research

TELEVERKET RADIO
NMT GSM
MOBILTELEFONI

Penetration

Number of Mobile Telephones per 1000 inhabitants
31 st of December, Sweden.



1,33	3,25	5,70	9,10	13,46	18,98	27,03	39,03	53,68
1982	1983	1984	1985	1986	1987	1988	1989	1990

TELEVERKET RADIO
NMT GSM
MOBILTELEFONI

Mobile telephony according to need

With our mobile telephone systems you can receive calls on your own terms. And you can always reach others.

Choose a system according to your needs:

NMT 450 - for those whose car is their workplace

NMT 900 - for those who need a telephone after they leave their car

NMT 450 RED - for those who need a mobile phone for evenings, weekends and on vacation.

If you connect your telephone to Mobilsvar, you will have your own telephone answering service. It's easy to make a call to find out who has been calling you.

If you combine Mobilsvar with a personal pager, you'll know when someone wants to get in touch.

TELEVERKET RADIO
NMT GSM
MOBILTELEFONI

A vision of human communication in the future

Integrated standards

One mobile telephone service

One personal mobile telephone

Further adaption to customer needs

Worldwide operation

9 out of 10 people will have a personal mobile telephone by the year 2000.

TELEVERKET RADIO
NMT GSM
MOBILTELEFONI

Technical development

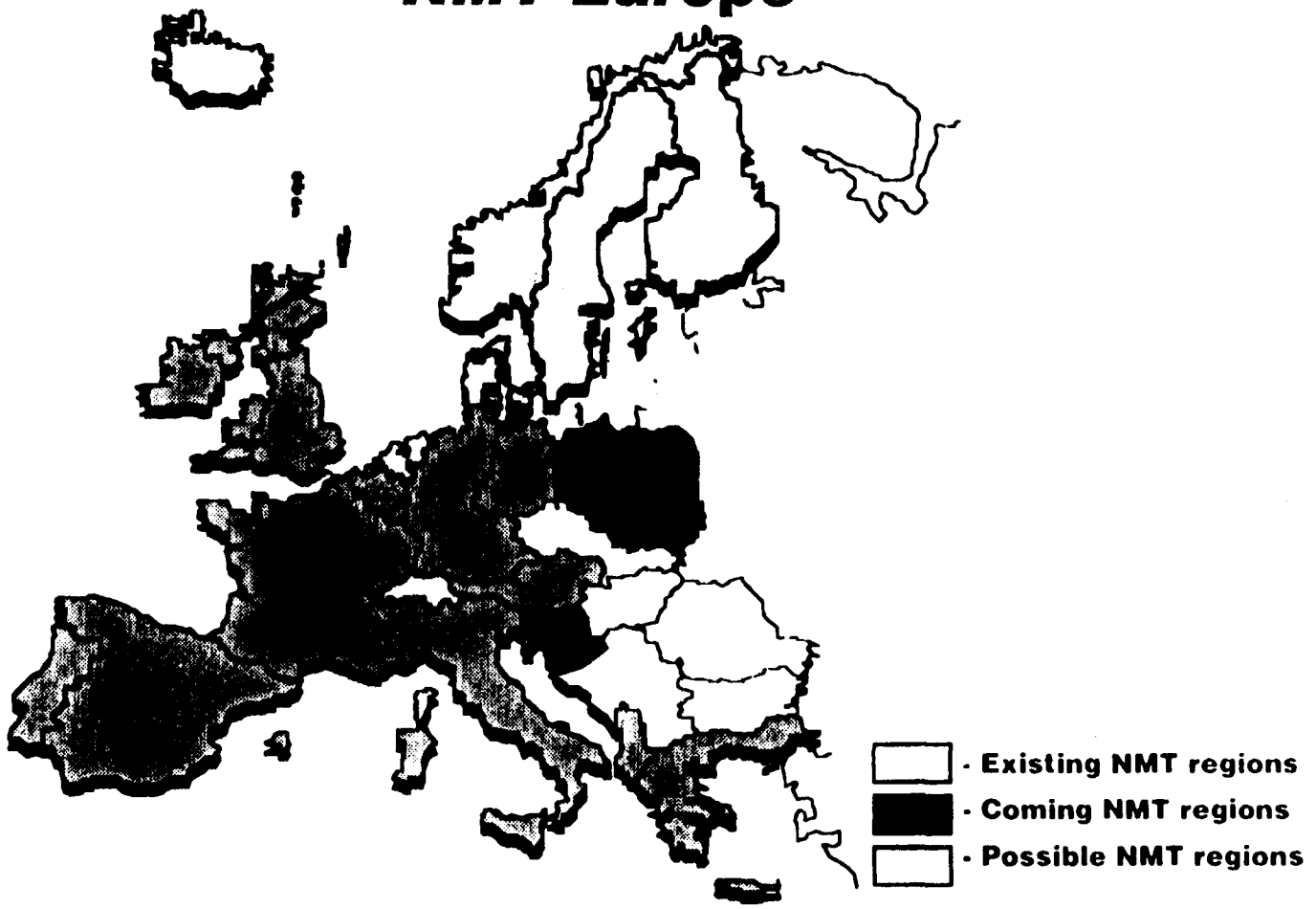
DECT	Digital European Cordless Telecommunication
ERMES	European Radio Message System
DCS 1800	Digital Cellular Systems
RACE	Technical research project within the EC in broadband network for joint telecom services
PCN	Personal Communication Network
FPLMTS	Future Public Land Mobile Telecommunication Systems
UMTS	Universal Mobile Telephone System

TELEVERKET RADIO

NMT GSM

MOBILTELEFONI

NMT Europe



Telia Research

European Cooperation in the field of Scientific and Technical Research

Research and Development in Advanced Communications Technologies in Europe

CODIT

Mobilise

EURESCOM

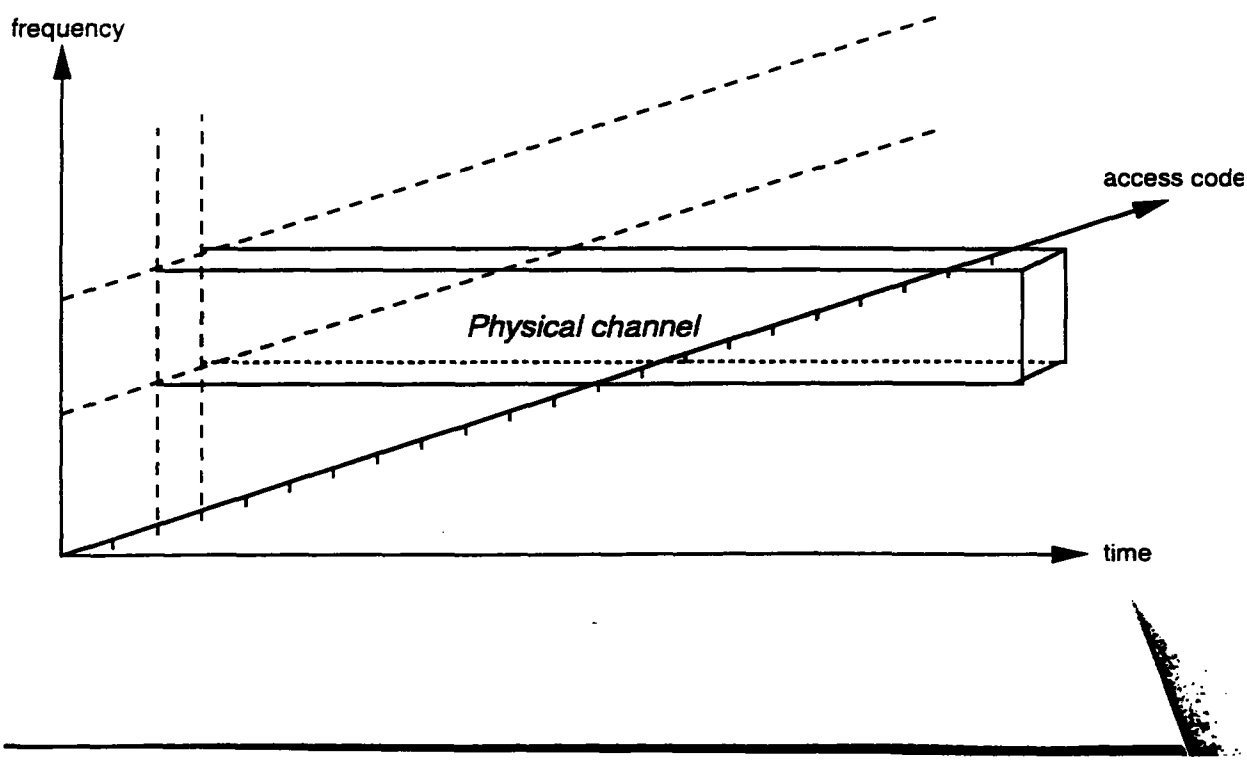
ETSI

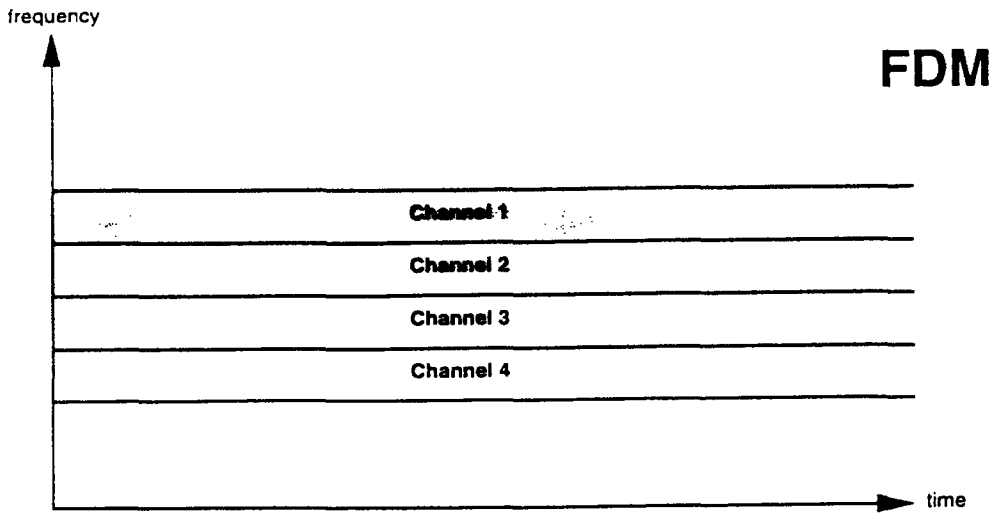
Telia Research

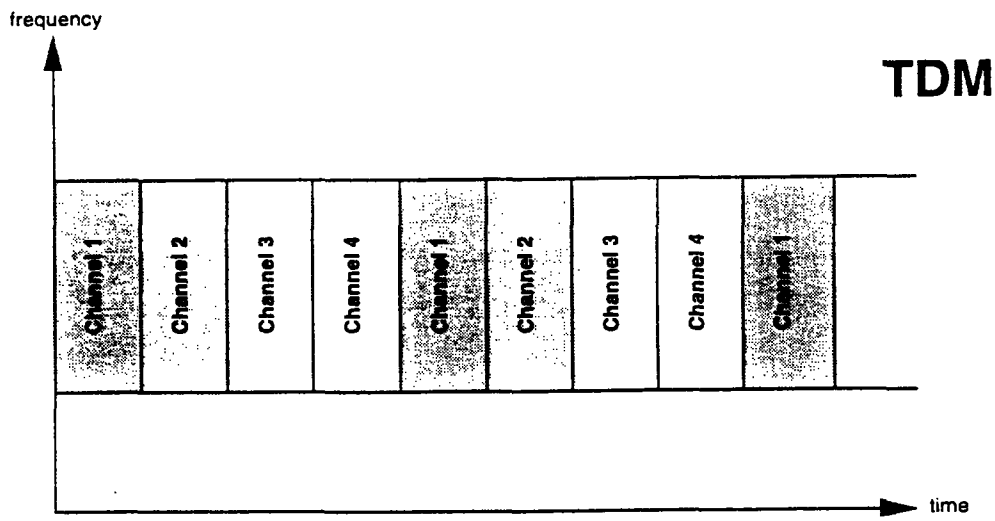
CODIT

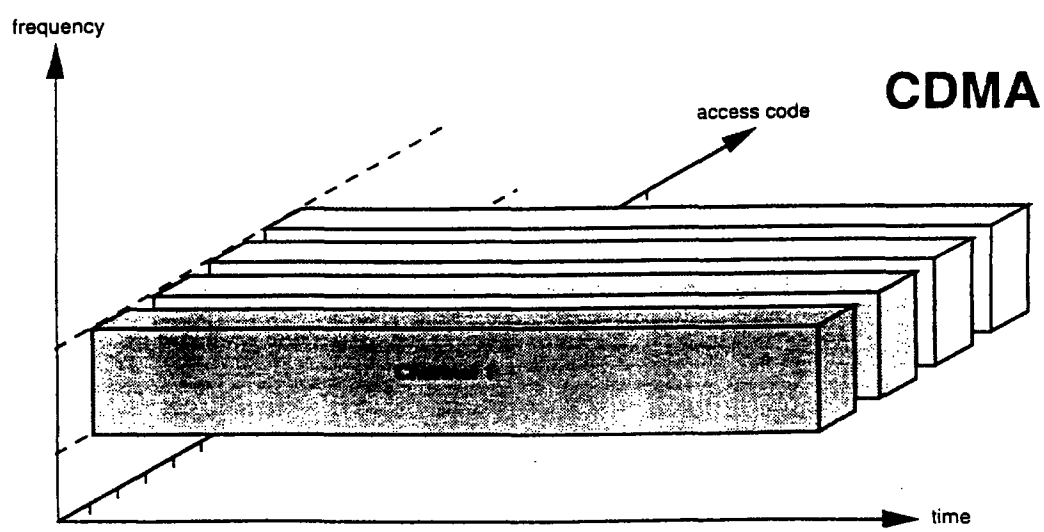
Code Division Testbed

RACE Project 2020




frequency
FDMA
Channel 1
Channel 2
Channel 3
Channel 4
time


frequency
TDMA
Channel 1
Channel 2
Channel 3
Channel 4
Channel 1
Channel 2
Channel 3
Channel 4
Channel 1
time


frequency
CDMA
access code
time

GOAL

To demonstrate a flexible radio interface for a future mobile communications system, based on CDMA-technology, characterised by:

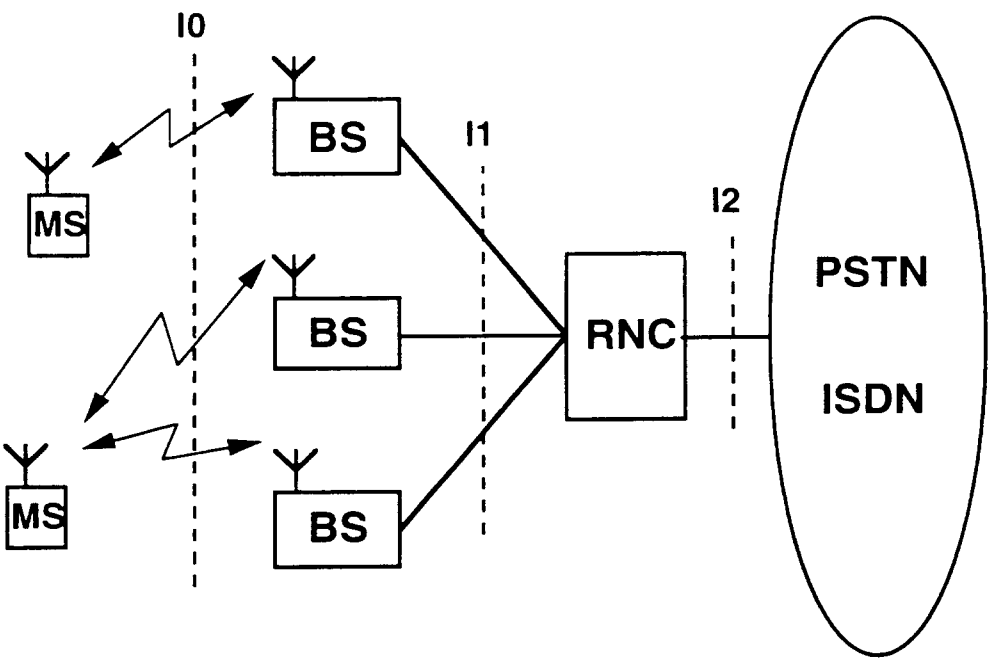
- Variable bitrate
- Integrated speech and data
- Flexible traffic capacity and cell size
- Flexible system architechture

OUTPUT

- Testbed demonstration
- Validation by simulation
- Full system concept for the radio interface for UMTS
- Input to ETSI

Telia Research

SYSTEM ARCHITECHTURE



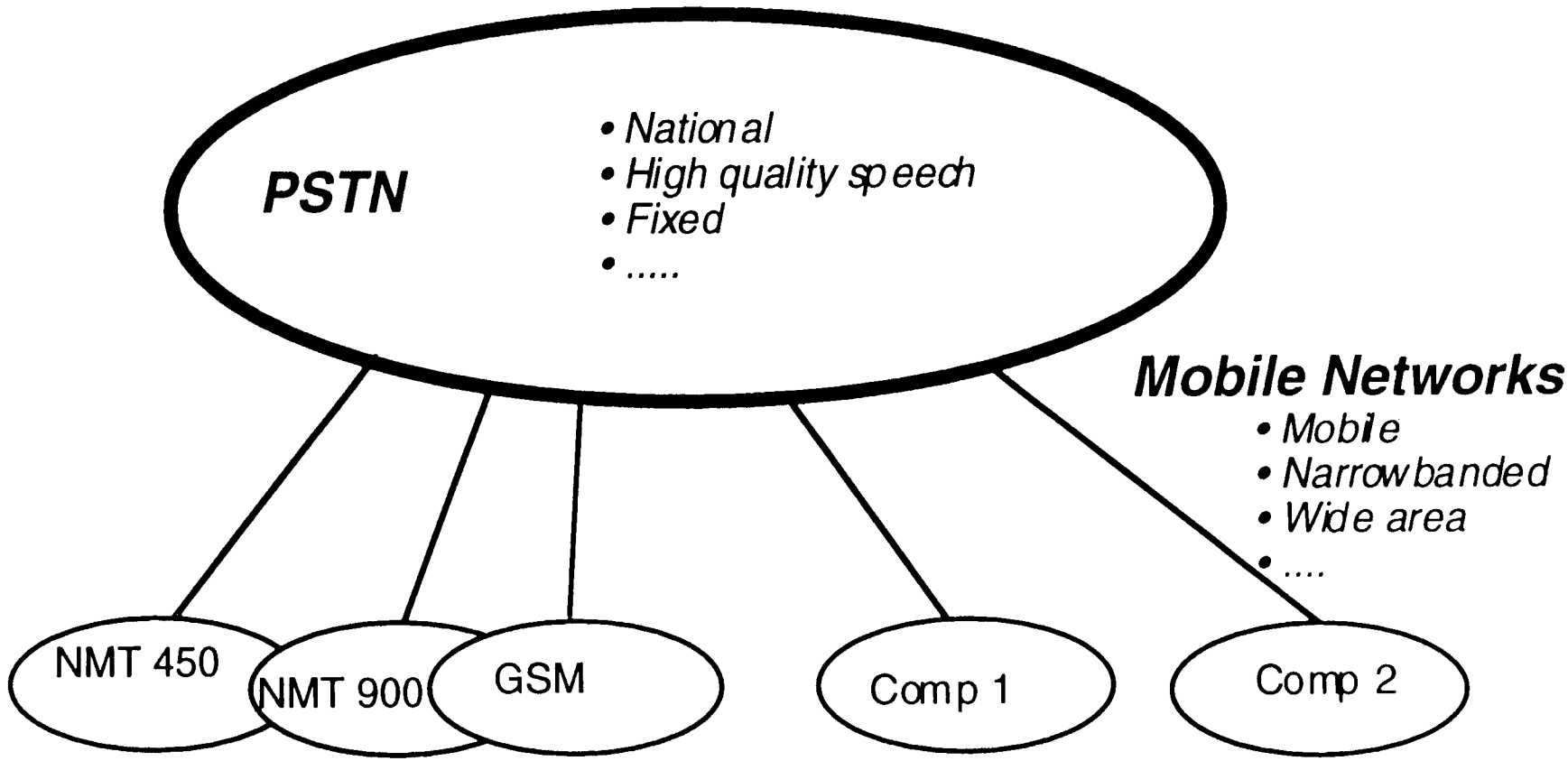
MS Mobile Station

BS Base Station

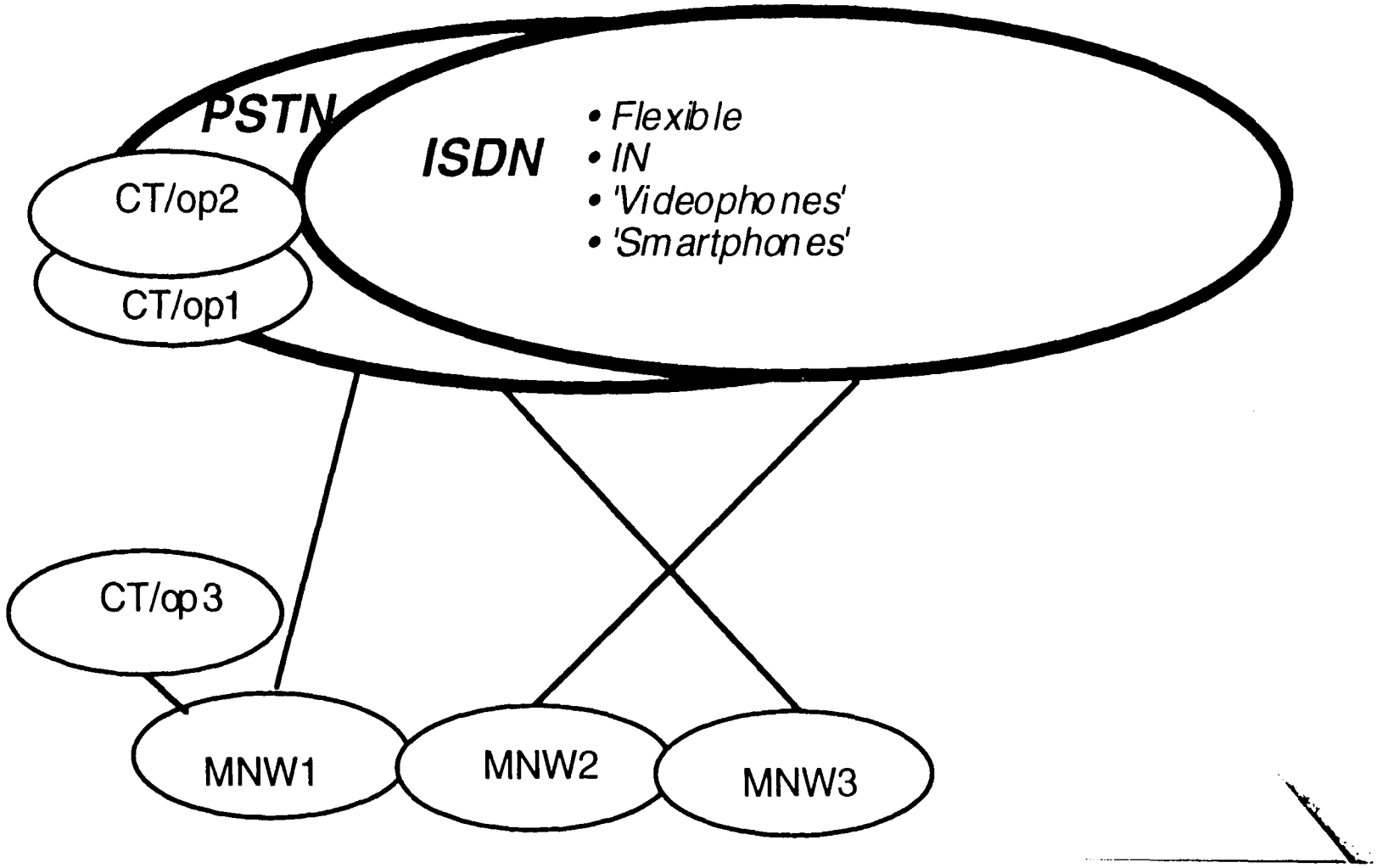
RNC Radio Network Controller

Testbed: 2 MS, 3 BS, 1 RNC

Today


PSTN
• National
• High quality speech
• Fixed
• .....
Mobile Networks
• Mobile
• Narrowbanded
• Wide area
• ....
NMT 450
NMT 900
GSM
Comp 1
Comp 2

Tomorrow


PSTN
ISDN
• Flexible
• IN
• 'Videophones'
• 'Smartphones'
CT/op2
CT/op1
CT/op3
MNW1
MNW2
MNW3

Personal Communication

Personal Communication offers to end-users, in their different roles, the ability to communicate and organise communication according to their own preferences in such areas as: time, space, medium, cost,integrity, security, accessibility and privacy.

The PSCS

- Personal Service Communication Space

PSCS is a service concept wherein a Service Provider offers Personal Communication to an End-User.

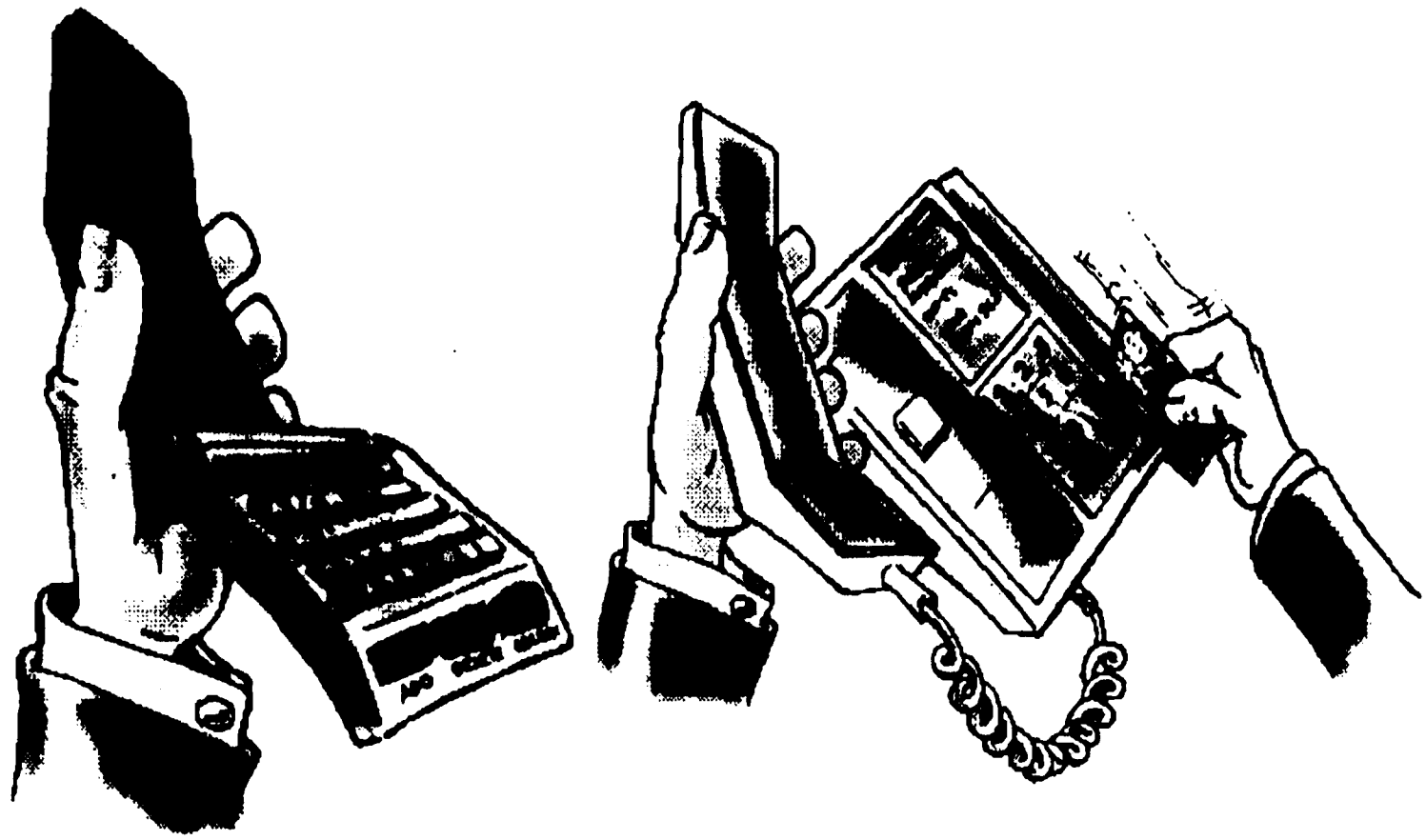
"A service that interacts with existing services and enables the end-user to be in control over his communication."

PSCS Features

- Personal Subscription
- Personal Mobility by Registration and Deregistration
- Personal Service Profile Management
- Organisation of Communication
- Service Integration

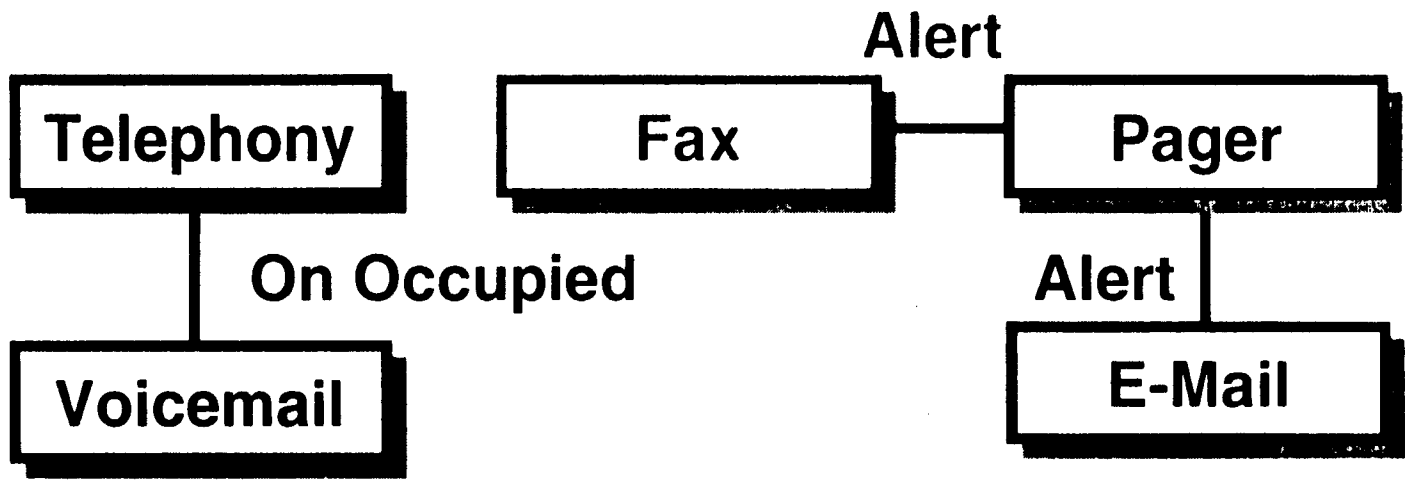
No support for terminal mobility!

Personal Mobility



Terminal Mobility

Service Integration



Summary

The objective of Mobilise is to design and specify a new service concept that offers PersonalCommunication to end-users.

This service concept is called the PSCS, the Personal Service Communication Space.

The main PSCS features will be support for:
- Personal Mobility
- Organisation of Communication
- Service Integration

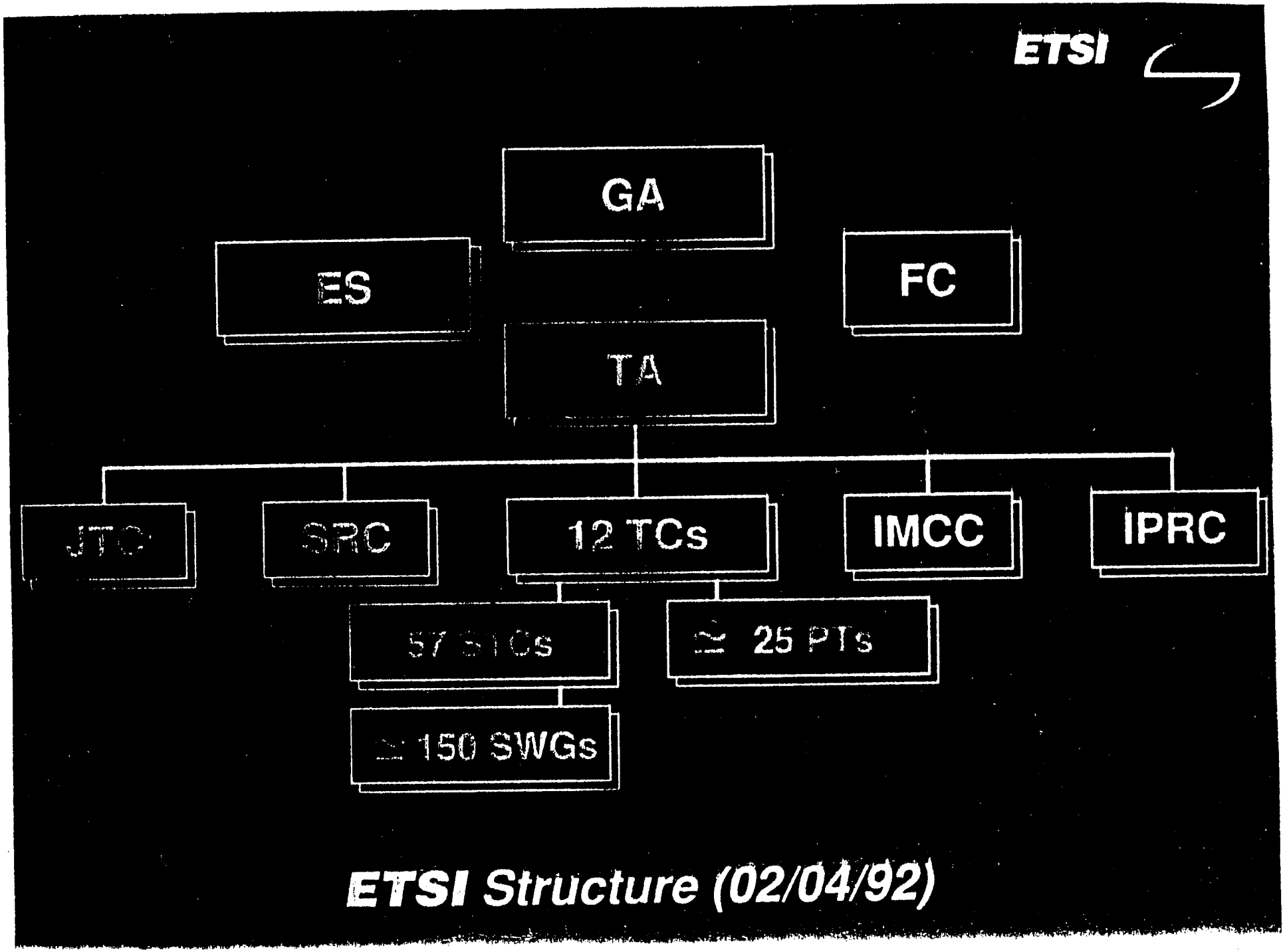
ETSI

THE EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE

ETSI

- Facilitate Integration of Telecommunications Infrastructure
- Assure Interworking of Future Services
- Achieve Compatibility of Terminal Equipment
- Create Pan-European Telecommunications Networks

Goals of ETSI



ETSI Structure (02/04/92)

ETSI

- [illegible] : Network Aspects
- [illegible] : [illegible]munications
- [illegible] : [illegible] Protocols, [illegible]ing
- [illegible] : Transmission & Multiplexing
- TE : Terminal Equipment
- EE : Equipment Engineering
- RES : Radio Equipment & Systems
- SMG : Special Mobile Group
- PS : Paging Systems
- SES : Satellite Earth Stations
- ATM : Advanced Testing Methods
- HF : Human Factors

Technical Committees

Radio in the Local Loop

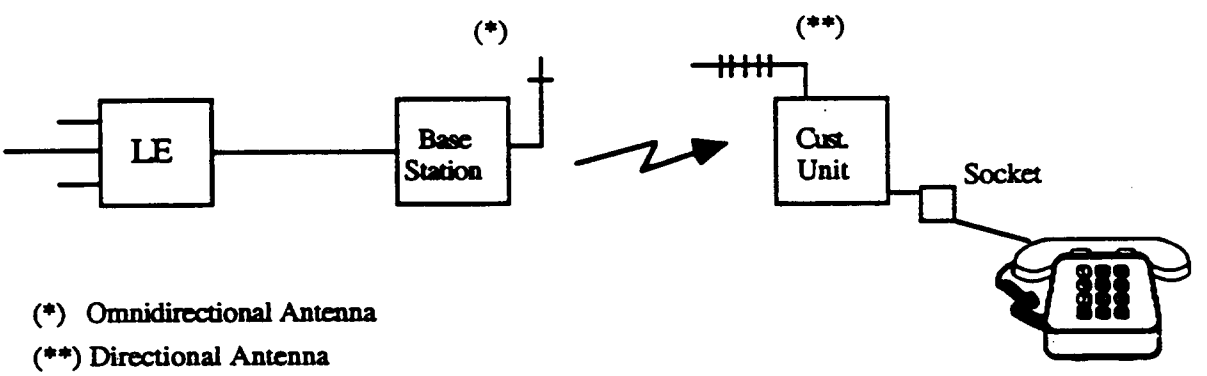
Operators:

* Flexible Network

Users:

* Terminal Mobility

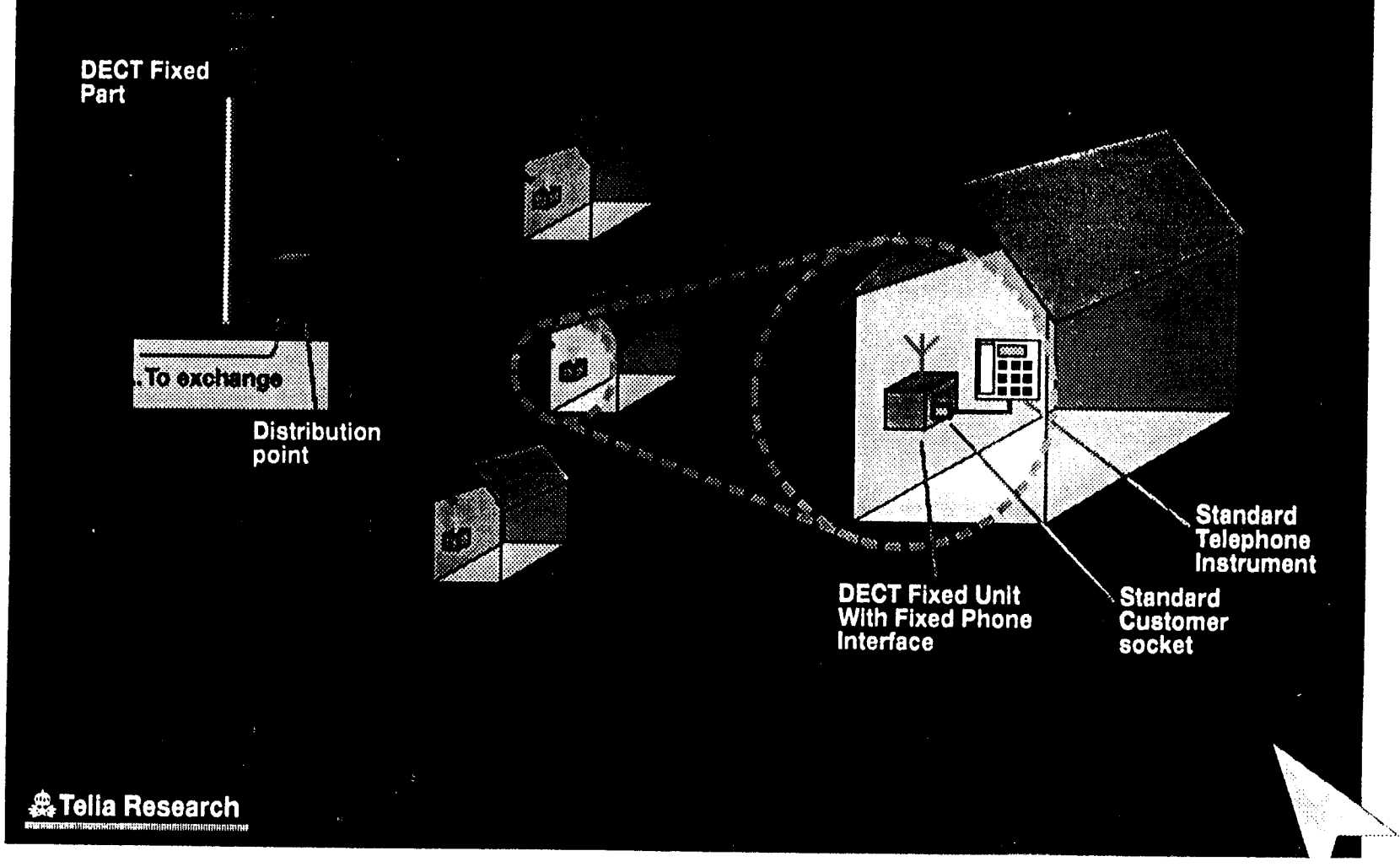
Local Loop Replacement



(*) Omnidirectional Antenna

(**) Directional Antenna

DECT In the Local Loop



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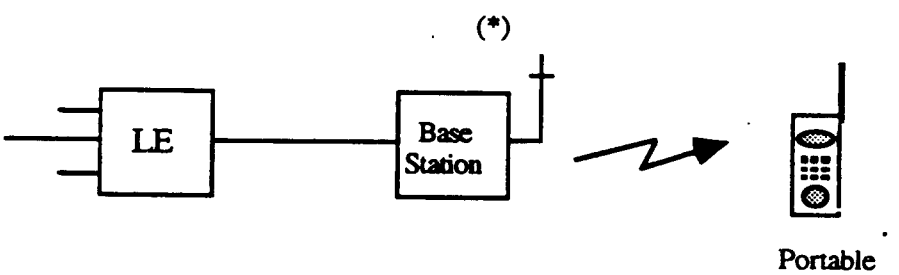
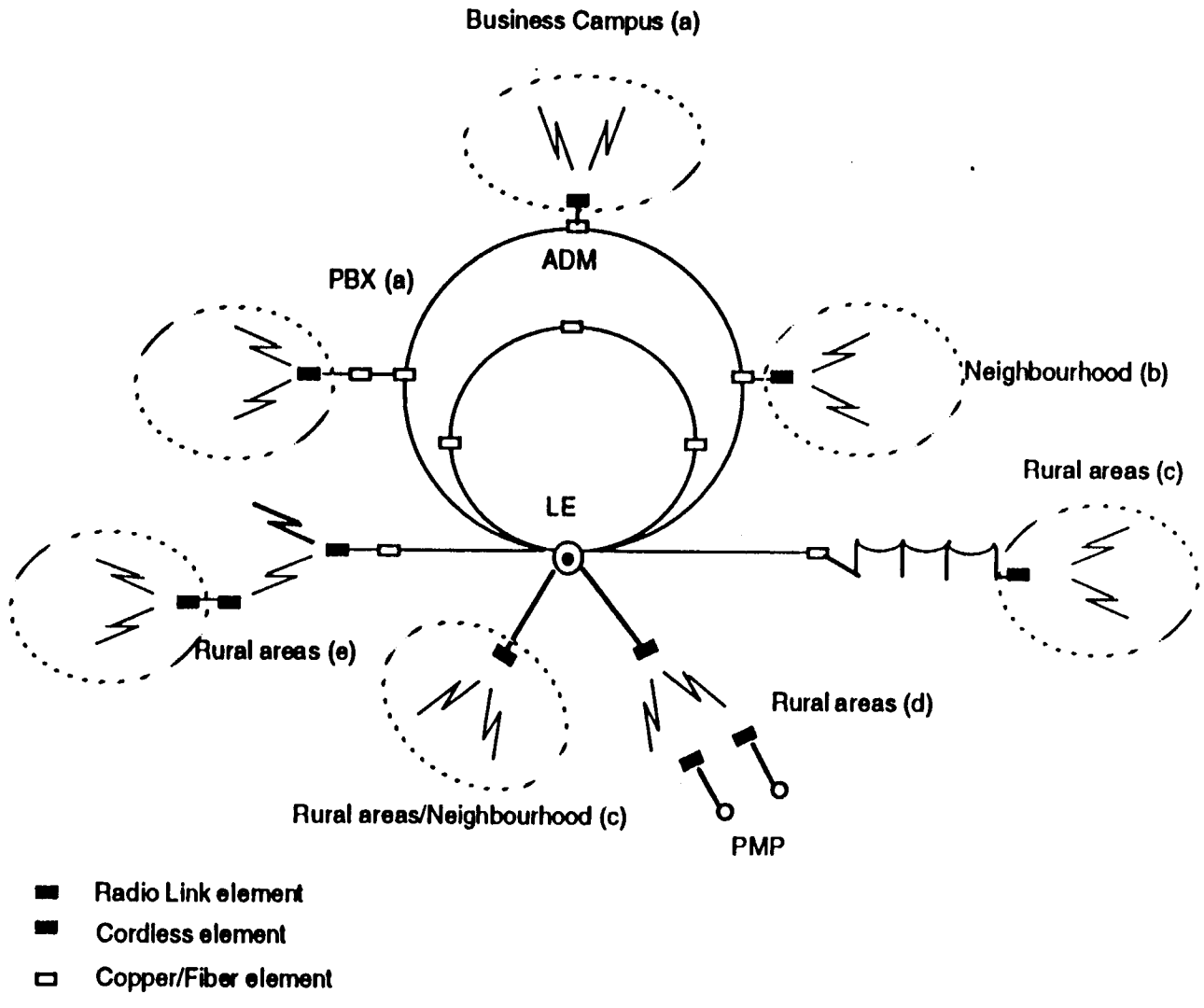
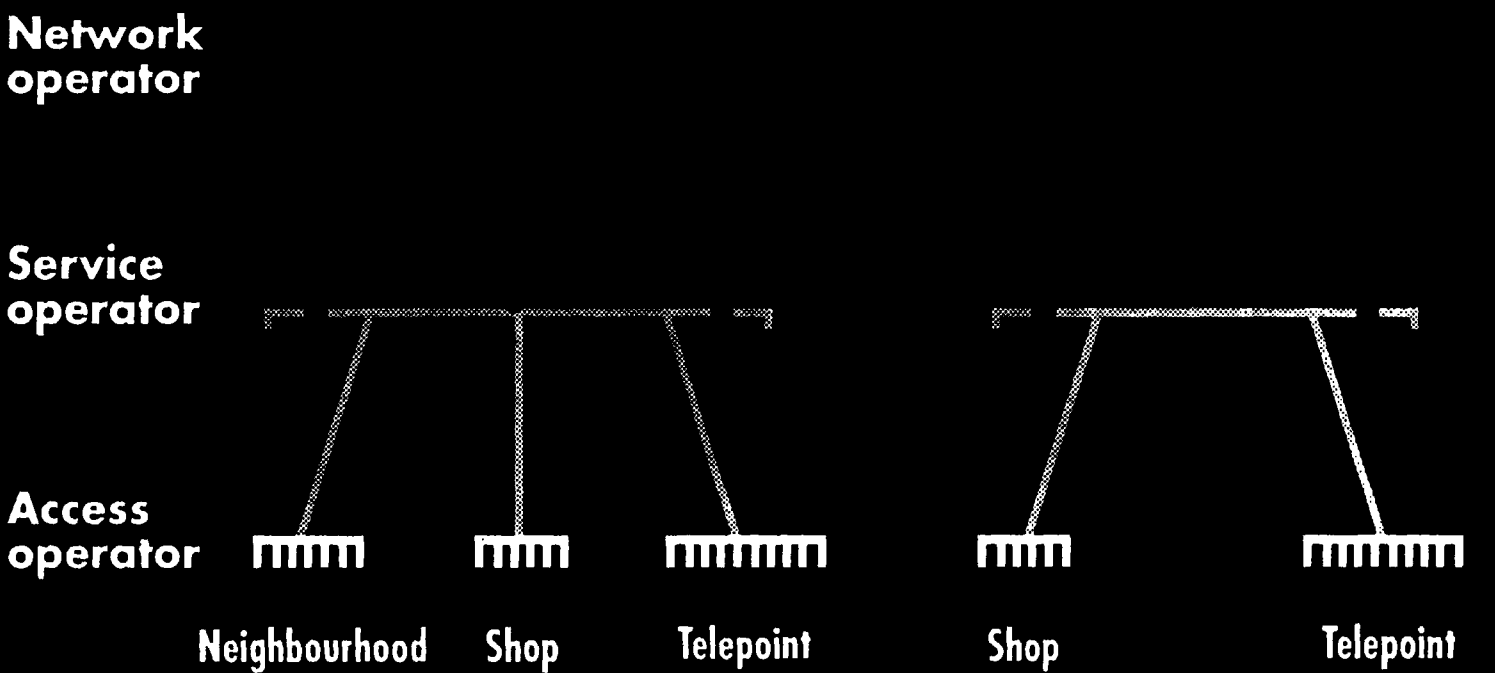
Neighbourhood Public Access



(*) Omnidirectional Antenna


Business Campus (a)
ADM
PBX (a)
Neighbourhood (b)
Rural areas (c)
LE
Rural areas (e)
Rural areas (d)
Rural areas/Neighbourhood (c)
PMP
Radio Link element
Cordless element
Copper/Fiber element

Global Network



Telia Research

Future Systems