Possible Changes in Logistic Chain Relationships Due to Internet Developments

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For many years EDI was considered as costly but excellent for quick and safe exchange of trade information in freight transport operations. Today Internet settlement suggests different business possibilities, in many ways complementary to EDI. For the last couple of years, we can observe that the Internet is becoming a pervasive technique. Large transport firms are now have a presence on the WEB, and propose direct services through this media. Also most of them use Intranet for their electronic links between their main trade partners. Individuals already apply the Internet for electronic commerce. However a problem still remains: the gap due to the SMEs which are numerous along the logistic chain. In this paper, we will first explain the gap in the IT use by small transport firms, secondly we will present the use of information technologies in the transport logistics field. Then we will present the new way of intermediation in the transport and logistic, and we will finish by discussing how the role of these concerns would be modified by Internet/Intranet.

1. TRANSPORT LOGISTICS AND INFORMATION TECHNOLOGIES (IT)

Information and communication technologies have played a significant role in transport for a long time. For instance, reservation systems appeared in the late sixties in the airline industry. There was not a common technology, instead they required advanced techniques in real-time management of large databases and broad telecommunication networks. These systems focused a fierce business battle for transport operators as well as for the information industry: Sabre versus Appolo, IBM versus Univac. We can observe that these reservation systems are still prominent today since the GDS (Global Distribution System) brought a competitive advantage to their owner.

In a similar way, the same focusing took place, at the same time, in the air freight business. In 1969 IATA came up with its Cargo Imp manual (1969) that described the standard procedures for data communication for freight management. At that time we have to note that the advantage of shortened delivery had to be backed by efficient document processing. Unlike the situation for passenger activities, ICT (Information Communication Technology) was more a competitive necessity in order to reinforce the time delivery characteristic. In the airline industry there has been a long tradition of co-operation between operators in order to share lines, equipment, etc., and telecommunication networks, since the value added co-operative, SITA, was set up in 1945. Now this company is the telecommunication operator that supports data and voice communication for many firms outside the air sector on a world wide basis.

Due to the lower co-operation tradition in the maritime sector and the lack of time-delivery pressure, initiatives took place much later in ports and harbours. Nevertheless PCS (Port Community Systems) were phasing in during the 80’s. At the same time, big shipping lines implemented their own ICT equipment in order to support new standards in logistics characteristics like “just-in-time” and “zero-defaults”.

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Due to native geographic dispersion of transport facilities, specialised and/or dedicated data communication networks and terminals are being used in the freight transport sector. For instance, the international public network like Telex has been extensively and intensively used for freight operation management. Teletypes progressively gave up their place to computer terminals and lost their share of the telecommunication infrastructures.

Because of their public monopoly, the telecommunication operators have for long been interested in voice transmission. Their standardisation bodies like CCITT and ITU fostered interoperability of the common telephone, neglecting corporate data communication needs. Thus it was difficult to transmit data cross border over public operators in a sustainable way! So big logistics operators have undertaken progressively to build a huge private telecommunication network, based on rented permanent lines, complemented with the use of international VANs.

From the first time that data communication took place between head offices and branches there were technological hurdles which prevented data exchanges between different companies. Information system interoperability is quite a difficult task for corporate net managers: there are many factors at play—different character coding, different file formats, different operating systems and data communication procedures.

In order to obviate these various impediments, they have to implement specific solutions, no matter how computers and/or telecommunication operate. Specifically logistic operators advances novelty like international VANs, teleports and CCS/PCS (Cargo Community Systems/Port Community Systems) according to their physical needs. Fig. 1. In addition to common functions like accounting, billing, etc., ICT backed two major transport business aspects: field management and tracing/tracking. In the eighties air companies proved that real-time management of capacity through varying their seat prices could be very efficient: they simultaneously increased loading factors and revenues through the appropriate discounting of prices. This would be quite impossible without very large ICT equipment that allowed field managers to be continuously aware of actual possibilities (occupancy rates). The same solutions were implemented earlier in the nineties for maritime freight, where shipping lines gave up fixed prices and adopted a strategy of proactive management of offers.

The existence of large specialised data communication networks also fostered the implementation of automatic identification technologies. As soon as recorded in the logistic chain, the identifier information along with date and place can be transmitted to the right database and/or to the expected next place. The appropriate mix of hardware and software allows the implementation of full tracing/tracking services, which directly interests the shippers and final consignee. This new capability to know in real-time the location of fleets and freight have also strongly contributed to improve the management of service quality.

2. IT NETWORK EVOLUTION

2.1. Legacy networks, from commodity to networks

The products and services offered by PTTs remained unchanged for a long time: telephone and a single service—numbering. After the Second World War, other economic sectors have driven TELEX quickly to transmit commercial documents like orders and invoices. Partly due to the law about “Universal Service”, Telcos (Telecommunication Operators/Companies) did not divide their services between households and professional sectors. This is not surprising because a monopoly always hampers initiatives. Even while electronic technology made huge progress from 1945 to 1985, Telcos proposed the same receiver for all their users during the same period.

During this period, major headway came from the computer industry to move data from one client site to another. It is not overstated to say that modems—initially a very simple electronic device—have hugely boosted professional telecommunication. The first American tele-communication deregulation in 1986 drastically changed the economical stakes in this sector.
2.2. Public Switched Telephone Network (PSTN)

Compared to new information technologies, this telecommunication system is doing more than just surviving. As a consequence of its very limited technical characteristics, which have been revealed to be its main advantage, it has been possible to maintain and extend it throughout the world with a quite remarkable degree of interoperability, but 50 years of efforts were required. It thus acts as a support for other services, such as the fax, which has completely replaced the specialised professional networks like Telex. It is also used in an intensive and extensive way as a support for data transmission, through the use of modems. Its low capacities are, to a large extent overcome by using widespread data compression techniques.

The marriage of the PSTN and computing is now well-known, but the gradual spread of call number signalling (Caller ID or ANI, Automatic Number Identification) is giving rise to some very promising new applications. With the development of specially adapted microcomputer applications, through TAPIs (Telephone Application Programming Interfaces), and/or vocal response units, the ordinary telephone allows companies to start using new and advanced applications. The set of these new abilities of the telephone is named CTI (Computer-Telephony Integration).

The PSTN remains, and will remain for a long time the universal system able to accommodate a large part of the interchange requirements, directly or with the help of equipment (modems, multiplexers, etc.) and it is specially the primary support of Internet for small and medium sized firms. In developed countries ISDN will gradually substitute access to ordinary telephones—but there is some doubt now with the advent of new compression technologies.

2.3. Private networks

Large companies became accustomed over the past ten years to do things without the skills of the public network operators by managing their own telecommunications resources. The electronics industry now sells its telecommunications products directly to companies, thus creating a very dynamic market for modems, bridges, routers, multiplexers, PABX, etc.

Although technical problems remain, notably for the simultaneous management of voice and data transmissions, companies are mastering these facilities, so enabling them to transfer information within companies. However, it is always difficult to communicate with other partners using these private networks. The slow rate at which EDI techniques are being adopted may be explained to a large extent by these factors. As long as one remains within limits where there is a clear unity of infrastructure management, it is possible to manage complex and advanced networks. To make different entities communicate with one another, consensus’s relating to techni-
Multinationals clearly have no problems with new information technologies. However, they are striving to improve their links with their clients, suppliers and partners. They have sometimes succeeded in establishing co-operatives to overcome these difficulties, such as SITA in the air transport, or SWIFT in the banking sector.

2.4. The reach of Networks: LAN, MAN, WAN, GAN

The growth in use of microcomputers has created networks of a new kind, LANs (Local Area Network). These allow transmission rates unheard of in the telecoms world, and they naturally support multimedia: further their modes of operation allow the implementation of quite varied topologies. Unfortunately, it is often difficult to extend them outside the sites where they operate. Now, it is possible to configure a LAN of global proportions—but it is still unusual, and costly (VPN: Virtual Private Network).

Covering a wider geographical area, although still limited, adapted solutions have been found, sometimes called teleports or MANs (Metropolitan Area Networks). These techniques have not met with great success but this was a good expansion opportunity for specialised units like CCS (Cargo Community System) that was progressively implemented in airport and ports, following the example of New York.

To convey data across borders, firms should use WANs (Wide Area Network) that do not really exist for data on public network basis. However leased lines in-house were set-up as LAN, MAN and even as WAN and they were used for rapid data flows—cf. Cadbury/Coca Cola net for month-end cash management.

2.5. The client/server model

All these developments favour the transformation of highly hierarchised information systems into the more horizontal and natural architectures of local networks, connected to each other by gateways or bridges, and possessing client/server machines. Distributed processing is the main motto theme of the Internet, because it is the today model of network without a compulsory mainframe.

The success of the term server to designate both a processing and information storage tool, and to replace the master or central computer, is a sign of this U-turn in information systems, which are now more directly serving the end user. From the outset, local networks have been operated from a non-hierarchical perspective: the various microcomputers could use resources they did not possess, and get access to localised disks on a more powerful computer or printer, or a telecommunications server with gateways, routers and bridges in order to access several other networks. This development towards horizontal information systems as opposed to hierarchical structures is gathering pace, especially in the Internet domain.

It is interesting to note that major companies have a tendency to extend their applications by putting them on servers, rather than increasing the size of the mainframes, to the great despair of the manufacturers of mainframes. These organisational principles have the great advantage that they allow flexible location of processing units—yet have the disadvantage of the loss of formal data protection that main-frame operators used to undertake as regular back-ups. It is not that end-users cannot do this, but that they are often lazy and do not do this (and also they may not have access to mass data storage disks).

2.6. Internet, a pervasive technology

Meanwhile the use of the Internet is booming. This network proves to be a potential universal network, like our POT (plain old telephone system), but specifically for data transfer. The operating cost is low, the speed is good and the functionality is large and open (Web).
Thanks to the simplicity of its design and to a massive sub-industry of software developers, the Web may be the first stage in the Information Super Highway. It can be used not only to browse throughout catalogues of vendors, but also to practically exchange information in real time even if it is not be guaranteed due to the design of the web and its protocol, to download or upload files that include a range of media, and to add and open new applications, as well as those previously used in specific information systems.

If the Internet suffers from the lack of security, today’s software providers will be supplying an increasing number of tools for overcoming this well-known problem. But the infrastructure of commercial transactions, including secure, easy-to-use payment, is nowhere near mature.

Like any revolutionary technology, the Web is the subject of many controversial discussions. Most have assumed recently that the Web’s major application would be electronic commerce. Certainly, the first WWW servers have been operated on a large area by advertisers and firms which want to sell goods and services. In the business area it has been seen as an electronic yellow page. New advertising and marketing practices have been created during the last twelve months.

It is estimated that the number of active Internet users is fewer than 5 million, even though more than 10 million of computers have on-line access the Internet and the growth is currently exponential. Potentially it is foreseen that 25 million computers could be connected to the Internet before the end of the year. The Internet access service will increase by 33% annually between 1995 and 1999 (Suhler and Associates report). The Internet marketplace just keeps on growing exponentially world-wide, and the growth includes not only networks and customers, but also new technologies and applications that operate over it.

Web servers can be implemented as a distributed database, carrying efficient support tools, existing in a domain name space: they use the Hypertext Marker Language (HTML) and the technology of Unified Resource Locator (URL). The implementor loads Web pages to the server (which can be conceived as a Word Processed document) with HTML keywords which “point” to other Web pages on the same server or on a remote one. In this way, Web users can continuously navigate through Internet network without apparent changeover between different servers. Due to the speed of transmission and the low cost of data transfer, most Web pages contain colour pictures, graphics and sound bites in a more or less ergonomic format (there is much discussion, as yet unresolved, on how to create fast to load, meaningful and artistic pages).

The Internet promises to become a global universal data network connecting entities to the global market place. It is targeted to be the primary path for open computer-to-computer communication. The Web can play a key role in implementing the future seamless information structure for business to business communication.

Logistic operations involve the exchange of a high volumes of information between many operators. The transport logistics is an interrelated network of heterogeneous parties such as shipping agents, freight forwarders, ports’ authorities, customs, etc. Here we are using “network” to mean a collection of agents necessarily interconnected through the needs of their business: we are not implying they have any electronic interconnection—though we believe they perhaps should avail themselves of this capability. Modern information systems and telecommunications have already been implemented in many major ports. These integrated networks would provide agents and transportation company’s value added services related to on-line port information services such as: container space reservation, ship schedules, and so on with connectivity sometimes with others’ networks.

In the transportation field, more than in other domains, the transfer of information “in time” becomes a key value-added component of the business. As earlier described, dedicated network architectures are not easy to implement. The communication costs and the connectivity problems remain a critical issue.

The Internet and its complement—WWW—could support a cheap, highly accessible and reliable transmission tool for much of the information concerning the transport of goods. The explosive growth of the Internet in the transportation field became evident during the last 20 months, and more precisely since January 1996. With the Netscape® or the Microsoft Explorer browsers and ‘search engines’, we tried last year to identify the possible Web activities of transport companies, ports, transport associations. Nearly 50 companies had created home pages.
The transport domain is seen as a service in trade business. In the international logistic chain, airport and maritime ports act as hubs for freight operations and information flows. Their role is to facilitate the transhipment of the freight. The maritime operators are highly diversified, and the service offered depends on the operational environments. Globally, the business relationships are growing and extending between suppliers and clients. The economy today is global and it exists to cater for a need for customer oriented services. The need for up-to-date, reliable, and real time information is extremely significant for the management of the physical flows of goods to support supply chain management.

In the transport logistics field, the vast majority of firms are small, having restricted resources. They have to face numerous, often one-off, clients asking for small and/or non repetitive services. The transport sector carries large diversity and much variability. The links and relationships in the transport chains are an intricate web. The generalisation of information system and telecommunications creates a wide divergence of technical solutions. Some kind of data communication is necessary, but its support depends on the nature of business and/or the requirements of the trading partners.

Electronic Data Interchange (EDI) is the inter-organisational, computer-to-computer exchange of business information through some standard machine-processable format. We know that EDI is often considered as the fundamental means to facilitate better relationships within transportation chain partners. It could provide a significant competitive advantage to all operators of the logistic chain.

Paradoxically the main reason for using EDI is the improvement of internal data processing operations. It is also expected to be an enhancement of customer service, to increase the ability to compete internationally, and a way to achieve better cost efficiencies. It allows proactive business management instead of passive management.

But these reasons are only attainable if EDI is completely integrated in the information system of the firm and their partner’s firms, and if information message exchanges are voluminous given that the implementation of EDI requires a re-engineering of the way business is done and a substantial outlay of capital. The relevant message format, the choice of network and EDI procedures request a reconciliation of diverse cultural concepts, a better understanding of the fundamentals of business processes of the partners, and of their shared advantages and disadvantages.

EDI requires the development of agreements and/or standards at all levels: networks, software, messages structure, implementation guidelines, inter-organisational business systems. We have observed during the past five years an amazing intellectual activity about EDI but, in contrast, this method of communications is very little used in the transport field, as findings of the COST 320 survey shows it: see COST 320 (1992). The implementation of this technique needs too many formal interfaces which makes it cumbersome and costly.

Before processing the inter firm’s exchange, one has to examine the nature of interchanges with their primary attributes:

- **formal** (i.e.: custom declaration), **semi-formal** (i.e.: ETA), or **informal** (web pages) depending on the commercial nature of transaction;

- transaction supports are **structured**, **semi-structured** or **unstructured** depending on the Information and Communications Technology.

- **Structured**: The EDI messages represent formal, formatted data exchanges, for instance the bill of loading;

- **Semi-Structured**: this is the case of E-mail. The information contained in the message is unformatted, free text. The envelope contains the electronic address of the receiver and some parameters depending on efficiency of the network. All E-mail network software tolerate the functions reply, redirect, forward, and forward a message to a list of receivers. Some supply acknowledge, coding-decoding, and functions of security as set of private users.
Traditionally this communication was performed primarily through the use of paper with the services of a courier. Later it was by the telegraph, by Telex then by using telephone line (Fax). More and more the Fax replaces the Telex, although the Fax is not in most cases a legal instrument. The Fax uses the Public Switched Telephone Network that transfers information at relatively fast speed (the fax transfers a digitised image of a sheet of paper—this is what makes it difficult to extract data from a fax). This support does not need any interfaces. For the time been, the firms that possess no Fax, are out of business.

The Customs Authorities are involved in all international transportation. They are not only in charge of the assessment and adjustment of VAT and the reduction of theft, they are also in charge of gathering the import and export statistics in many countries. In Europe, the port authorities are also charged with the management of dangerous goods under the EU HAZMAT directives.

In some OECD countries, these controls are undertaken electronically, such as those relating to customs documents and loading lists of dangerous materials, in order to significantly reduce the transit times of goods in the harbour (US, France, Belgium).

In many cases, the port and/or customs authorities have provided technical and financial assistance for the implementation of their port community solutions. By sharing information processing resources and teams of computer experts, small operators in some ports are able to reach the required critical mass. However, it may be observed that, in Europe, these port community systems have not had a great impact on the operation of the transport chain, except in relation to customs clearance. They use direct or indirect subsidies from states and the European Commission, in order to provide the service. These loss-making systems were implemented for competitive reasons, each port wishing to make itself more attractive by showing that it offered modern services which could speed up movements and/or improve the quality of port services.

Implementing a inter-operable network of Cargo Community Systems is a very complex operation. Its success is dependent on the commitment of all parties involved, and on the total integration of all types of commercial operations and the genuine support by the government.

### 4. PROSPECTS FOR THE COMING YEARS

#### 4.1. Economic changes in IT

The overall effects of the development of the Internet in the transport industry, as well as in many other fields of activities, may be expressed by a single sentence.

Compared with EDI, the use of the Internet presents much lower barriers to entry; monetary costs are much lower. Efforts in training and reorganisation are incomparably easier, as it is not necessary to develop a whole set of rules, protocols, well defined messages and so on; nor to re-organise large parts of the decision structure of firm.

The very decentralised structure of the Web makes its use much more supple and flexible, through a “request and reply procedure”; rather than to develop a whole set of agreements. It is enough, to make a booking, for instance, for the supplier of the service, to present on the Web an electronic form containing all the details he needs to reach an “agreement” in that deal. The interested consumer fills that form, always electronically, using its own tools and rules.

One of the consequences of this easiness of entry is to make all forecasts much more difficult: beyond the general statement that the use of the Internet will grow substantially, it is hard to
express a judgement about the shape and the parameters of a growth curve, as the past data, except for academic and scientific users, cover only a few years. How can we know whether the growth law will be of the exponential type (probably not in the long run) and with what growth rate, or will it, as often, take the shape of a logistic curve, and if that case, when will the inflexion points appear?

On a more qualitative level, we may, on the base of our knowledge on the past of Information Technology, more or less imagine part of the applications which could be boosted by Internet developments. But the very fact that access will be so much facilitated, compared to previous techniques, opens the field of possible innovations probably beyond what most of us could imagine, while we know so little yet about the shortcomings and difficulties which will act eventually as brakes to further growth.

Of course, all what is done automatically in the case of EDI, such as finding the data in the proper place(s) within the system of the originating party and transferring it to the proper place(s) in the consignee systems, is not done by Internet, nor e-mail, and must then be performed within the systems of each partner.

This suggests the definition of two broad categories of customers; the first will be people with frequent and substantial needs of data exchange, with a strong experience in Information Technology. For these it will be worthwhile to invest time and money in creating a full EDI relationship. For the others, EDI is probably a heavy investment given the negative perceived results from a cost/benefit analysis (which unfortunately they may not have undertaken). They will be interested in less expensive solutions, either simple ones like faxes or P.O.T., or more sophisticated ones like the Internet and the Web.

Small and Medium Enterprises (SMEs) are, of course, more likely to be found in the second set than in the first. This is important, as so many firms in the world of transport (carriers of various modes, transport auxiliaries of various functions) belong to this category.

Undoubtedly, in the Web universe, growth rates are, and will remain for some time, high. They also are, and will stay uneven, geographically, and by types of industry. In principle, no obstacles result from border crossing, nor by connecting different brands of hardware or software. It is nevertheless impossible to ignore geographical differences, especially the fact that a huge majority of users, of different status, are located in the United States, and that many of the users located elsewhere (which actually means Western Europe, Japan and a few “rich” countries) are branches, subsidiaries, subcontractors, . . . of American firms or agencies.

It is quite possible that these differences will tend to narrow in the coming years; the converse is also quite possible. At any rate, if, let us say to-day, a Port Community or a Port Authority wants to develop the use of the Internet for its exchange of information with its natural or usual partners, it will find a larger range and number of these partners ready to respond to its efforts if it is located in North America than elsewhere. This is not necessarily a stable situation, and the possibility exists that appropriate policies can be developed in order to reduce this gap (as well as the likely larger gap between the “developed” world and the rest of it). Anyway, the initial (present) situation must be kept in mind by all interested parties.

5. TECHNOLOGICAL TRENDS, FROM NETWORKS TO INTRANET/INTERNET

It is always dangerous to predict technological changes through a simple extrapolation of the present situation. Few experts, for example, imagined the present-day success of the fax. Even if, today, its technical and financial barriers to entry are quite low. The sectors of electronics, computing and telecommunications have for a long time made progress on parallel lines, but this is now no longer the case. To a large degree, the same tools and the same concepts are being used in them to deal ultimately with the same object, information. The digitisation of telecommunications networks is widely under way, opening up very major prospects for new services or considerable improvements in existing ones.

The Internet can be viewed as a new telecommunication technology but it is worth addressing it as the model of support for future electronic communication.
Below we now discuss the key features of a public network of networks (Internet) that are the same as for private network of networks (Intranet), as they can both be used in transport logistics.

5.1. The future role of the Internet

The US’s administration ruled a deep restructuration in the telecommunication sector, with three major actions.

- relinquishing the control of ARPANET/Internet in 1991,
- numerous initiatives toward Information Highway Infrastructures since 1993,
- a nearly complete deregulation in 1996.

The European Union also planned a significant level of deregulation for 1998, and several European countries passed new regulation laws—by edict of the EU and in advance of a global agreement under the World Trade Organisation.

At the same time this sector grows steadily, boosted by law but also by the breakthrough in technology due to the ability of Very High Scale Integration, the development of wireless technology, the amazing progress of data processing with PCs.

All these economical and technological factors foster the development of initiatives that could strongly influence the way of doing business. The most symbolic new tool is the Internet and its prospects of electronic commerce. At the opposite end of traditional telecommunication networks, at this time, the Internet has unique attributes:

- **low operating costs**, regardless of distance, but the local connection time-cost is the same as a fax or voice minute by minute;
- **global availability** with world wide points of presence (directly or indirectly), only if there is a phone line, or a satellite connection locally;
- **large openness** with the native support of electronic mail services and client/server implementations;
- **strong easiness** with the support of multiple kinds of data: texts, pictures, voices, etc.,
- **significant operability** through a wide-spread availability of sophisticated (low cost) browser software.

This is the first time in the data communication history that users have an international and universal means of data communication. The first consequence is the blurring of borders that strongly hampered commercial data communication, especially EDI. So it is not very surprising that shipping companies and global logistic operators already offer interesting services through the Net, fairly before other business.

More specifically, the operating mode of the Internet will allow one to consider the global networks as a virtual organisation, with numerous remote branches (although the Internet is basically decentralised). The Hyper Reference techniques (Hypertext, . . .) interlink different organisations in an apparent unique “web” of partners. Many professional organisation already offer that kind of services. The factor of physical area for port communities could decrease to the benefit of electronic presence through the Net.

All these favourable factors contribute to the Internet attractiveness for the SMEs (small and medium-sized enterprises). For instance, traditional EDI data communications often require specialised telecommunication services like X25, demanding high costs for equipment and high cost-rates for communication. Conversely, instead of demanding additional assets, the access to the Net can be performed through the POT (Plain Old Telephone) with marginal costs of transmission. The development of E-mail and E-Form thanks to the connectivity of the Net could modify relationships in the logistic chain. But this fancifully ignores the learning costs in the SME and the fact that most do not know the meaning of a database even though they have one, albeit as paper records.

Nevertheless the new operating concepts for data communication for business use also generate new critical issues. There are concerns about the safety and security of the Net. Several of these problems already exist with EDI connection between partners, they worsen with the ease...
of use that also imply easy means of diverting and/or tampering with messages. Yet learning about the new possibilities and their impediments, and training employees to new procedures will likely take some time.

The complexity of safe procedures and the payment issues could give a new important role to the middle agent (intermediation). But the position and the role of these new kinds of agents in the web will differ from those of the agents in a chain, in logistics as well as in telecommunication.

5.2. New operational communication stakes through the Internet

In the immediate future, information technology will be pulled in a strongly downward direction, i.e., it is no longer a complicated instrument which resolves a few complex problems, but it can, in a simple manner, analyse and solve many of them. This technology is indeed making itself available to a constantly growing population of users. It has become a relatively common practice.

These problems are now more economic than intellectual in nature. Large processing centres will probably be the exception by the year 2000. Already today, total processing power is greater in work stations than in mainframe processing centres, even if these local capacities remain under-used, as a consequence of the high speed of transition. Significant issues remain—the nature of shared data is but one.

In addition to this market factor for reducing the size of equipment, voice is progressively seen as a poor media, because it is slow, not reliable and such information cannot be easily processed and stored in corporate databases. Furthermore, it required a synchronous exchange—i.e., two partners interconnected at the same time—not always possible due to time difference or because the nomad partner is engaged with something else.

In this new computerised world, more and more intelligent devices, terminals and software are being installed at the periphery of the network, especially on customer premises. Moreover, the emergence of powerful personal computers and local area networks capable of handling multimedia, as well as switching technologies like Asynchronous Transfer Mode (ATM), are blurring the borders between public and private networks, wire and wireless networks and between voice and data. More generally, asynchronous mode avoids too much coupling between remote processes in order to attain more flexibility.

Technological and regulatory limits have accustomed us to simple broadcasting methods: either the point-to-point mode of the telephone, or broadcasting from 1 to N, as with radio or TV. Despite recent progress, the architecture of ordinary telecommunications networks does not allow N to M broadcasting (Multicast—CCITT) to be managed simply. In the professional sphere, there are many applications for targeted distribution as required in a marketing application. These kinds of business tools allow one to keep strong links with customers in order to continuously adapt products and/or sales to customer requirements. These methods are also useful in the transport sector for transhipping goods in urban zones with a fleet of vans, for communicating with a group of partners implied in the tracing of the same cargo.

This new variety of possible broadcasting methods is one of the most promising aspects of future services predicted through information infrastructures. They will support many modern communicating methods like Document Conferencing, Groupware, etc.

6. CONCLUSION: PERSPECTIVES OF ELECTRONIC COMMERCE

Electronic Commerce is at its very first stage, but the premise of its activities allows one to induce some perspectives.

The new telecommunications networks (Wireless, VPN, Intranet, . . .) and the increased use of the Internet and its on-line services are entering a standardisation phase. This involves the gradual introduction of new forms of industrial and commercial systems. All teleservices, will force European transport and telecommunications companies to develop their structures which will take into account more direct links with their customers and suppliers.
Table 2. Comparison of SA results with FixedC optimal solution values for U(1,10) processing times and U(5,10) changeover times

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<tr>
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<td>55 40 71</td>
<td>247 166 360</td>
<td>599 437 900</td>
<td>1130 859 1322</td>
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<td>866 756 1021</td>
<td>1959 1266 3227</td>
<td>2570 1549 4208</td>
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Table 3. Comparison of SA results with FixedC optimal solution values for U(1,10) processing times and U(5,10) changeover times

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<td>Ave 0.00</td>
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<td>Max 0.00</td>
<td>Max 0.00</td>
<td>Max 0.00</td>
<td>Max 0.00</td>
</tr>
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<td>21 18 25</td>
<td>45 39 49</td>
<td>85 56 121</td>
<td>119 66 155</td>
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<td>30 25 36</td>
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<td>54 46 62</td>
<td>125 103 149</td>
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Table 4. Comparison of SA results with FixedC optimal solution values for $U(1,10)$ processing times and $U(5,\max\{10,4C\})$ changeover times

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Table 5. Comparison of SA results with FixedC optimal solution values for $U(1,10)$ processing times and $U(5,10)$ changeover times

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<td>secs</td>
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<td>&lt;</td>
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<tr>
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<td>secs</td>
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Table 6. Comparison of SA results with FixedC optimal solution values for U(1,100) processing times and U(50,100) changeover times

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Table 7. Comparison of SA results with FixedC optimal solution values for U(1,100) processing times and U(50,100) changeover times

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Table 8. Comparison of SA results with FixedC optimal solution values for U(1,100) processing times and U(S0,max(100,40C)) changeover times

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<td>Min</td>
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Table 9. Comparison of SA results with FixedC optimal solution values for U(1,100) processing times and U(50,100) changeover times

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Table 10. Comparison of SA results with FixedP lower bounds for U(1,10) processing times and U(5,C) changeover times

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Table 11. Comparison of SA results with FixedP lower bounds for U(1,10) processing times and U(5,max{10,C/2}) changeover times

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Table 12. Comparison of SA results with FixedP lower bounds for U(1,10) processing times and U(5,4C) changeover times

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<td>34.81</td>
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<tr>
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<td>7</td>
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<td>38.80</td>
</tr>
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<td>59</td>
<td>73</td>
<td>521</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
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<td>15</td>
<td>15</td>
<td>15</td>
<td>51</td>
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<td>% gap</td>
<td>7.82</td>
<td>6.98</td>
<td>9.39</td>
<td>8.78</td>
<td>10.79</td>
</tr>
<tr>
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<td>5</td>
<td>5</td>
<td>5</td>
<td>44</td>
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<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
</tr>
<tr>
<td>% gap</td>
<td>13.33</td>
<td>11.24</td>
<td>15.10</td>
<td>16.74</td>
<td>18.88</td>
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<tr>
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<td>SA CPU secs</td>
<td>10</td>
<td>10</td>
<td>14</td>
<td>87</td>
</tr>
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<td>&lt; &lt; &lt;</td>
<td>20</td>
<td>19</td>
<td>22</td>
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</tbody>
</table>

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Table 13. Comparison of SA results with FixedP lower bounds for U(1,10) processing times and U(5,2C) changeover times

<table>
<thead>
<tr>
<th>D = 2</th>
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<td>Min</td>
<td>Max</td>
</tr>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.51</td>
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<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
<td>7.82</td>
<td>6.98</td>
<td>9.39</td>
<td>8.78</td>
<td>10.79</td>
</tr>
<tr>
<td>% gap</td>
<td>13.33</td>
<td>11.24</td>
<td>15.10</td>
<td>16.74</td>
<td>18.88</td>
</tr>
<tr>
<td>F = 3</td>
<td>SA CPU secs</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>44</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
</tr>
<tr>
<td>% gap</td>
<td>13.33</td>
<td>11.24</td>
<td>15.10</td>
<td>16.74</td>
<td>18.88</td>
</tr>
<tr>
<td>F = 4</td>
<td>SA CPU secs</td>
<td>10</td>
<td>10</td>
<td>14</td>
<td>87</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
<td>&lt; &lt; &lt;</td>
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</tbody>
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<: less than 0.1 seconds.
Table 14. Comparison of SA results with FixedP lower bounds for U(1,100) processing times and U(50,10C) changeover times

<table>
<thead>
<tr>
<th>C = 10</th>
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<th>C = 50</th>
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<tr>
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<td>Min</td>
<td>Max</td>
<td>Ave</td>
</tr>
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<td>SA CPU secs</td>
<td>10</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
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<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
</tr>
<tr>
<td>F = 3</td>
<td>SA CPU secs</td>
<td>29</td>
<td>28</td>
<td>31</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
<td>7</td>
</tr>
<tr>
<td>% gap</td>
<td>27.45</td>
<td>26.11</td>
<td>28.75</td>
<td>27.25</td>
</tr>
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<td>SA CPU secs</td>
<td>56</td>
<td>54</td>
<td>62</td>
<td>463</td>
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<tr>
<td>FixedP CPU secs</td>
<td>22</td>
<td>21</td>
<td>22</td>
<td>356</td>
</tr>
</tbody>
</table>

<: less than 0.1 seconds.

Table 15. Comparison of SA results with FixedP lower bounds for U(1,100) processing times and U(50,max{100,5C}) changeover times

<table>
<thead>
<tr>
<th>C = 10</th>
<th>C = 20</th>
<th>C = 30</th>
<th>C = 40</th>
<th>C = 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>D = 2</td>
<td>Ave</td>
<td>Min</td>
<td>Max</td>
<td>Ave</td>
</tr>
<tr>
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<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>F = 2</td>
<td>SA CPU secs</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
</tr>
<tr>
<td>% gap</td>
<td>8.04</td>
<td>5.78</td>
<td>8.98</td>
<td>7.15</td>
</tr>
<tr>
<td>F = 3</td>
<td>SA CPU secs</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
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<td>&lt;</td>
</tr>
<tr>
<td>F = 4</td>
<td>SA CPU secs</td>
<td>10</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
<td>1</td>
<td>&lt;</td>
<td>1</td>
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<: less than 0.1 seconds.
Table 16. Comparison of SA results with FixedP lower bounds for U(1,100) processing times and U(50,40C) changeover times

<table>
<thead>
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<th>C = 30</th>
<th>C = 40</th>
<th>C = 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave</td>
<td>Min</td>
<td>Max</td>
<td>Ave</td>
<td>Min</td>
</tr>
<tr>
<td>F = 2</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
</tr>
<tr>
<td>SA CPU secs</td>
<td>21</td>
<td>16</td>
<td>24</td>
<td>113</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
</tr>
<tr>
<td>% gap</td>
<td>29.19</td>
<td>25.81</td>
<td>31.73</td>
<td>30.99</td>
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<td>&lt;</td>
<td>&lt;</td>
<td>7</td>
</tr>
<tr>
<td>SA CPU secs</td>
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<td>34</td>
<td>40</td>
<td>317</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
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<td>&lt;</td>
<td>&lt;</td>
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</tr>
<tr>
<td>% gap</td>
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<td>36.54</td>
<td>35.07</td>
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<td>&lt;</td>
<td>7</td>
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<tr>
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<td>21</td>
<td>22</td>
<td>351</td>
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</tbody>
</table>

<: less than 0.1 seconds.

Table 17. Comparison of SA results with FixedP lower bounds for U(1,100) processing times and U(50,20C) changeover times

<table>
<thead>
<tr>
<th>C = 10</th>
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<th>C = 50</th>
</tr>
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<td>Max</td>
<td>Ave</td>
<td>Min</td>
</tr>
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<td>0.00</td>
<td>0.00</td>
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<td>&lt;</td>
<td>&lt;</td>
</tr>
<tr>
<td>SA CPU secs</td>
<td>9.07</td>
<td>6.35</td>
<td>11.01</td>
<td>8.30</td>
</tr>
<tr>
<td>FixedP CPU secs</td>
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<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
</tr>
<tr>
<td>F = 3</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
</tr>
<tr>
<td>SA CPU secs</td>
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<td>10</td>
<td>14</td>
<td>93</td>
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<tr>
<td>FixedP CPU secs</td>
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<td>1</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>

<: less than 0.1 seconds.
Electronic communication will most probably continue to develop in the forthcoming years, opening new fields of investigation directly or indirectly linked to logistics—like electronic mail and electronic payment.

The use of electronic communication also imposes change in the organisation of society, namely in remote action: tele-education, etc. In concrete terms, in the distribution sector, this is translated by an important increase, world-wide, in remote sales (mail order or TV-induced).

This will have a direct effect on logistics, by production according to demand instead of the storage of large quantities of products in warehouses and depots, and an indirect effect by modifying commercial urbanisation and distribution networks in towns. Tables 2–17.