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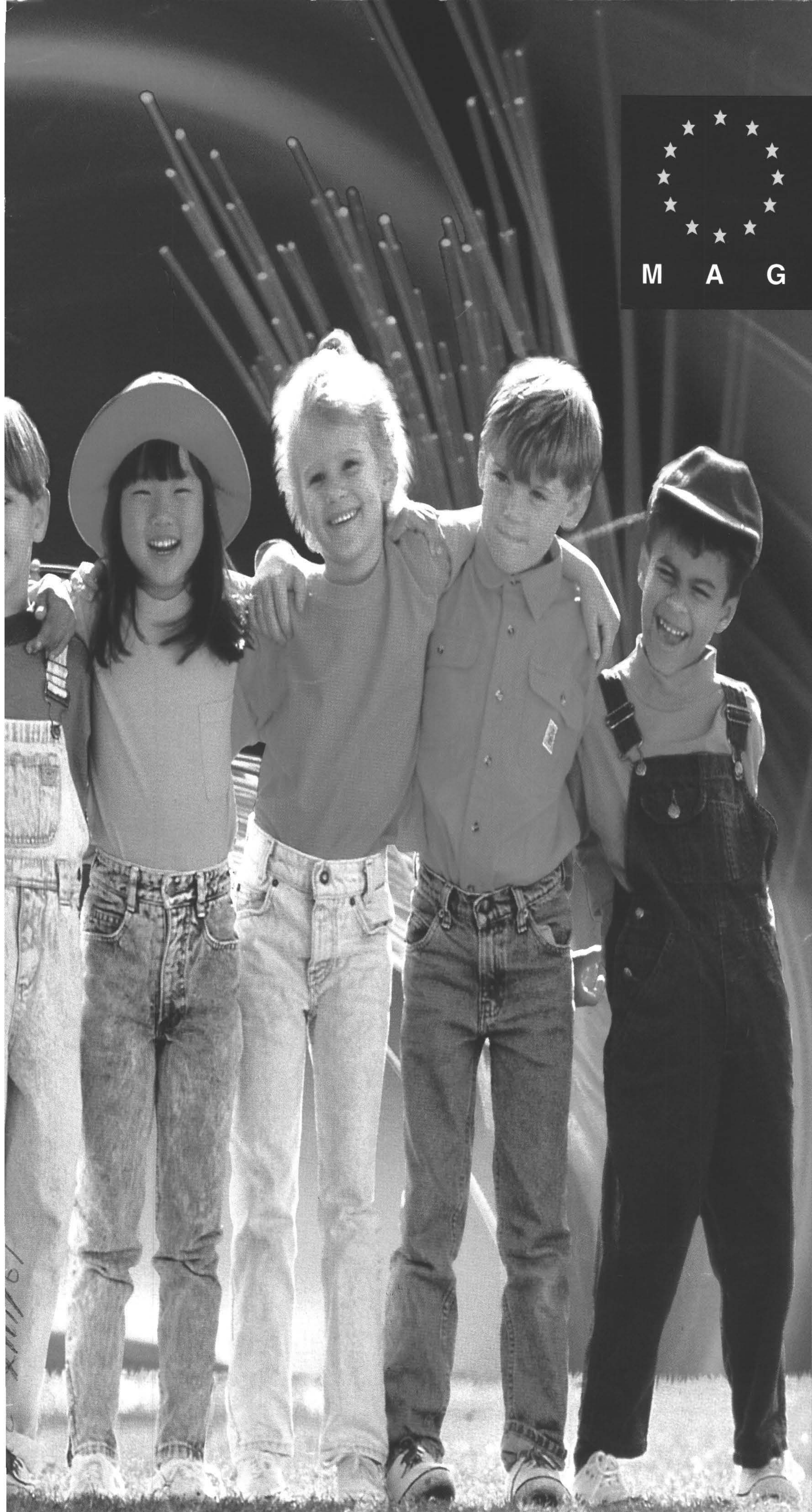

Transeuropean information networks

Special issue

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THE WHITE PAPER on growth, competitiveness and employment, introduced on 5 December 1993 by the President of the European Commission, Jacques Delors, gives particular weight to the setting up of large European infrastructures (energy, transport, telecommunications), both to develop European competitiveness and to "guide progress to serve the needs of employment and improve living conditions."

At a meeting in Brussels on 10 and 11 December, the European Council asked for a report to be prepared for the next session on specific measures to be taken in this area. It requested that the report be drawn up by "a group of people fully representative of all industries involved in the Union, users and consumers."

To this effect, two special groups were appointed by the Commission and the Council. They are the Christophersen Group for transport and energy networks and the Bangemann Group for communication networks.

At the time of going to press, these two groups were preparing to finish their final report for the European Council meeting to take place on 24 and 25 June 1994 in Corfu.

We do not wish to pre-empt their conclusions. But at a time when the debate on "electronic highways" is intensifying, a review of future information infrastructures seemed appropriate, in the light of the White Paper and Community policy on telecommunications hence this special issue. ■

The White Paper and information infrastructures

From digital integration to social integration

Entering the 21st century

The European Commission's White Paper[1] analyses the state of the Union in terms of growth, competitiveness and employment. However, its true ambition is better expressed in the subtitle: "challenges and paths for entering the 21st century." This symbolic reference to the year 2000 is a direct expression of the political desire to go beyond a simple diagnosis and to propose measures that will enable us to rise to the challenges which, taken together, are forcing us to look for a new model of development.

The White Paper bases its approach on a few basic principles. First, it rejects the temptation offered by regressive policies: we do not want protectionism, the relentless inflationary pursuit of the same policies, the widespread reduction of working time, or the alignment of wages and social protection with our competitors in developing countries. It then suggests positive strategies which aim at a sound, open, solidarity-minded, decentralized and competitive economy. It is careful not to put forward any miracle cures and reminds us that our efforts and policies will only succeed at the cost of a profound change in employment policy, which must be repositioned in the overall strategy.

Even when the economic climate has been good, the Union has been unable to obtain a satisfactory level of employment. It is true that competitive relationships have changed a great deal. Those countries which made a determined entrance into international trade in the 1960s now hold extremely strong positions. In the past 10 years, we have seen the widespread adoption of this economic development strategy based on entry into international trade. The Japanese and Korean miracles can now be seen in Asia and Latin America. Moreover, since the late 1970s, the former communist countries have been looking to base their development on international trade.

To this must be added the change in competitive relations associated with a series of technological revolutions, the greatest of all being the microelectronics revolution.

Nevertheless, these geopolitical and technological developments are not enough to explain all the difficulties. Quite the contrary, since theoretically and historically, both the development of international trade and technical progress lie at the heart of economic expansion.

The disastrous situation in the jobs market stems both from the contradiction between the intensity of structural adjustments demanded by competitive and technical processes, and from the ability of economies to reallocate physical and human resources quite quickly in such as way as to exploit their new comparative advantages and thus to revive growth, competitiveness and employment.

This contradiction is understandable. Globalization, supported by the development of methods of communication and transport, is accelerating and amplifying the pain of increased competition. Furthermore, while in the past our economies underwent formidable structural changes, employment was clearly less of a separate issue than it is today. Then, when it was still substantially linked to manual labour, people could move easily from one sector of activity to another. This is no longer the case today, primarily as a result of the technological revolution.

The result of the creation and destruction of jobs is reflected, at the sectorial level, by either a scarcity or a glut of labour, depending on the qualifications being sought. Indeed, technical progress is having the effect of removing society's proletariat dimension although it is having the counter-effect of increasing the number of social outcasts and boosting the population of the Fourth World.

Even if technological innovation does add fuel to the flames of competition and is accentuating short and medium term problems on the jobs market, in a world where relationships are truly worldwide such innovation is not vital to safeguard company competitiveness. However, a whole new logic for innovation is now materialising – one which goes beyond the dogma of "productivity at all costs" and extends into the area of social adjustment. It is this logic that is stressed for the first time in the White Paper and which constitutes its main development axis.

From the Los Alamos laboratories to the Lascaux caves

Initially, computers were massive calculating machines for use by scientists. At Los Alamos, for example, computers helped design and manufacture the first atomic bomb. This kind of calculation was clearly ideally suited to the binary expression of electronics and as a result quite spectacular progress was made. With robotics and office automation, computing has now reached our workplace and our work tools. Computerized data transmission networks have revolutionized the way the financial markets work.

Just a short time ago, this revolution did not really serve human relations as such. For this to be the case, two preconditions need to be met.

First, in a human relationship, we communicate by speaking to, listening to and seeing our interlocutor. If the computing revolution is to serve human relationships we need to extend digitization to embrace the three ways in which we express our knowledge: through text, sound and image. We then need to integrate them into a single communication system – this is what is commonly termed multimedia communication. This should not be confused with the world of virtual reality which is not aimed at inter-personal communication.

Second, social relationships in their physical reality have no need for electronics. The characteristic feature of an electronic revolution that serves human relationships necessarily lies, in its multimedia form, in remote communication systems.

This double precondition has only very recently been met by technology. We can talk by telephone and send computing data and faxes, but only by using different machines and, above all, without seeing each other. Until a short time ago, the limits of processors and storage and transmission capacities were reached as soon as an image, even a still image, was introduced into the digital universe.

Let us consider the example of a picture of one of the Lascaux cave paintings: digitized in 24-bit coded colour with a definition of 500 x 500 pixels, it requires 6,000,000 bits of storage capacity. To make the transition from a still to a moving image with TV-picture quality, we need to display at least 25 images per second, which requires a transmission capacity of 100 million bits per second. The traditional switched telephone network is clearly unable to cope with this kind of throughput.

Fortunately, a digital message can be compressed. The compression algorithms that exist today are already capable of reducing transmission rates by a factor of 20 or more. As for optical fibre, where it exists, it overcomes virtually all the barriers of transmission capacity.

From Copenhagen to Brussels

At the European Council summit held in Copenhagen in June 1993, Commission president Jacques Delors for the first time mentioned the idea of developing (digital) information infrastructures, which he termed "a veritable blood supply for the economy of the future." He also stated, however, that "the most spectacular innovation will be an instrument for exchange linking voice, image and text."

The Commission's approach was made easier by the provisions of the Maastricht Treaty. Title XII of the Treaty for European Union states that the Community shall contribute to the establishment and development of trans-European networks in the areas of transport, telecommunications and energy infrastructures. "The Community shall aim to promote the interconnection and interoperability of national networks as well as access to such networks." This provision of the Maastricht Treaty on networks extends the Single European Act within the framework of the single market. In its White Paper, the Commission suggested to the heads of state and government at the Brussels Council summit that the main development axis be the production of these information infrastructures, continuing along the same lines laid out by Jacques Delors at the Copenhagen summit.

Digital integration serving social integration

The world of multimedia, by adding a new dimension relating to integration and interactivity, further strengthens "remote" relationships. Letting our children use terminals to communicate with each other and access knowledge, possibly in direct contact with their teacher, and with the same pleasure with which they today watch television or play video games, would indeed be a great step forward. It is clear that electronic communication cannot and must not supersede direct contact, but it is there to facilitate and increase the frequency of exchanges.

Overcoming distance also often means being able to overcome time constraints. Following an adult training course using telematic applications is one of the key ways in which we can progressively improve the situation of people on the jobs market. The increased training and retraining possibilities themselves generate new jobs, both at the moment of their creation and because they require the continued presence of teachers through the use of multimedia.

Providing citizens with remote access to public administrations and their various departments and the possibility of being able to go through electronically the same procedures that currently have to be done over a counter will revolutionize relationships and will improve the efficiency of services. Here again, it is the multimedia approach that will prevent these applications from resulting in job losses, since the dialogue between the citizen and the civil servant will be maintained and possibly even broadened.

In the area of health care, citizens tend to mobilize the more cumbersome structures (the emergency wards of hospitals rather than the doctor himself) whereas, more often than not, there is no good reason for such actions. Telematics can make each one of us an informed patient and directly involve us in our own health care. Personal medical decision-making telematic systems, accessible 24-hours a day with additional on-line consultancy if necessary, are already being developed in the

United States. Of course, such applications lead to a number of questions that health officials will not fail to raise.

In the wake of the California earthquake, the breakdown in the road infrastructure leading to Los Angeles led to a real interest in remote-working. This is another perspective opened up by multimedia, whether it involves working from home or from a neighbouring advanced communications centre. Here, too, technological evolution has led to a whole new debate and new perspectives in the field of town and country planning.

From the way in which we could educate, train or care for ourselves and the way in which we could work, we can see that this technological evolution also concerns the individual and his or her relationship with others, whereas until now, information and communication technologies were primarily concerned with man-work and man-machine relationships. By moving beyond the purely commercial sphere and a strictly production-oriented logic, multimedia developments could make a positive contribution towards finding a solution to three problems.

First, in addition to the economic crisis there is a social crisis. It is hard to grasp today the full meaning of electronic communities. We can merely note that, where they exist, they show a remarkable vitality. Some people are afraid that such networks serve to "virtualize" still further the reality of social interaction, to place the emphasis on individualism and favour the development of "closed" electronic communities. Each technological development stirs as many hopes as it raises concerns. We should simply note that, in our increasingly organized and complex societies, we probably need areas for "random" meetings. More than one set of inhibitions are lost in front of the monitor and keyboard, and the information highways of tomorrow could well offer opportunities for personal interaction that we would shy away from in the street today. (The only danger would be if we kept off the streets a little more: in other words, we should not prolong electronic exchanges).

Then what would emerge would be an instrument that should make up for the institutional deficiencies we spoke of earlier and which partly serve to explain the difficulties of the job market. Education and training in new skills as well as information on work available should be made considerably easier with multimedia telematics.

Lastly, we should ask ourselves what contribution this technological evolution could make to growth. Since it is a new infrastructure, initially we could expect it to have a positive effect on growth because of the amount of investment needed. Competition in industry and services is bound to benefit from this. Looking beyond these traditional effects, however, are not more original perspectives being opened up?

Economic studies reveal a growing demand for services linked with child education, adult training, health, culture, and information in the more general sense. Many of these services are provided by the state. Schools, clinics and museums are either completely or very considerably dependent on the public authorities. The services they offer are being increasingly rationed by tight budgetary controls. Now, with multimedia communication, these services could find a real market and new financial resources. While respecting the status and prime vocation of the institutions, the school could market education applications, the hospital could supply applications such as we have already discussed, the museum could offer pictures and presentations, etc. All this could be done by charging a fee calculated according to the time spent on the applications. If the institutions do not try to win these markets, there is a great risk that they will be edged out by other economic players acting solely according to the logic of the marketplace.

This article was intended to stress the social aspect of the new communication systems. As everyone knows, or could guess, communication infrastructures open up a number of other perspectives. In particular, together they could constitute a new area for exchange, that of remote transactions. The emergence of this 21st century "electronic marketplace" will facilitate the commercialization of additional services by certain public services.

Close encounters

The implementation of information infrastructures is a major challenge for the private sector and for the regulatory bodies, the Commission in particular.

We must not lose sight of the fact that over the past century telecommunications developed according to the principle of the natural monopoly and with the paradox that the conventional telephone, a universal tool for communication which only needs very low data transmission speeds in the version we all know, uses networks of wires whose installation requires major mechanical work out of all proportion to the data throughput. Radio broadcasts and television, which require very high data transmission rates, use Hertzian waves, which are a rare resource.

The major development which we may witness this decade will reverse this situation. The telephone of the future will need no wires and will give the user greater mobility (the GSM system, developed in Europe and currently entering service throughout the European Union and in a number of other countries, is leading the way), while multimedia networks will be cabled. Only the magic of digital compression could make the communications scene a little less ordered than that.

The installation of these cabled multimedia networks is as great a technological step forward as micro-computing was in the last decade. With digitization now reaching image technology, the merging of the worlds of computing and telecommunications has led to a "close encounter of the third kind" with the world of entertainment, i.e. cinema, TV and video. With the telephone network, ground or mobile, and the computing network, the third cable operators network (remote distribution) is now adding fresh momentum to the debate on digital infrastructures.

The regulatory separation of the activities of telecoms operators and cable operators differs greatly from one country to the next. This separation (in the regional operator's zone of operation) exists in the United States, for example, except in a few states. There is no regulatory separation in the United Kingdom. In Germany, almost all cable lines belong to the public operator, Deutsche Telekom. In France, the installation and technical operation of the cable network falls almost completely to France Telecom.

On the technological level, these networks are potential competitors. The transformation of a teledistribution network into a switched network providing a telephone service that competes with the public network operator could be an opportunity to double income for an increase in investment in switching technology of barely 25%. A switched cable network can also serve to develop interactive television: personal programming, active participation in TV shows, etc.

The telephone network operators are preparing for this threat, where it exists, and are envisaging developing the system of video-on-demand. Digital compression techniques mean that it is now possible to transmit a video image of VHS quality over the conventional network. For the cable operators, video-on-demand is a drop in the ocean compared with the capacities of coaxial networks which have the potential to offer up to 500 TV channels.

For their part, the cable operators are faced with the threat of competition from direct broadcast satellites. This threat is all the more serious since conventional image compression (PAL, SECAM and NTSC) makes it possible to relay 10 or more pay-TV channels from just one satellite repeater while the cost to the user of the reception equipment required is today very reasonable.

Mobile telephone systems have already significantly altered the old monopolies enjoyed by the telecoms operators. In most Member States a duopoly now exists. This relatively calm regional competition could, however, be threatened by projects for worldwide mobile telephone networks using low-orbit satellites which would not be the result of a direct initiative by the current operators.

In short, the multiplicity of new transmission techniques means that the world will have to implement major strategic operations. These will present even more of a risk since the potential markets are often hard to estimate and the regulatory context is still being hammered out.

Political stakes

The most profitable markets capable of supporting private investments in the information infrastructure are corporate communications and markets at the other end of the scale of social priorities: video-on-demand, teleshopping, video games, E-mail systems, lotteries, etc.

At first glance, we may be tempted to conclude that multimedia telematic applications and terminals will initially be based on developments in the corporate communication market while interactive television will be based on developments in consumer attitudes. To assume this would then run counter to the starting hypothesis of this article, which identified multimedia telematic communications as being a instrument for social integration and thus destined for very broad diffusion in households.

This risk of contradiction, if we recognize it, can be greatly reduced by the political approach. These various markets that are profitable for private investment can give society as a whole an information infrastructure if political attention is focused, as the Treaty suggests, on the interconnection and interoperability of the networks, so that all the pieces of the puzzle come together to make up a coherent infrastructure that is accessible to everyone.

In this case, the regulatory framework itself will have to take account of the guidelines set out by the European Union. In the White Paper, the Commission and then the heads of state and government, stressed the importance they place on current developments in communication resources in relation to the economic and social issues of our time. They linked digital integration to an instrument of social integration rather than to the development of new leisure activities.

The technology already exists and the White Paper clearly states that the important thing now is to invest. That is the responsibility of the private sector, which will need a regulatory framework to be able to make reliable economic calculations. Taking into account the political objectives set, this will be the number one priority of the Commission and of the European Union.

As certain telematic applications are true instruments for integration into social and economic life, political responsibility also involves ensuring citizens have access to these networks and applications, and at a reasonable price. The notion of providing a universal service will not disappear as technology progresses – on the contrary, it once again comes strongly to the fore.

The social significance of this same technology should also serve to convince the national, regional and local public authorities that public investment no longer stops at road and rail networks. The dissemination of information and telematic applications through adequate infrastructures is probably as important today as the railways were during the industrial revolution of the 19th century.

All these issues are on the agenda of a high-level group representing all interests and entrusted by the European Council to draw up a report and make concrete suggestions in June 1994. The heads of state and government will then adopt an operational programme for the implementation of the pan-European information infrastructure. ■

A Stekke and J P Valentin *DG XIII*

[1] Bulletin of the European Communities, supplement 6/93, Office for Official Publications of the European Communities, L-2985 Luxembourg

An enlightening look at policy development

Over the last ten years, Community telecommunications policy has been setting up the starting blocks for the adventure of electronic highways and the information society

June 1993: Presentation by President DELORS at the Copenhagen summit, among the guidelines for the economic recovery of Europe, of the creation of a "common information area" . . .

September 1993: The American government unveiled its programme to boost the development in the United States of the National Information Infrastructure (N.I.I.), destined to be the core network for the distribution of information in all possible forms and which will revolutionise the dawning of the second millennium . . .

December 1993: President DELORS published his "White Paper on Growth, Competitiveness and Employment", in which the concept of a common information area is furthered developed. It is identified as one of the pathways for European society to the 21st century. It will be achieved through the creation of trans-European "electronic highways" giving access to all the information required for the functioning of the economy and of society. This new society will henceforth be fuelled more by the production of intangible goods than by traditional products.

These two practically simultaneous approaches both aim to draw the greatest benefit from the progress made by information, audio-visual and telecommunications technologies, in order to lay new foundations for the prosperity of our society. The media stir caused by these initiatives would seem to suggest that they proffer a totally new concept, a sudden discovery which will revolutionise our lives. In actual fact, and this is highly commendable, it is more a question of drawing together into a global and coherent vision all the developments which have gathered pace in the last ten years, and which have enjoyed substantial support from the Community.

The first steps in the Community's telecommunications policy

After a few timid and highly specific forays in the seventies and early eighties, Community action in the area of information technologies and telecommunications really began to take the shape of a genuine policy with the ESPRIT pilot programme, launched in 1983. It was also in 1983, on the initiative of Vice-President Etienne Davignon, that Community telecommunications policy was conceived. On November 4 1983, it was discussed for the first time during a Council of Industry Ministers, opening the way to the presentation by the Commission of a detailed action plan on May 17 1984.

It is useful to look back at the six main lines of this action plan:

a) Cooperation between network operators for the introduction of new generations of networks and services in a European rather than national context. This is the "trans-European networks" approach later applied to the integrated services digital network (ISDN), mobile telephony, E-mail, etc and which now underpins the information networks in the White Paper.

b) Achievement of a European terminals market. This aim prompted the Council to take various harmonisation and regulatory measures to create such a market, notably by establishing a set of standards to ensure the end-to-end interoperability of these services.

c) Cooperation between industrialists in the sector and network operators in the field of R&D for the implementation of broadband integrated services networks. This aim gave rise to the RACE programme, the results of which enable the Community to master the technologies required for the establishment of "information highways."

d) Ensuring that the peripheral States of the Community benefit from specific measures giving them equality of opportunity with the other Member States as regards the establishment of infrastructure and modern services. For this purpose, the STAR and then Télématique programmes contributed to closing the gap between these two groups of countries. On the basis of the experience acquired, an increased effort should be made to ensure that the peripheral countries draw full benefit from the opportunities offered by the "information society."

e) Consultation of management and labour on the measures to be taken in the area of telecommunications policy: regular consultations with trade unions in the sector led to the creation of a Joint Committee in this field. This framework will be used to foster labour consensus around the evolutions proposed in the White Paper.

f) Avoidance of uncoordinated presentations by the Member States in international bilateral and multilateral negotiations with the industrialised countries and international organisations. The consequence of this has been sustained activity within, notably, GATT, the ITU and negotiations with the United States and Japan. Cooperation with the United States and Japan is now envisaged in the framework of the White Paper.

The rise in power of telecommunications policy

The outline features of Community information technology and telecommunications policy thus began to emerge

The concept of trans-European "electronic highways" is more a question of drawing together into a global and coherent vision all the developments which have gathered pace in the last ten years.

Since 1984 and in particular through its liberalisation process, Community telecommunications policy has clearly demonstrated its aim of establishing trans-European networks.

from 1984. The implementation of the White Paper is naturally going to be underpinned by the action lines chosen at that time.

In the following years, the Council, acting on Commission initiatives, adopted dozens of measures, resolutions, directives and regulations, giving tangible form to Community telecommunications policy. Up until 1987, the Community concentrated its efforts on harmonisation, convergence and R&D measures. Then, in June 1987, following the Single Act and in light of the forthcoming completion of the internal market, the "Green Paper on the development of the common market in telecommunications services and equipment" was published. This document moreover set in motion the process of amending the regulations governing telecommunications services and equipment in the Community.

Thus far, a distinction can be made between two major phases in the evolution of the regulatory framework, combining harmonisation and liberalisation.

The first phase saw in 1988 the liberalisation of the market in telecommunications terminals, followed in June 1990 by the Council's adoption of a harmonising Framework Directive introducing the concept of Open Network Provision (ONP) and by the Commission's adoption of a Directive liberalising telecommunications services (with the exception of voice telephony). The latter directive for the moment allows the monopoly system to remain in place in the area of infrastructure.

The second phase began in 1992, with the publication of a re-assessment of the situation in the telecommunications service sector in the Community. It has been marked by the adoption of the Council Resolution of June 1993, providing for the liberalisation of voice telephony in the majority of Member States by 1998 (Ireland, Greece, Spain and Portugal enjoy an extension running to 2003), and for the publication in 1995 of a Green Paper on infrastructure, which will open discussions on its liberalisation. During this phase, work efforts have been directed at making greater allowance for the concepts of universal service, data security, protection of the individual, industrial property rights, etc.

The harmonisation and liberalisation of satellite communications services were put on track after the publication of a Green Paper in 1990. The Community strategy for the future development of mobile communications is also the subject of a Green Paper, on the point of being made public.

Thus, since 1984 and in particular through its liberalisation process, Community telecommunications policy has clearly demonstrated its aim of establishing trans-European networks. As far back as 1988, the Commission, under the second Community R&D framework programme, ran actions for the development of large-scale trans-European applications in fields of collective interest, such as health care (AIM), road traffic management (DRIVE) and distance learning (DELTA). Other action fields followed, from 1991, in the framework of the specific programme for the development of telematic systems of general interest. The Commission furthermore invested a great deal of effort to strengthen the political support for trans-European networks in the three infrastructure areas vital to the Community: transport, energy and telecommunications.

In December 1989, the Council, acting on a Commission initiative, adopted a Resolution (dated January 22, 1990) calling for Community action in favour of trans-European networks. The European Councils of Strasbourg (December 1989) and Dublin (June 1990) reiterated the need for this. The Commission tabled its action programme in a Communication to the Council in December 1990, and, on March 31, 1992, the Council adopted conclusions in favour of such action. On February 7, 1992, the Heads of State adopted in Maastricht a draft Treaty devoting a specific title, Title XII, to trans-European networks; it came into force in November 1993. In addition to this, the December 1992 Edinburgh summit and that of June 1993 in Copenhagen set up financial facilities designed to stimulate the development of trans-European networks.

The march towards the information Society

In the field of telecommunications, the Commission transmitted to the Council on March 12 1993 a proposal on trans-European telematic networks between administrations, followed on September 1 1993 by a proposal on the development of ISDN as a trans-European network and by a Communication on broadband trans-European networks. These three action fields were judged to take priority, in that they concern the basic networks and the management of the internal market established on January 1, 1993. In its global vision of the "information society," the White Paper identifies six other fields where the Community must make a strategic effort: electronic mail, access to databases, interactive video networks, teleworking, telemedicine and tele-information.

Through its implementation of Community telecommunications policy, the Commission has laid the firm foundations required for the achievement of "electronic highways": these highways will circulate key information around our society and enable it to enter the twenty-first century on a firm footing in terms of competitiveness and social cohesion. A massive effort still remains to be made, but the instruments are at our fingertips and success will depend on the use made of them.

First of all, the political commitment to implementing the actions proposed in the strategic fields must be firmly re-emphasised at the highest level: the work undertaken by the Group of leading figures (Bangemann Group), meeting at the instigation of the Brussels European Council, should make it possible for the June 1994 European Council to confirm this commitment.

On the basis of this political agreement, it will then be necessary to create a climate encouraging public and private operators to make the necessary investments. This is a role for the Member States and the Commission which, for its part, make judicious use of the limited financial resources available at Community level and take action on the sectorial environment. Furthermore, special attention should be devoted to the regulatory context, the evolution of which is already well under way, and to aspects touching upon standards, universal service, data protection and security and industrial property.

It is by making best possible use of community access and through a renewed partnership between all the players in this field and the public authorities that the reserves of competitiveness, growth and employment inherent in the "information society" will be tapped. ■

C Garric *DG XIII*

Testing time for Europe's broadband future

In ten years broadband telecommunications will be providing Europeans with a multitude of interactive, distributed, multimedia services. Will they be made and provided by European companies?

THE INFORMATION Superhighway. Ask a European in the street what it is. If you get any answer, it is likely to be: isn't that some American thing, where people will have a videophone and home shopping and a hundred TV channels?

Well, partly. "Information Superhighway" is a well-publicised term for the US programme to develop broadband communications, although the origin of the term is European from the mid-'80s. Most Europeans don't realise that years of research, a lot of it funded by the European Commission's RACE programme, has put Europe in the forefront of broadband development, alongside the US and Japan.

Now the collaboration is up for renewal, under the Commission's next five-year Framework Programme for scientific research. Last year member states earmarked 630 million ECU of the new Framework budget for advanced telecommunications, up from 489 million in the last programme. Why is research investment on the information superhighway so important for Europe?

Even if we do not make that investment, the technology will be with us soon from the US and Japan. By early next decade, many people will be as lost without broadband as they would be now without a telefax. The question now is whether European companies will be providing the services, and reaping the profits.

Now most telecommunications are based on sending electrical pulses down copper wires. Broadband is possible when instead you send light pulses down glass filaments, or fibre optics, or when you "digitise" information (like music on CDs) and compress it for transmission as radio signals you can pick up directly or which are bounced off a satellite.

Operational trials will be the focus for all the R&D in ACTS, the new programme for Advanced Communications Technologies and Services.

You can send a lot more information down one line with light than you can with electricity. Information is always sent in a code, made up of different amplitudes and frequencies of whatever electromagnetic wave you are using. There are simply more frequencies to choose from when you use light, than when you use electricity – the band is broader. Hence, broadband.

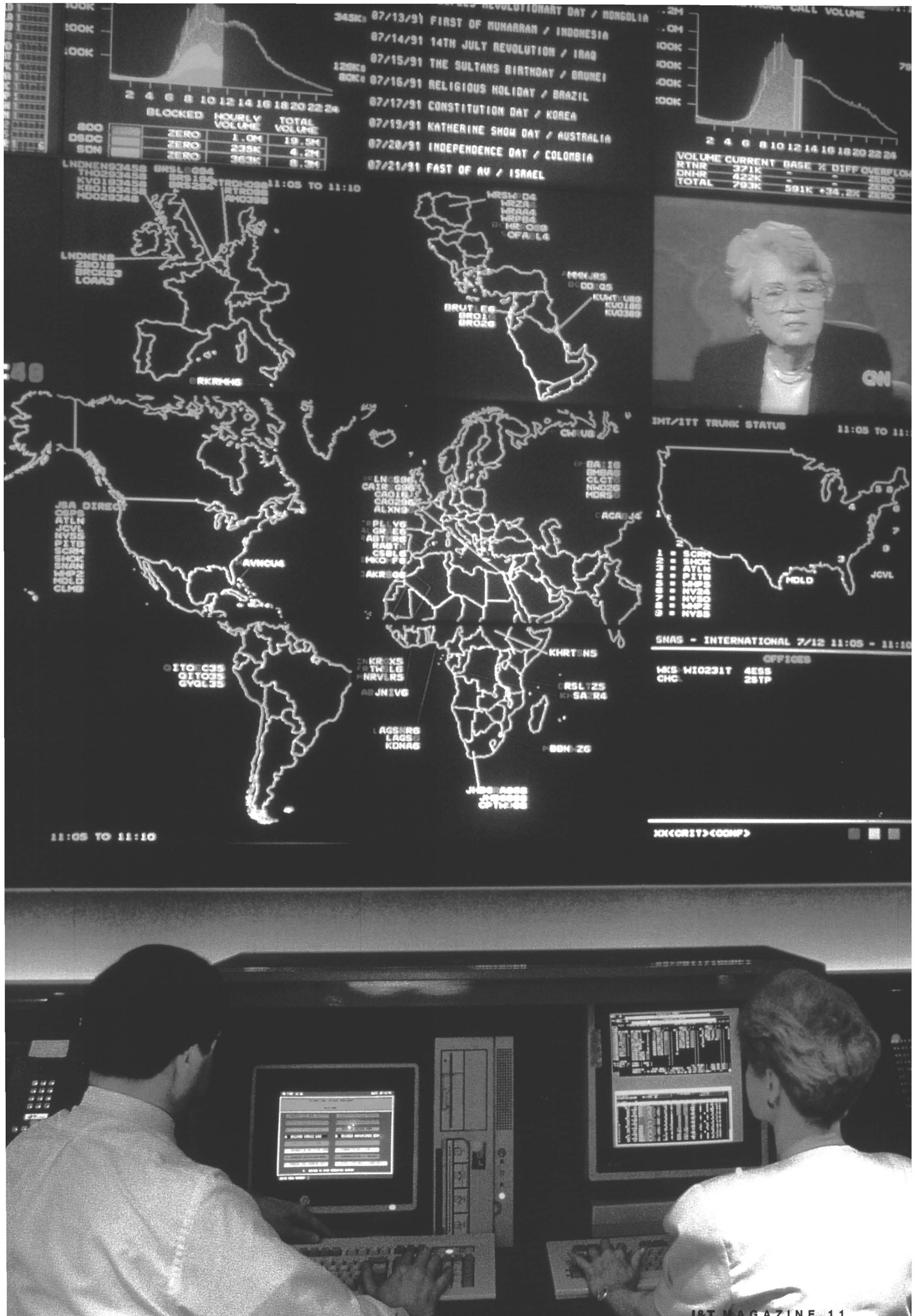
So much for theory. In practice, it means you can use those frequencies to send different kinds of signal down one line. It can therefore carry many different services, which require the sending to and fro of far more information than can be squeezed down copper wires.

The Commission is now helping to fund experimental broadband systems, starting with dedicated links between computers. Large volumes of computerised data exchanged at high speeds will make new services possible in, for example, banking, manufacturing, and the travel industry. Trials of networks between banks have been underway for some time, for example in the City of London.

Eventually ordinary subscribers will have access to a public broadband network. Among the first services will probably be those hundreds of channels of movie-quality cable TV, for which you pay as you watch, choosing the language of the soundtrack. The ability to transfer large amounts of data back and forth will allow educational TV to be interactive.

The same data capacity will permit high-quality videophones and other services. Some people will be able to replace commuting, with all its pollution and congestion and energy consumption, with "teleworking."

As applications develop, anyone with the right terminal will be able to send graphics, data, text, or real-time images to anyone else over the phone line. Designers of all types will work with colleagues across the continent. Distant doctors will confer in mid-operation. Companies will fine-tune manufacturing and merchandising with telecommands. More people will make more uses of databases, electronic mail and publishing.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07/16/91 RELIGIOUS HOLIDAY / BRAZIL
07/17/91 CONSTITUTION DAY / KOREA
07/19/91 KATHERINE SHOW DAY / AUSTRALIA
07/20/91 INDEPENDENCE DAY / COLOMBIA
07/21/91 FAST OF AV / ISRAEL
BLOCKED
HOURLY VOLUME
TOTAL VOLUME
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RACE research showed the superiority of ATM "before it was fashionable"... Now everyone is using ATM.

That is the pie in the sky. Back on earth, we still have to get the systems to work. Broadband may just be a matter of "working out the engineering," but the engineering problems are not trivial. Copper wire had a limited capacity for signals. With fibre optics, the capacity is virtually limitless. So the problem becomes the switching and directing of millions of signals.

Among many other things, that requires new materials for detecting and deflecting light pulses at very high speeds, new lasers for producing them, and new ideas about how to organise immensely complex networks. We must invent the software and the terminals that will allow people to use broadband networks. We must learn how to shift from optical to electronic signals and back, fast.

The research is underway in all industrialised countries, but Europe had to overcome an obstacle its competitors did not have. Europe's telecoms industry is fragmented among national telephone monopolies, equipment suppliers, and different regulations and technical standards.

As a result of RACE, the industry has united around broadband R&D. John Forest, head of National Transcommunications in Britain, says RACE "created an R&D community where there was none before."

Geoff Hill, head of advanced networks modelling at British Telecom, says "Europe needs successors to RACE, because broadband research is too expensive for one or two companies alone." This does not just apply to Europe. The Americans collaborate through BellCore, the old Bell Telephone laboratory. The Japanese work through MITI, the Ministry of Industry and Trade.

Not only has RACE allowed European researchers to pool expertise and costs, says Hill, it has allowed them to agree common standards and approaches. The most notable has been a decision to use a coding and switching system called ATM (asynchronous transfer mode) as the basis of the future European network.

RACE research showed the superiority of ATM "before it was fashionable," says Spyros Konidaris of the Commission. "Now, everyone is using ATM", and Europeans have a head start. Such collaboration, he says, will keep broadband from repeating the mistakes of television and video, where different standards fragment the European market.

But does Europe still need a large, Commission-funded research programme to develop broadband? A panel headed by Wisse Dekker of Philips Electronics concluded last year that lack of research is not the main obstacle to broadband development in Europe. That consists more of regulatory fragmentation, national telecoms monopolies, rules which prohibit telephone companies from carrying cable television, and the like. The panel said that in view of the fact that the RACE programme had been successful in meeting its objectives, Europe should now concentrate on regulatory reform.

But it also said it was "not proposing that Community R&D turns its back on this sector, in which European players have the potential to be global winners." It wanted development of broadband to be "concerted between manufacturers, service providers, public, business and private users."

Roland Hüber, director of advanced communications research at the Commission, agrees. "We have finished the phase of the research that was emphasised in RACE," he says. That mainly concerned basic features of the network, such as ATM. The research community RACE created, and the links it forged between researchers and standardisation bodies, can continue much of that work, says Hüber.

The new programme proposes to move on from RACE much as Dekker recommended. It is called ACTS, for advanced communications technologies and services. Hüber emphasises the last two words. "Operational trials will be the focus for all the R&D in the programme," he says. This will bring prospective users together with suppliers, to develop services people want. It will also help turn research results into working systems.

The focus on services is not completely new. One set of projects underway now is concerned with encouraging telework. "Telework" means people working at a distance using advanced telecoms between personal computers and mobile telephones.

This can create jobs. Some studies estimate that if only a tenth of the workforce in information management made use of new telecoms infrastructure, there could be 10 million teleworkers in Europe. Telework is a strategic objective in the Commission's White Paper "Growth, competitiveness and employment" of last December.

The telework research teams have already been selected. They include a major trial of an ATM link between laboratories in Portugal and Spain; a survey of the impact of telework on traffic congestion in France, Spain, Holland, Britain and Finland; a code of business and contractual practice governing teleworkers; experiments in telework links across borders and between small businesses; and local teleservices centres for small businesses in six countries.

But the basic engineering research must continue too. "We originally aimed to have an integrated broadband network in place by 1995," says Goff Hill. "We've made a lot of progress, but the applications still need work." The trials planned in ACTS, he says, will be a "good move" in that direction.

Besides, says Konidaris, RACE may have helped develop the first generation of broadband, but what about the next one? "You have to keep doing research," says Hill. "It takes 15 years to develop new ideas into services."

Jacques Benoit, head of optoelectronics at the French telecoms firm Alcatel, says Europe needs Commissionled research "so we can develop a common vision of what service we will want in ten or twenty years, how much traffic the network will have to handle, how to evolve from the existing system to the next." Manufacturers and telecoms operators on their own, he says, cannot do this.

"Europe has put 25 years of research into optoelectronics," says Benoit. "It would be a pity if it ended up like silicon." Silicon is the basis of current electronics, in which Europe also pioneered the research, but was left behind commercially because of lack of investment. Benoit says that will happen to broadband if Europe does not collaborate on R&D now. But just as importantly, Europe will have to change its regulatory framework to stimulate and allow investment of all the actors.

To be left behind in broadband will not only hurt telecoms companies. Other high-tech industries will not be able to work with European suppliers to develop the broadband systems they need. The White Paper called advanced communications the key generic technology in fields ranging from training to industrial design, from entertainment to banking, from retailing to medicine. It is, in many ways, the key technology for the next few decades.

Certainly the Americans and Japanese think so. Europeans must continue to work together if they aren't to be left behind again. ■

Debora MacKenzie *New Scientist*

Information highways worldwide: challenges and strategies

Information infrastructures have become a vital area of international political debate and strategic manoeuvre in industry

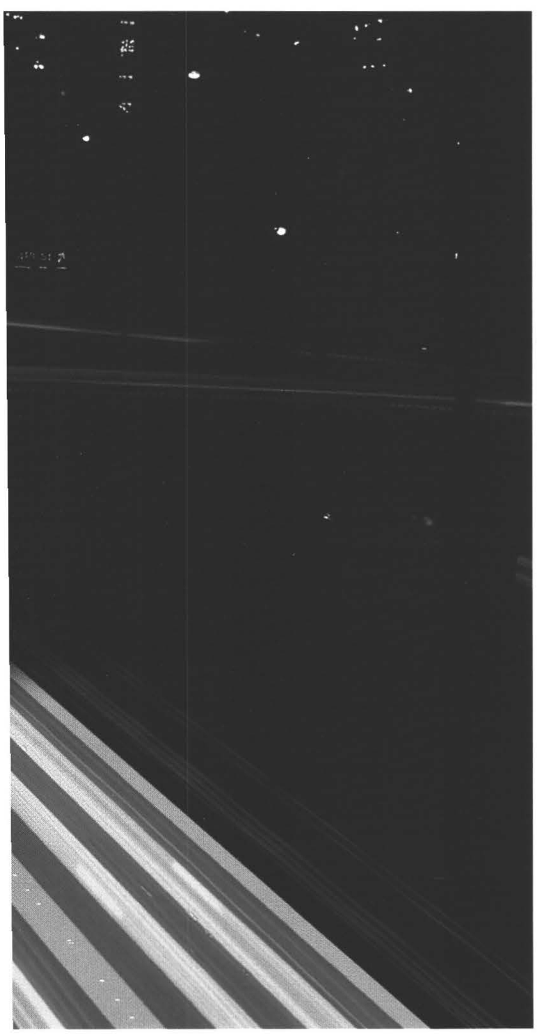
DEPENDING ON WHETHER you are a protagonist of scientific popularisation or an advocate of terminological correctness, you may like metaphors or distrust them. "Information highways" is a case in point. When it first surfaced in Europe in the middle of the eighties in the form of "electronic highways"[1], it was given a relatively chilly reception by some political decision-makers and relegated to the ranks of insipid rhetoric. It re-appeared in the United States, during the Clinton-Gore presidential campaign, as "information superhighways." The phrase caught on like wildfire, not only in the United States where it opened up whole new digital vistas to modern-day argonauts – the "infonauts" – but also in other parts of the world. The European Union took the expression "information highways" on board in the Commission's White Paper on Growth, Competitiveness and Employment, published in December 1993. In Japan in March 1994, the Ministry of Post and Telecommunications (MPT) unveiled a report calling for the launch of a programme to establish an "info-communication infrastructure."

"Everything simple is wrong. Everything complicated is unusable." This aphorism of a French poet sums up perfectly the advantages and incon-

veniences of such metaphors. But the crux of the debate is elsewhere. Information highways, which have now become the first legendary step towards the Information Society highlight three key facts against the backdrop of globalization and economic and social crisis:

- the techno-industrial system has entered a new age, that of information and communication;
- the transition to this new era brings in its wake major industrial and also economic and social challenges;
- the successful accomplishment of this transition requires a fresh equilibrium between the private and public sectors.

Information infrastructures have become a vital area of international political debate and strategic manoeuvres in industry. Companies, both public and private, are preparing to build and use the networks of the next century that will enable ultra high-speed links for voice, data and images. Governments, for their part, are setting objectives, supplying the capital to trigger the process and striving to create favourable regulatory environments. What is striking is the simultaneity of the process in the United States, Japan and Europe to build the information highways that will one day transform our planet into a "global village." In Singapore, the government is supporting several "information superhighway" projects, one of which – Library 2000 – seeks to digitalize and establish simultaneous user access to some 10,000 documentaries, language courses and videos in other areas. However, this is as far as the similarities go. In the United States, the focus is mainly on the regulatory reform required to accompany the strategic alliances which are emerging between telephony companies and cable television operators. In Japan, attention is being given to the strategies which public authorities and industry must implement so that local companies can "catch up" in the area of multimedia. In Europe, the emphasis is on the liberalisation of telecommunications services and the fostering of competition. Elsewhere, in Singapore and also in Canada, there are numerous projects but at a less advanced stage and drawing largely on technologies developed abroad.



A new era for the techno-industrial system

"Technological progress is a determinant growth factor."
Robert Fogel, Nobel Prize for Economics, 1993

In every era, the products on the marketplace fall into a techno-industrial system, operating much like an ecosystem, with its predators, rivalries and symbioses. It teams up with a cultural system in which society perceives and watches itself, rather like a mirror. A glance at history reveals that civilisations tend to stabilise their techno-industrial system in order to preserve their social structures. The staying power of this techno-industrial system – as regards its influence on society and nature – determines the degree of morphological stability.

A substantial technical change, perceived as a major innovation, does not necessarily cause a new burst of industrial transformation[2]. For example, the transition from steam to electricity or oil, the advent of the automobile and the development of the petrochemical and plastic industries did not spark off a wave of transformation throughout the techno-industrial system. Even when inventions are numerous and upgrade quality, they rarely cause a break with the past. For this to happen, certain technical and socio-economic conditions must be fulfilled. When this is the case, a new-age techno-industrial system is born.

The period since the end of the eighteenth century is usually divided into three main techno-industrial eras: the steam age, the steel age and the electronic age. From the seventies, electronics, as a medium for information processing and transmission, have driven modern industrialised societies into the electronic age. The focus of the techno-industrial system has shifted from raw material or energy to time structuring. Universal time, defined by time zones, has been superseded by "world time," determined by the circulation intensity of money (stock exchanges), means of transport (air traffic) and information (computer or telecommunications networks). Instantaneous time transmission unifies space and synchronises the planet in a way that defies calendar organisation systems. To take just one example, the collapse of the New York stock exchange in 1929 took several days to reverberate around the world; whereas the 1987 crash hit all the financial markets of the entire planet in the space of just a few seconds.

Taking a simplified approach, we can postulate that the development of (transport and energy, telecommunications) infrastructure tends to eradicate the space dimension, whereas electronic progress, enabling the programming of events taking place in femtoseconds (millionth of a billionth of a second!), tends to eliminate the time dimension. The primary aim of information and communication technologies is to compress time; in other words, to divide it up into increasingly more finite units. The measurement of time, and the instruments used for this purpose, are the mirror image of any new techno-industrial system and of the social organisation which it underpins. In the electronic age, information highways are the metaphor for a planetary scale organisation of information production, processing, exchange and storage.

In technical terms, the information highway is a fibre optic network that, by the end of the century, will combine the advantages of television, computer technology and telephony. The concept throws up the vision of a "network of networks" to which, by the year 2000, companies and also organisations such as schools, libraries, hospitals and clinics could be connected. Ultimately

The challenges of the information highways are not just industrial. They reflect the social model on the basis of which Europe seeks to forge its identity in the world economy and exercise its ability to respond to economic and social problems.

every individual, regardless of his location within a given area, would be able to access immediately and at an affordable price the entire and vast range of services and information responding to his needs. Eventually, the planet will be a huge network connected by wire or satellite. The vision of Zbigniew Brzezinsky, former adviser to US President Carter, who in the seventies predicted a "technotronic revolution" characterised by the increase in information processing capacities and the acceleration of the transmission speeds and storage capacities of this information, is becoming a reality. A truly planetary consciousness will spring from the establishment, at world level, of bi-directional information highways accessible to all individuals.

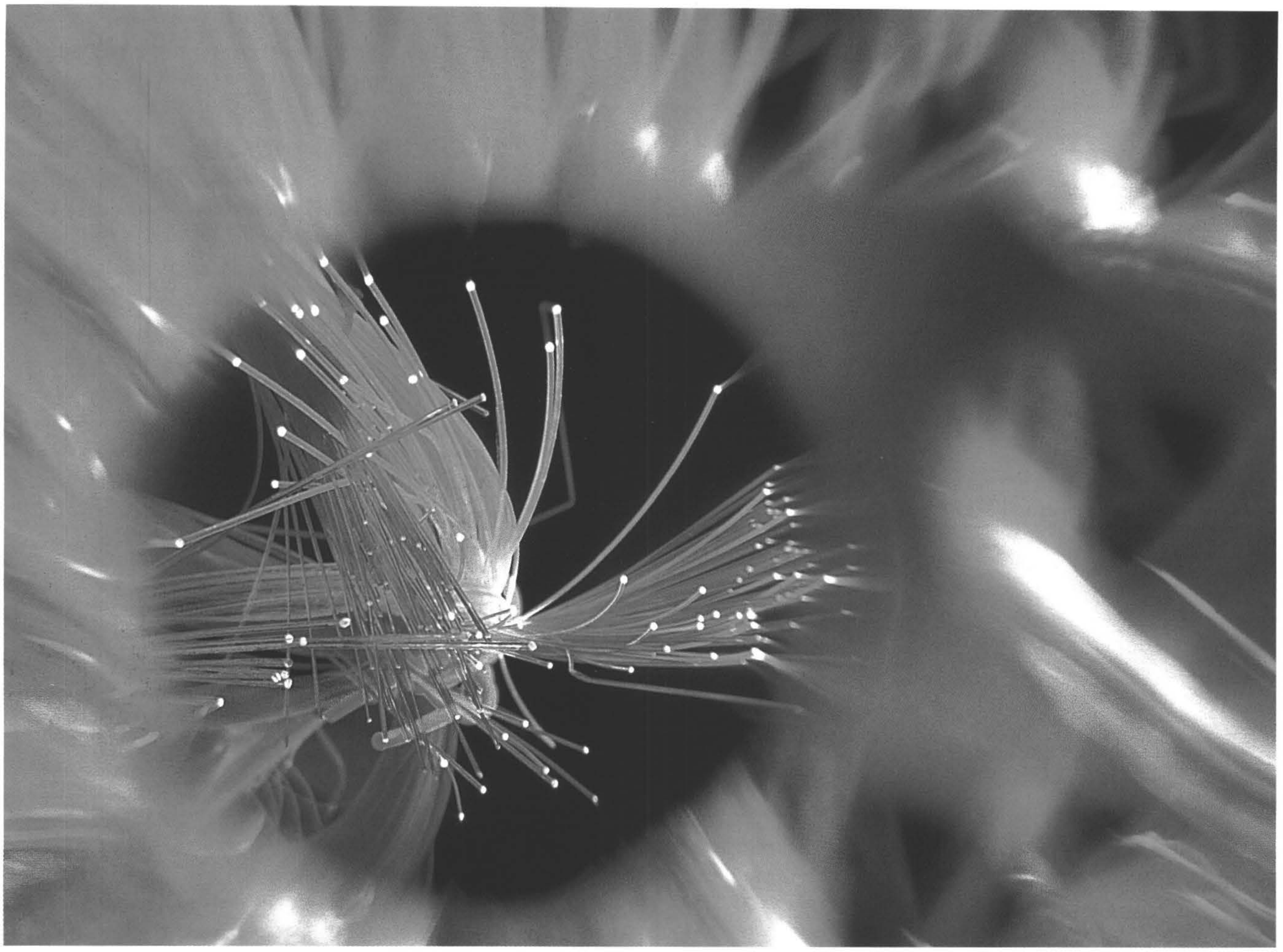
The movement has gathered the greatest pace in the United States. Priority number one of the Clinton Administration for the development of national infrastructure is the trans-continental data "superhighway" (NII programme) for a high-speed, ultrafast computer network. In the field of information circulation, it will assume the role played by the trans-continental railway in the last century or the motorway networks in the last decades.

This is an immense challenge, for over and above the technology, the competitiveness of American companies on the world market is at stake, along with the substantial progress likely in the economic and social spheres.

In the same way as in the past it needed to build motorway networks or airports to link up all the different areas in the country, the United States must now establish the infrastructure to carry digital data. By enabling ultrafast, low-cost broadband data transmission, the digital revolution will transform television, telephony and micro-computing. The United States enjoys the advantage of already being cabled, either fibre optically or coaxially. It also has satellite networks for wireless data transmission and cellular telephony networks. The investment which the private sector must make in order to transform this cabling into an interactive network is consequently affordable ($50-100 billion over ten years).

The prototype of the information superhighway – Internet – was designated by Vice-President Gore himself. The descendant of ARPANET, a computer network set up in 1969 by DARPA (Defense Advanced Research Projects Agency) to enable researchers working in the defence sector to exchange files, Internet is now trying to branch out from the world of research into industry. This network, which operates on the SMTP transfer layer (itself based on TCP/IP), offers a wide range of services – E-mail, forum, file transfer, general information hosts and even videoconferencing. A *de facto* standard offering world cover, it is widely acknowledged that the Internet network has nearly 20 million users throughout the world. It is currently growing faster than any other telecommunications system and should reach the figure of 100 million users throughout the world by the end of the decade. The American Government is supporting Internet via the NSF (National Science Foundation), whose NSFNET network forms the backbone of Internet. The transformation of Internet into a quasi-commercial venture would symbolise what is meant by "information superhighway."

In Europe, there is a feeling of "catching the boat" on time in both the public and private sectors. It is true that there were only three months between the publication in the United States of the basic document on the national information infrastructure and that of the European Commission's White Paper on growth, competitiveness and employment. The first case, however, is an initiative with a precise work programme, whereas the second is a reaction, the scale and impact of which will only become clear in the coming months.



Industrial, economic and social challenges

"The computer will speak, television will listen and the telephone will transmit pictures."
Ray Smith, Managing Director of Bell Atlantic

In February 1994, Paramount, one of the Hollywood giants, was acquired by the American cable operator Viacom, owner of the music channel MTV, after a fierce financial battle with the home shopping channel QVC Network. The merger of Viacom, Paramount and a third player, Blockbuster Entertainment, has given birth to the second biggest multimedia group in the world, after Time Warner. At the same time, in France, the groups Havas, Générale des Eaux and Société générale formed a "shareholders' pact" to gain control of Canal Plus, the only Hertzian pay and encrypted channel in the world. Should the simultaneity of these two events, thousands of miles apart, be seen as pure coincidence? Probably not, for the drivers of these different developments on either side of the Atlantic are the same: technological convergence, market internationalisation, industrial concentration.

The challenges raised by the information highways are first and foremost industrial. The telecommunications, computer and audio-visual industries are experiencing the effects of the rapid and continuous change that epitomises information and communication technologies.

In the United States, flux within industry is particularly visible. Cable operators face competition from local telephone companies which, thanks to major progress in signal compression, can transmit images and a wide range of telematic services into American homes via their copper or coaxial networks. However, this is not enough to achieve interactivity. As a consequence, the telephone companies, both regional and national, are investing in a new fibre optic backbone. Cable operators, who do not enjoy the same resources, are rushing to install fibre optic cables in subscribers' homes or are concluding strategic alliances with telephone companies for the turnkey installation of coaxial connections, sufficient for short distances.

The regional telephone companies have a strong hand in this industrial reshuffle, thanks to their networks and millions of subscribers. Their strategy revolves mainly around alliances with cable operators. For example, US West has invested in Time Warner (May 1993). For their part, the five biggest cable television companies (Tele-Communications Inc., Cox Cable Communications, Continental Television, Time Warner and Comstat) are developing new advanced telecommunications services – notably videotelephony – with the assistance of the Teleport Communications Group[1]. This network dimension is teamed up with a computer dimension for data digitalization and the supply of host computers which can carry the programmes. This is why some major computer companies are involved in alliances and strategic projects for interactive television and multimedia networks.

It must be emphasised that the private sector began adapting to the new competitive environment well before the launch of the NII programme. The following anthology gives a very incomplete picture of the initiatives taken by the private sector since the beginning of 1993; however it does illustrate the scale of the phenomenon.

As early as February 1993, Southwestern Bell, one of the seven regional telephone companies, set the tone for the race into capital investments, acquisitions and joint ventures, by announcing its decision to acquire 650 million dollars' worth of cable television systems from Hauser Communications.

In March 1993, AT&T, DEC and the Massachusetts Institute of Technology (MIT) formed a consortium with the aim of studying the use of fibre optic transmission capacities to improve the American national information network and notably create an information superhighway. The consortium has received $8.4 million in aid from the Defense Advanced Research Projects Agency (DARPA).

The cable operator TCI announced, in April 1993, a $2 billion investment programme for the fibre optic modernisation of networks in over 250 communities by the end of 1996. TCI's announcement came just a few days after Pacific Bell unveiled its plans to make a broadband network available to all homes in California before 2015.

For their part, the regional telephone company US West and Time Warner, the world's biggest communications group, announced in May 1993 the conclusion of an agreement for the constitution of a vast network, giving clients cable access, from home or office, to all the information and data currently available from either group. This alliance should pool the know-how of Time Warner in the area of leisure programmes, US West's skills in the area of telephone-accessible services and, in addition, Toshiba's talents in the area of consumer electronics. Through being able to use Time Warner's coaxial cable and offer its customers connection to the long distance telephone network, US West becomes a serious competitor for the other regional companies in areas where Time Warner clients are to be found.

In the near future, Time Warner will run a trial project for the connection of around 5,000 homes in Orlando (Florida) to a supernetwork for both individuals and businesses, capable of simultaneously carrying television programmes, communications and computer data. Time Warner is hoping that this experimental scheme will validate its technological choices, particularly the adoption of a mixed approach, combining fibre optics for the major axes with coaxial cable for local subscriber service (representing 75% of the investment). Real-scale operation could begin as early as end 1995.

In June 1993, GTE Telephone Operations announced that it was to invest 240 million dollars over three years in the building of 50 fibre optic highways in twelve states. GTE is to purchase its SONET equipment from AT&T (80%) and Northern Telecom. GTE has declared that it will invest 170 million dollars in SONET electronic equipment and an additional $70 million in the purchase of fibre optic cables. In January 1994, the company moreover announced that in the framework of a five-year deployment plan for ATM technology in areas where there is strongest demand for high-speed communications, it would begin the installation of around 60 ATM exchanges in 13 States.

In October 1993, the regional telephone company BellSouth acquired a 22.5% holding in the capital of Prime Management, a company which manages cable television systems servicing over 500,000 subscribers. This announcement was overshadowed by the signature of a draft merger agreement between Bell Atlantic, TCI and Liberty Media.

This mega-alliance, which would have represented an investment of around $33 billion and made Bell Atlantic one of the biggest communications companies in the world, was broken off four months later.

The interest of this event lies in its instructive outcome. On paper, it seemed like the ideal marriage: Bell Atlantic contributed its exceptional financial resources and its dominance of the telephone connection market on the east coast of the United States; TCI supplied its cable television know-how, its knowledge of interactive networks and major holdings in several programme companies (e.g. Turner Broadcasting, Discovery Channel, QVC Network). Together, Bell Atlantic and TCI would have reached 42% of American homes, enabling them to wield considerable influence over a nascent market with high growth potential.

But by transforming itself from a telephone company with stable revenue (+4% on average turnover growth between 1988 and 1992) to a company hedging its bets on a uncertain and capital intensive industry, Bell Atlantic lost the confidence of its investors. As a consequence, its stock exchange value fell by around a quarter. TCI was brought to book by the cable industry regulators who imposed a cut in its rates affecting its main source of revenue. Its share price plummeted by 30%.

What was initially seen as one of the marriages of the century, between the world's 10th telephone operator and its biggest cable operator, collapsed due to mundane differences over the evaluation of the two companies. Shortly afterwards, however, TCI found consolation by teaming up with Microsoft for the creation of an interactive network giving PC users direct access to computer and home shopping services on cable.

In January 1994, MCI Communications, the American no.2 in long-distance communications, announced that it was to invest over $20 billion, with other partners, in the creation of an international fibre optics network which will be able to carry traditional telephony, video programmes and computer data. This network will be accessible throughout the United States by the end of 1994 and on the MCI networks across the Pacific and Atlantic by the end of 1995. Its capacity will rise from the current 2.5 gigabits per second to 10 gigabits per second.

In February 1994, the regional telephone company Ameritech announced its intention to spend $29 billion over the next fifteen years to improve its network and build data highways.

Information highways also raise economic and social challenges. The interconnection of networks (cable, satellite, modernised telephone) will give rise to new interactive multimedia services, irrigating the entire world economy. Interactivity opens up new vistas both for the general public and for companies. Individuals will be able to guide their trolleys through the alleys of a virtual supermarket and do their shopping without leaving home, reserve a theatre seat by "visualising" the theatre and "sitting" on their seat before choosing it, not to mention the many other telematic services made more attractive by the multimedia dimension. At professional level, there are numerous and already very advanced applications, particularly videoconferencing and homeworking.

In addition, the new infrastructure will make it possible to have a medical diagnosis without leaving home, thus reducing expenditure on health care; in the area of education, it will culminate in new concepts of "wall-free" schools and life-long education, training people for the six or seven careers which they will have throughout their life. In the final analysis, the transition from an analogue to a digital society will decentralise decision-making and increase flexibility.

US President Clinton has best summed up this global vision of telecommunications networks:

"We must work with the private sector to connect every classroom, every clinic, every library and every hospital in America to a national information highway by the year 2000. Instant access to information will increase productivity, help educate our children and provide better medical care and create jobs. I call on Congress this year to pass legislation to establish the information superhighway."[4]

Japan and Europe are not standing by the wayside. In December 1993, the United Kingdom inaugurated its first broadband data communications highway; a Switched Multi-megabit Data Service (SMDS) built by BT. Two months later in France, an interministerial committee appointed Mr Gérard Théry, former director general of telecommunications, to draw up for presentation in June an analytical report on information highways culminating in proposals for measures.

In Germany, the telephone operator Deutsche Bundespost Telekom, the Bertelsmann group, the film distributor Leo Kirch and the public channel ZDF have joined forces with a view to breaking into the pay-TV market through the creation of the company Media Service.

The United States has already acquired a substantial advantage on the psychological level. The programme to establish a national information infrastructure, made public in September 1993, clearly lays down a global vision of how the economy and society will evolve:

"The benefits of the NII for the nation are immense. An advanced information infrastructure will enable U.S. firms to compete and win in the global economy, generating good jobs for the American people and economic growth for the nation. As importantly, the NII can transform the lives of the American people – ameliorating the constraints of geography, disability and economic status – giving all Americans a fair opportunity to go as far as their talents and ambition will take them."

This is indeed a vision of a bright future, where the new information and communications technologies will be at the service of companies (making them more competitive on the world market), the nation (making it more prosperous) and citizens (increasing their sense of independence).

Public sector/private sector: in search of a new equilibrium

"There is no path. You must trace your own path step by step."
Antonio Macado, Spanish poet

The main theoretical justification for state intervention in the creation of a country's infrastructure is that the private sector will not invest in something when it cannot reap all the benefits from it.

United States: deregulation and open competition

In the United States, where industrialists are used to defining their own products and markets, the intervention of the public sector is viewed with suspicion. Some fear that if the federal state puts money into something, it will end up also defining the products that should be experimented. Others maintain that if there is no federal State contribution, the big companies will just carve up the market between them, pushing out both smaller operators and more especially some categories of users which the superhighway is supposed to serve across the country: schools, universities, public administrations, hospitals and clinics, American homes. In any event industry must take a leading role in establishing the national information infrastructure. It is industry which will build and manage the networks, supply the information tools and the bulk of the information transiting through the networks and develop most of the applications using the networks.

Vice-President Gore has on numerous occasions confirmed the intention of the US government to foster integration of industries in the telecommunications sector by abolishing the legislative and regulatory barriers separating the telephone industry from those of cable television and programmes. The funds which the US Administration intends distributing under the NII programme are modest ($1.2 billion p.a.) compared with the substantial investments which only the big telephone or cable operators can afford to make. But in the United States, the main stranglehold on the establishment of an information superhighway is not financial, but legislative and regulatory.

Regional telephone companies do not have the legal right to use the regional exchange, supply information services or sell audio-visual programmes on their own territory (1984 Cable Act). Similarly, long-distance telephone operators cannot use local telephone networks.

Cable operators, which at present cannot sell telephone services, are beginning to invest in the market. The NII programme is thus seen as a godsend by all of these companies which, in return for a loosening of the regulations, have agreed to build interactive broadband networks at their own expense[5]. This implicit deal is the key to understanding the challenges inherent in the NII programme.

In January 1994, the American Administration published a White Paper on the reform of telecommunications regulations. This is the biggest reform of the telecommunications sector since the break-up of the AT&T monopoly in 1984. Several questions are tabled, notably cable-telco cross-ownership, competition on local services markets and the restrictions in the Modified Final Judgement (long-distance services, information services, manufacture and R&D).

The new regulations will make it possible for long-distance telephone companies, such as AT&T, MCI or Sprint, to compete against the "Baby Bells" that currently enjoy a monopoly in local communications. A telephone company will also be able to foray into the cable broadcast of television or video programmes. However, for at least five years, it will not be able to purchase a cable company operating on the same territory in order to prevent the constitution of regional monopolies.

Japan: closing the technological gap

When the concept of information highways first became a discussion topic for the apprised few, before graduating to a subject for public debate, two main players were in the arena: the United States and Europe. For the first time in twenty years, Japan appeared absent from the club of countries holding the future of the world electronics industry in their hands.

In 1993, it became assumed knowledge that the history of the digital industry would be written by the new companies born of the convergence of telephone, computer and television. AT&T, Bell Atlantic, US West, TCI, Time Warner and a few other American firms would combine their forces, resources and talents to invent a new industry and, subsequently, disseminate a new "Americanised" culture throughout the world.

Europe, it was thought, stood a chance of being admitted to the club: its telecommunications industry is in the process of being liberalised, its know-how in the area of image synthesis is internationally recognised and its industrial groupings are powerful and varied. Moreover, the concept of trans-European networks, written into the Maastricht Treaty and as described in the White Paper, could easily be paralleled to the information highways.

Japan, on the other hand, while still leading the field in all other categories of electronic hardware, found itself suddenly pushed into the shadows on the world stage by the shift from a "material" to an "immaterial" society, where the added value of products and services has switched to the software and information content. This impression that the Japanese electronics industry was slipping from dominance was heightened by the fact that American companies had re-gained the upper hand in the micro-electronics sector and that the Japanese high definition standard Muse, developed by NHK and the audio-visual industry with ten years of advance on the West, seemed to have been relegated to the museum of technological wonders for which no market exists.

This apparent decline in the Japanese electronics industry was paralleled by a certain falling off in Japanese economic power overall: collapse of the property and stock markets, the bite of recession, loss of company competitiveness and plummeting profits due to high valuation of the yen. Will this situation prevail?

Nothing could be less certain, for the Japanese still have key assets, notably the ability to combine a qualified workforce with innovative companies capable of fierce competition in an essentially private market. Furthermore, the Asian-Pacific Economic Cooperation (APEC) meeting in November 1993, Seattle, symbolically marked the emergence of an Asian-Pacific area, home to half the world's trade and industrial output. There is no doubt that in the medium term, Japan will be able to draw on this highly integrated area – members' trade is 66% with one another, compared with 60% for the European Union – to come back in force.

In the meanwhile, Japan has no intention of being left by the wayside on the information highways. The Japanese Ministry of Post and Telecommunications (MPT) has set up an ad hoc Telecommunications Council, charged with making recommendations to MPT on the launch of a programme to establish an "info-communications infrastructure." This new infrastructure – in fact a much more extended fibre optic network which will eventually be able to serve each subscriber (Fiber to the Home) – would create jobs and raise the Japanese standard of living. Some estimates predict that it will create a vast market and, more especially, 2.4 million new jobs.

The establishment of such an infrastructure requires substantial investment: 33 million billion yen between now and 2015 according to the MPT, 36 million billion according to the Institute for Post and Telecommunications Policy, 45 million billion according to Nippon Telegraph and Telephone (NTT).

In April 1993, NTT announced that it was to spend a similar sum on the establishment, by 2015, of a new national telecommunications network in fibre optics. The project seeks to extend the communication possibilities enjoyed by home and industry, enabling faster connection times and services combining telephone, television, fax and computer. More specifically, the fibre optic network should lead to the development of advanced scanning services in the fields of medicine, bi-directional television, electronic newspapers and a wide range of multimedia communications.

Japanese industry is redeploying its forces in preparation for the advent of the "info-communication" age. It fears in fact that American competitors will take advantage of their technological advance to snatch up all the patents.

Fibre optics were first developed in the sixties by an American company, Corning Inc, and it was only at the beginning of the eighties that NTT began laying fibre optic cable in Japan. Since then, one-third of the 194,000 km of cabled lines between cities have been converted from metallic wire to fibre optics. NTT, which invests 280 billion yen a year in research and development, enjoys valuable assets in the shape of its twelve laboratories employing in all 8,500 researchers. While it severely lacks software engineers, it is planning to recruit at least 2,000 graduates in 1995 compared with only 800 this year in preparation for the "Age of Multimedia."

Moreover, in January 1994, NTT decided to acquire 0.9% of the American mobile radio company Nextel Communications, costing 75 million dollars. Under the terms of this strategic alliance, the Japanese operator will help Nextel to introduce its first high speed digital mobile radio service in several American cities. Along with other US companies such as General Magic and 3DO, Nextel is at the core of the strategic alliances currently emerging and revolving around multimedia. NTT and also industrial groups such as Sony and Matsushita Electric form part of these alliances.

Again in January 1994, NTT entered an agreement with a foreign software company, General Magic, for the first time. In doing so, it joined Apple, AT&T, Motorola, Matsushita and Philips. NTT is thus aspiring to a technology which could one day become the *de facto* industrial standard for portable multimedia communications.

For its part, NEC announced in January 1994 that it was to relocate production of ATM systems to its Oregon factory in the US. This move should make it possible to neutralise the effects of a rising yen and avoid any bilateral trade conflicts in a sector as sensitive as telecommunications. At the same time, NEC is offering a supplier service to regional American companies. It is worth bearing in mind, at the time when industries and technologies are converging, that firms such as Sony, Mitsubishi and Matsushita have made substantial investments in the United States in the past five years, a strategy which should boost their competitive position on the emerging multimedia market. Thus, for example, Sony has taken over Columbia Pictures and CBS Records, whereas, for its part, Matsushita has purchased MCA, owner of Universal Studios and three big record companies. Matsushita has also teamed up with AT&T and Time Warner to launch a multi-record interactive turntable in the United States, designed as an access point to "electronic highways."

Europe: between fascination and quiet confidence

Caution must be the watchword when comparing the respective strategies of American and European companies in the area of information highways. First of all, telephone and cable markets in the United States are closed entities, since telephone companies are not allowed to offer video services. In addition, American cable operators are heavily in debt, whereas telephone companies for the most part have healthy finances. Each of the protagonists is trying to break into the other's market, often through alliances.

The situation is very different in Europe. For example, Deutsche Bundespost Telekom has over 13.5 million cabled subscribers, more than TCI, the biggest US cable operator (11 million). France Telecom is the third biggest French cable operator, behind Générale des Eaux and Lyonnaise des Eaux-Dumez, with around 210,000 subscribers. It is moreover already present on the multimedia market, with 6.5 million Minitels installed. For its part, BT could soon be the first European telecommunications operator to launch itself into interactive television channels, provided that the British Government relaxes the restrictions placed on BT's activities until the beginning of next century in order to allow cable operators to grow.

Several initiatives have been launched by network operators in recent months to develop pan-European networks. Mention can be made of EURO-ISDN, aiming at the introduction of ISDN making possible terminal and application portability on a European scale; ATM-Pilot, a consortium involving several public network operators, seeking to pool experience on ATM technology and assess the reaction of users to trans-European broadband services; METRAN, a service transmission network operating at up to 140 Mbits (operational start-up: beginning 1995); GEN (Global European

Network), a network operational since April 1993 and using fibre optics to operate at speeds up to 140 Mbits. These industrial initiatives are in the same fields as those tackled by Community initiatives, particularly through the RTD programme RACE. The two sets of initiative are obviously complementary and fully coordinated.

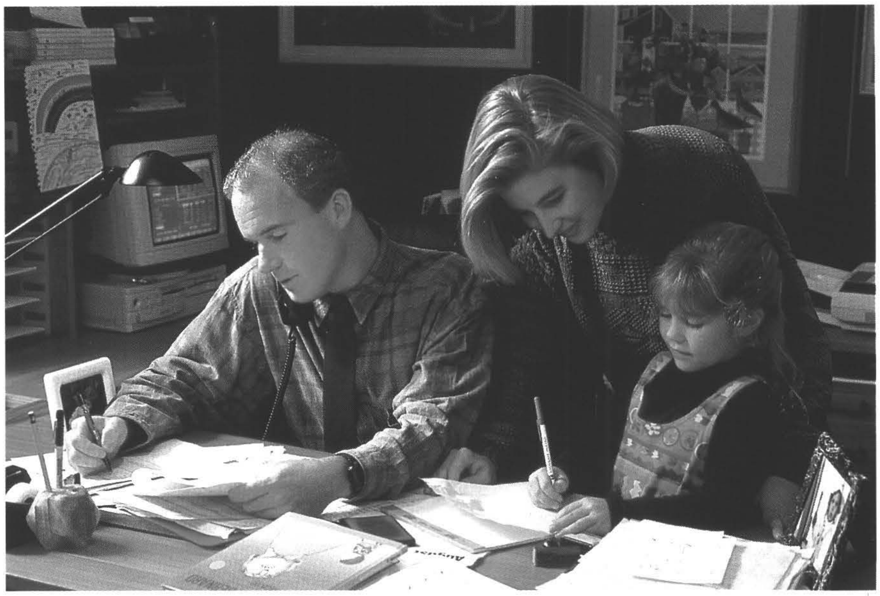
The concept of building information highways across Europe falls in with the aspirations of the White Paper to relaunch economic growth, boost industry's competitiveness and sustain job growth. Yet the conceived scope of trans-European telecommunications networks must stretch beyond the current boundaries of the European Union. In the coming months, new countries could join the Union and thus demand the advantages of such infrastructure. But why stop there?

At a time of confused, and sadly sometimes violent, re-distribution of the geostrategic cards in the Central and Eastern Europe, the public authorities and industry of the European Union could use information highways to send a message of solidarity and hope to their Eastern neighbours. With a little audacity and imagination, the information highways could build bridgeways between the two parts of Europe separated by nearly a century of history, economic growth and cultural development.

Industry is already rising to this challenge. For example, in January 1994, Deutsche Bundespost Telekom inaugurated its information highway, Trans European Line (TEL), which will link its telecommunications network to that of the countries in the other part of Europe thanks to 14,000 kilometres of fibre optic cable.

In the next ten years, at least 150 billion ECU will have to be brought into play. For its part, the White Paper identifies nine priority projects, representing an outlay of 67 billion ECU over the period 1994-1999. The bulk of this must come from private investors, with national and Community authorities providing marginal financing and incentives.

There is much debate about the question of financing within the European Union, probably due to its political and ideological diversity. Those who favour market liberalism believe that the abolition of monopolies will suffice to channel private investment into infrastructure projects. Companies would set their priorities on the basis of purely economic criteria, i.e. according to what



they perceive to be the most profitable investment opportunities. The need to coordinate investments would fall away, for operators would be free to deploy their activities throughout the Community. Such an approach, maintain its advocates, is the only efficient one because public expenditure, regardless of whether it is financed through taxation or through borrowing (which amounts to differed taxation), in the final analysis only displaces jobs rather than creating new ones.

We will not go into this debate which, its simplistic approach aside, at least has the merit of suggesting the need for a new balance to be struck between the public and private sectors. However, it is necessary to clarify what is at stake.

Be it the NII programme, trans-European telecommunications networks or the Japanese info-communication networks, the required investment is huge. The education or health care markets are not capable of such a financial effort. In actual fact, the markets which can support the development of these infrastructures are at the other end of the scale of social priorities: video-on-demand, home shopping, video games, etc. There is no doubting that the opening up of these profitable markets to a maximum of private investors can contribute to the achievement of information highways. But in fields not seen as priorities in market logic terms, such as telemedicine, teletraining and even some forms of home working, public intervention is indispensable.

The advent of the electronic age described above creates a responsibility for public powers to remove the obstacles preventing the European economy from making the necessary structural adjustments: unadapted legal framework, inadequate management of intellectual property rights, fragmented markets preventing economies of scale, insufficient standardisation, critical mass which is difficult to attain for the new generic services and applications, human and cultural obstacles, etc.

It is the task of the information highways to facilitate the transition to the electronic age, for example by helping to bring health care costs under control, solving road and air traffic congestion problems, generating new productivity gains (better service quality at a reduced cost) and enabling greater flexibility in the workplace and better skill use.

Another, perhaps even more fundamental, debate is unfolding in Europe. It expresses on the one hand the fascination which the American concept of information highways exercises on Europe and on the other its quiet confidence in the assets already under its belt. The crux of the issue is whether Europe, like the United States, should encourage the private sector to invest massively in new electronic highway infrastructure or whether it should simply push evolution in the existing infrastructure to enable the development of new services in much less costly economic conditions. The pragmatists maintain that Europe already has advanced telephone, ISDN-type digital networks, cable and satellite infrastructure. All these information media, based on existing or rapidly installable hardware, could be combined to improve, create or experiment services which would, on installation, have a wide audience. In other words, simply by modernising the infrastructure of existing networks and mobilising its resources and talents, Europe could do at least as well as the United States (or Japan), while spending a great deal less. At the other end of the scale, those advocating a purposeful approach to this question believe that close cooperation between the public and private sectors is vital to promote a new network infrastructure contributing to the all-round competitiveness of Europe – industrial, economic and institutional – in the emerging world economy.

The White Paper takes the middle line between these two approaches. It places the emphasis on the economic and social progress which the establishment of electronic highways, the nervous system of the common information area, could generate for the Union. The main constituent parts of these electronic highways are trans-European networks, the importance of which the Commission has been stressing since 1989. Before the publication of the White Paper, three types of trans-European network were earmarked for Community support: the EURO-ISDN network (TEN-ISDN), broadband networks (TEN-IBC) and the telematic network between public administrations (TNA-IDA). The White Paper proposes taking into consideration six new fields, either consisting of generic services or applications of collective interest. In some fields (ISDN, E-mail, data base access), implementation stage was reached some time ago but the national situation still varies a great deal. Efforts must therefore be continued to standardise and implement operational and inter-operable services at Community level.

On the other hand, the other trans-European networks proposed will be achieved thanks to Community R&D activities successfully conducted up to the stage of pilot project implementation. While further research is still needed, the results already achieved and validated make it possible to move on to large-scale implementation. By drawing simultaneously on the infrastructure of existing networks and the most recent results of research conducted at Community level, this approach enables the establishment of information highways responding as far as possible and in a differentiated manner to the needs of different user categories. In the areas of collective interest identified by the White Paper, public intervention in the form of funding of pilot projects is vital in order to provide the impetus necessary for the establishment by the relevant operators of the networks, services and applications envisaged.

The line taken in the White Paper is that information highways should meet the criterion not just of "universal service," but also above all of "public service." In the first case, the aim is to ensure that everyone enjoys access, at affordable prices, to services with a high market penetration rate (telephone); in the second, it is to guarantee the availability of services, possibly multimedia, whose markets fall well short of attaining a critical mass. This concept of "public service," justifying partnership between the public and private sectors, is the defining feature of the European vision of information highways.

How can we forget that the challenges of the information highways are not just industrial or strategic? They are also cultural, and reflect the social model on the basis of which Europe seeks to forge its identity in the world economy and exercise its ability to respond to economic and social problems. If we are to ensure that the electronic age does not give rise to a society where personal time is filled with boredom and the storage of merchandise, taking over from direct contact between individuals, Europe must re-think the way in which it uses technology and the time freed by it. The electronic age and its latest metamorphosis, the Information Society, present Europe with a truly fundamental challenge. ■

G Santucci *DG XIII*

[1] See, for example, Richonnier, M. (1985), *Les Métamorphoses de l'Europe*, p. 104.

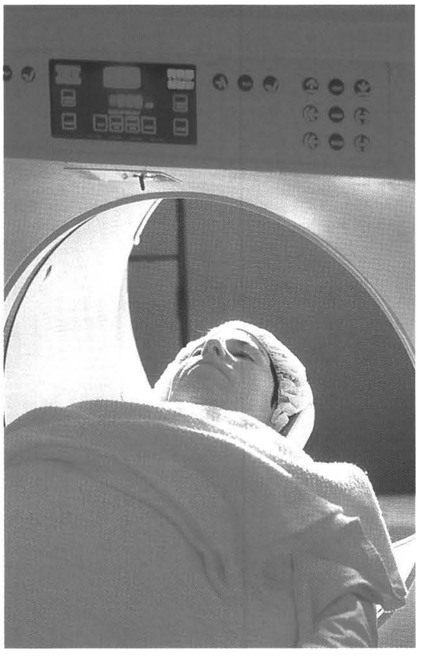
[2] For an in-depth analysis, see for example Humbert M. (1993) *L'Europe face aux mutations mondiales*, Economica, Paris.

[3] Teleport, which competes against local telephone companies, has for the last ten years been offering business clients access to fibre optic telephone networks in eleven city metropolitan regions.

[4] State of the Union address, January 25, 1994.

[5] In April 1993, the regional telephone companies declared to Vice-President Gore that the lifting of the restrictions in the "Modified Final Judgement" (MFJ) would enable them to invest $125 billion between now and $2000 and $450 billion between now and 2015 in wireless telephony, digital switching and transmission and fibre optics.

Information highways should meet the criterion not just of "universal service" but also above all that of "public service."



"Information highways"... to where? Some telematic responses

For a little more than five years, a range of Community actions in telematics has provided some idea of the socio-economic applications which information highways will make possible.

A GREAT PUBLIC debate on "information highways" opened up in Europe towards the end of last year. These "highways" inspire both enthusiasm and scepticism, prophetic fervour and words of warning. One thing is certain: the intensity of these debates reflects the way in which Europe intends to mobilise.

Paradoxically, however, it is noteworthy that until now questioning has focused less on the purpose of electronic highways than on the means to be used to build them. Whether we like it or not, their actual purpose is still quite hazy. On the one hand an almost ideal society is conjured up, straight from scientistic dreams of the last century: the "global village" and "global" economy will soon be within the reach of an integrated terminal; and on the other, the happiness the "multi-media" bestow on us seems limited to the joys of teleshopping and choosing between thousands of audio-visual programmes from your sitting room. Certainly it's a safe bet that one of the market levers will be leisure services (the nebulous area of entertainment), but will that be the only purpose of the information revolution?

As for the debate on the advantages electronic highways will give to key figures in the economy, this usually conforms to a traditional view, oriented essentially towards increasing competitiveness.

The use of technologies, of which we expect simply that they will introduce our societies to a true new era – the information era – assuredly calls for in-depth consideration and raises many questions. Will our societies merely undergo and conform to this new technological transformation, as has generally been the case since the industrial revolution of the 19th century? Conversely, because it is unprecedented, is this change not a dream opportunity to adapt information and communication technologies to the essential needs and urgent requirements of our societies? Is this not an opportunity finally to take control of a range of technologies which up until now tended to impose their rhythm on us rather than to follow ours?

Either these technologies will continue to be used mainly in a traditional economic perspective – i.e. within an exclusively productivist framework – in which case the likelihood is of an increase in the imbalances our societies already suffer from; or they will be used to their fullest potential, thereby taking up the many economic and social challenges of the end of the century.

This is not an ambition based only on a few vague ideals. For a little more than five years now, a range of Community measures in telematics has provided some idea of the socio-economic applications which information highways will make possible. Not only do these community measures form a basis for reflection, but they also offer a field for experimentation. Over the next four years the new Community Programme for Telematics will widen the sphere of action already taken and increase the applications. This deserves to be looked at in detail. But first, a brief historical overview will not go amiss.

Community experience and the new programme for telematic applications

Since 1988, the second Community framework programme for research and technological development (RTD) has launched three exploratory measures – DELTA, DRIVE and AIM[1] – whose aim was to evaluate the extent to which information technologies could be

applied to the respective fields of home study courses, road transport and health care.

With a view to promoting the development of trans-European telematic networks and services, the third framework programme for RDT Community measures (1991-1994) proposed a "specific programme for the development of general interest telematic systems." It comprised seven areas, which included the themes of three pilot programmes: administration, transport services, health care, home study courses, libraries, research and language engineering, telematics development in rural areas. A total budget of 424.7 million ecus was allocated to this.

On this basis and within the new framework programme (1994-1998), on 10 March 1994 the Commission proposed a "specific RTD and demonstration programme in the area of common interest telematic applications."[2] Its budget is 843 million ecus and activities will focus on nine application sectors, based around three main areas:

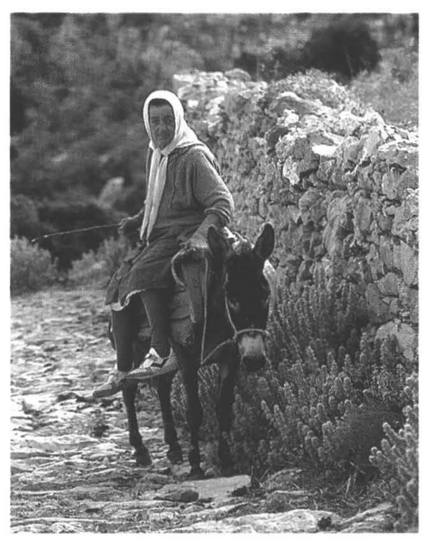
- administration, health care and transport (road transport but also air, sea, river, rail and "multi-modal" transport);
- serving research, education and training, libraries;
- urban and rural areas, handicapped and elderly people, environmental protection.

A fourth area is added, which comprises RTD activities in telematic engineering, information engineering and language engineering.

This new telematic programme is clearly oriented towards applications, as an outline of its implementation shows. First, the concrete needs of the many user categories involved in each of the spheres of action (from elderly and handicapped people to air traffic controllers) must be identified.

Second, these needs must be translated in telematic terms; i.e. a range of functional specificities must be defined which respect the common requirements of users involved and allow interoperability of equipment and services on a European level.

On this basis, "demonstrators" must then be provided, as part of an RTD activity which would attempt to integrate



four elements: generic networks (e.g. high-speed optic fibre or satellite networks), generic equipment (multimedia work stations, portable means of storing and processing data, etc.), generic services (electronic mail, remote access to data or knowledge, possibility of interactive simulation and virtual environments), specific hardware and software.

The fourth stage will consist in validating these demonstrators in a real situation with groups of users, involving the competent public and private institutions more closely than in the past in order to facilitate dissemination of these new telematic applications.

Lastly, validated applications will be accompanied by a plan for the utilisation of results, recommendations to the standardising bodies and to legislators, and guidelines for monitoring implementation of these applications.

Thus it is a question of putting the telematic revolution on European rails – in the spirit of the European Union Treaty which gives fundamental importance to infrastructures, including telecommunications infrastructures, in order to allow citizens of the Union, economic players and regional and local authorities to fully benefit from the advantages of an area without internal borders (cf. Heading XII of Treaty).

Telematics at the core of social changes in Europe

How can the telematic revolution help Europe not only to develop its environment but also to meet the challenges of the end of this century?

Whereas for the last twenty years or so the electronic revolution has been mainly in the productive sphere (consumer goods, manufacturing processes, tertiary industry, etc.), the years ahead will be characterised by the development of networks which should ideally allow everyone to access – any time, any place – multimedia and interactive services and applications. Essentially, telematics is destined to spread, not only in companies but in society as a whole. It should bring about significant changes, both in the way we work and in the way we organise our lives.

Telematics is thus a versatile tool: parallel to its beneficial effects on competitiveness, economic growth and job creation, it can also help our societies find solutions to its most acute problems, e.g. in the areas of education and training, public health, transport or even the isolation of people in urban and rural areas. In short, it can contribute to improved living conditions.

The framed text in this article gives a brief overview of what telematics can contribute in the respective areas of health, road traffic management and training. The aims defined by the new telematic programme for *"employment and improvement in living conditions"* particularly reveal the structuring abilities of telematics. This sphere of action has three priorities: to encourage better town and country planning, to increase the independence of elderly and handicapped people, and to ensure better protection of the environment. Let us have a look at this in more detail.

With regard to **town and country planning**, the ORA exploratory measure of the Third Framework Programme has shown that rural areas no longer benefiting from an economic, social and cultural infrastructure, attractive for companies and citizens, can partly overcome this handicap by means of telematic systems and services. These services can optimise the professional environment of companies, enrich the quality of life of the entire population and create jobs thanks to home working. Many urban areas where activities are declining or underprivileged areas of large cities today suffer from similar handicaps; they should also be able to benefit from these new tools.

The aim of the telematic programme is to encourage new economic activities, to reinforce traditional activities and improve the quality of life, both in underprivileged rural and in urban areas. Companies which are set up in these areas will have remote access to basic services: databases, maintenance, assistance, professional training; in addition, people living in these areas will be able to avail themselves of nowadays essential services for medicine, training and culture as well as of social services. Telematics will also have the benefit of curbing the exodus to large urban areas, decreasing congestion in towns and encouraging people to move to rural areas.

TIDE exploratory measures taken by the Community since 1991 have shown that information and communication technologies can be expected to provide answers meeting the specific needs of **handicapped and elderly people**. The aim of the telematic programme for the next four years is to help improve the independence and living conditions of these people, as well as to facilitate their integration into society.

Work carried out will be based around two main areas: access to telematic services and "functional compensation," i.e. making available equipment and services which compensate for handicaps.

The first case will, for example, involve developing interfaces and equipment facilitating access to home working, home study courses or cultural problems. Functional compensation will mainly involve developing systems to improve the mobility of individuals, their potential for interpersonal communication and their ability to deal with their immediate environment (alarm and orientation systems, etc.)

The third aim of the "Employment and improvement of living conditions" action line involves exploratory measures regarding the **environment**.

Research activities will focus on a variety of applications for monitoring nuclear power stations, chemical factories, pollution and the prevention of natural catastrophes. Particular importance will be also given to the development and interconnection of networks for the prevention of these risks.

Parallel to its beneficial effects on competitiveness, economic growth and job creation, telematics can also help our society to find solutions to its most acute problems . . . it can contribute to improved living conditions.

Either information highways will be developed unimaginatively or they will form one of the preferred ways of organising our societies and of fully benefiting from the information revolution.

Choosing our future

These examples of the application of telematics bring us back to the initial question: electronic highways – to where?

Never before have our societies spent so much on education and training, but never before have criticisms of the social performance of teaching been so severe. Never before have our societies given so many resources to health, to the point of reaching the limits of state budgetary capacity. Never have our societies spent so much on offsetting the consequences of social problems, and yet the number of people living in precarious conditions continues to increase. Paradoxes of this kind are legion and new social requirements are enormous. These requirements need, furthermore, to be met in the very short term. Thus, in the area of training (see framed text), the number of professional training days required to meet the needs of employees is estimated at a minimum of approximately 1 billion; the reintegration of unemployed people requires a similar number.

Clearly, technologies alone will not enable society to take up these challenges; but instead of our submitting passively to the economic and social changes of the end of the century, technologies enable us to control the rate and effects of these changes. Either information highways will be developed unimaginatively, in an economic context which shows its limits. Or else these highways will form one of the preferred ways of reorganising our societies and of fully benefiting from the information revolution. They offer the young European Union a unique opportunity to direct its future. It is up to society as a whole – industrialists, citizens and political decision-makers – not to miss the boat. ■

Y Domzalski *DG XIII*

1 DELTA: Development of European Learning through Technological Advance
AIM : Advanced Informatics in Medicine
DRIVE: Dedicated Road Infrastructure for Vehicle safety in Europe

2 If the Council of Ministers adopts the programme in June, invitations to tender may be launched on 15 September. If there is any delay they will be postponed until 15 December.

TELEMATICS SERVING HEALTH

All countries are today confronted with two major challenges in health care. On the one hand, it is imperative that the increase in expenditure be controlled: in some countries it represents over 10% of the GDP. On the other hand, medical professions must be helped deal with the increasing complexity of knowledge required. Medical telematics provides appropriate answers to these problems.

First of all, it can improve the organisation and management of health care. At the core of a medical telematic system is the *computerised medical file*, which contains all data and medical plates for each patient. Telematic links between the various parties involved (general practitioners, laboratories, hospitals, social security bodies) allow efficient and reliable management of the health system, on the one hand reducing the necessity for traditional "paper" media and on the other hand avoiding costly or even dangerous repetitions of medical examinations.

Examinations and medical treatment will also be provided at lower cost and in better safety conditions, thanks to remote consultation, teleradiology, telemedecine or medical assistance at home. These facilities will benefit not only patients but also doctors, who will thus be able to readily access medical expertise of colleagues located anywhere within the European Union. Finally, networks and telematic services will also enable data banks on organs or bone marrow to be linked up, significantly increasing a receiver's chances of finding a compatible donor.

With its six million health professionals and 340 million citizens, the potential market offered in Europe by medical telematics is very high. Total investment required for telematic equipment is estimated at around 35 billion ecus over 10 years.

The health sector in brief:

■ *Between 6% and 11% of GNP according to its member States*
■ *6 million jobs (including 850,000 doctors and dentists, 1,100,00 nurses, 150,000 pharmacists)*
■ *Approximately 4% of expenditure goes on equipment (70% is for staff).*

TELEMANAGEMENT OF ROAD TRAFFIC

In spite of the density of their networks, our countries are faced with serious road problems. The number of victims remains very high: 55,000 are killed and over 1,800,000 injured in Europe every year. Traffic jams cause millions of work hours to be lost and detract from the quality of life. Road traffic also has injurious effects on the environment.

Community R&D work carried out over recent years on the application of telematics to transport has shown that telematic systems ensure more efficient use of the existing road infrastructure, improvements in traffic safety and a decrease in environmental nuisance by reducing traffic jams.

These systems are based on the automatic exchange of information between the vehicle and an "intelligent" infrastructure on the one hand, and between the vehicle and its driver on the other. They provide drivers and operators in charge of road infrastructure management with information in real time on the location of vehicles and the traffic situation. They also allow use of guidance systems, the sending of alarm messages in the case of accidents, transmission of information to drivers in their own language – whatever the country in which they are situated – on the state of traffic, roads and weather conditions. The combination of these various services will ensure more efficient, safer management of road networks.

Catalyst investments required for the deployment of these systems should represent a total of approximately 10 billion ecus over the next five years. Over fifteen years the road telematics market should offer computer, telecommunication and car companies a potential market of around 200 billion ecus.

Cost of investments

■ *The total cost of investments required in Europe for the next 10-15 years is estimated at 60 billion ecus: 14 billion for the infrastructure and 46 billion for "carrier-borne" equipment (i.e. equipment installed in vehicles).*

Infrastructure

Networks and services developed will be deployed mainly in urban areas and routes of European importance:

■ *Inter-urban routes: 20,000 km are judged to have priority among the 55,000 identified as being of common interest. The cost of the telematic infrastructure to be deployed in this first priority block is estimated at 12 billion ecus. This estimation is based on an average of 600,000 ecus per km to be equipped.*

■ *Urban and peri-urban areas: 80 sites are judged to have priority and expenditure is estimated at 2 billion ecus, based on an estimate of 140 million ecus per town with over 5 million inhabitants, 30 million ecus per town with over 1.5 million inhabitants and 10 million ecus per town with over 300,000 inhabitants.*

Carrier-borne equipment

■ *The 46 billion ecus allocated over the next 15 years for equipment in vehicles cover radiotelephones, RDS-TMC receivers, signal receivers from satellites and beacons, flat screens, voice generators, anti-collision system actuators, drive aid systems, etc.*

TELETRAINING

To remain competitive in a world where scientific and technical knowledge is increasing at a spectacular rate, European countries must improve the efficiency and quality of their teaching and professional training.

Nowadays approximately 5.5% of the European Union's GDP is devoted each year to the educational system, while companies devote 2 to 5% of their salary fund to professional training. Existing training structures no longer seem adequate to meet future needs. Hence the number of professional training days required to meet the needs of employees and companies is estimated at a minimum of 1 billion. Reintegration of unemployed people will require a similar number of training days. Flexible and efficient education and training methods are thus called for.

Recent research has shown pedagogical and economic efficiency of telematics applications for education and training, both in the design of teaching materials and the dissemination of knowledge.

Multimedia teaching material is very costly. Only an efficient telematic network makes co-operation on a European scale possible between design centres and production centres for training courses; it enables unit costs of teaching materials to be reduced while at the same time improves their quality.

Telematic networks also ensure wide distribution of courses to isolated users, companies (particularly SMEs), universities and training centres. These courses can be disseminated at any time and with maximum choice and flexibility, thanks in particular to interactivity.

Over the next five years, deployment of such a teletraining infrastructure should require investments estimated at approximately 5 billion ecus.

Estimation of training expenditure and requirements

■ *Public expenditure on education: 5.5% of the GDP of the European Union, of which 20% for third level.*

■ *In-company training: the aim is to reach 2% to 4% of salary expenditure (currently 1.5%). The number of training days required to maintain the qualification of employees is estimated at 600 million (based on 5 training days per year and per employee).*

■ *Total expenditure for education, initial and ongoing training: 500 billion ecus.*

■ *Technology-assisted training: 1.5% (of 500 billion ecus), or 7.5 billion ecus. (in 1990)*

■ *Rapid growth in use of technology (25% to 30% per year), or expenditure of approximately 30 billion ecus per year between now and the year 2000.*

■ *Training of unemployed people: 1 billion training days for an objective of at least 3 months' training per unemployed person.*

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