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PREFACE

The education and economic systems both at national and European level must look afresh at their roles. New technologies will play a key role in this, as they are changing the way we work and communicate.

Consequently, new training curricula are needed for the different jobs the European market now offers.

The partnership between Schools, University, Enterprises and Training centers can encourage the review of training courses adapting them to the education needs which firms and markets will define.

Despite the cost of the ICT equipments and the problems that may arise from the managerial point of view, the enterprises are adopting telework because of the flexibility it offers, for the opportunities teleworkers may have as to labour contract (anyone can have a regular contract, while others can operate as independent workers, or they can be temporary employees engaged only to carry out particolar projects) and due to the possible general costs reduction.

Moreover, this new way of working produces productivity improvements: fewer interruptions while working, employees' concentration improves, job motivation increases, no time wasted in commuting.

Despite all these advantages teleworking is not spreading as quickly as one could expect especially in Italy. Therefore, this is an important field of studies and experiments in order to think over how it could be organized and developed.

In 1986, the ISRI (Industrial Relationships Studies Institute) pointed out that factory or decentralized office at home or electronic-cottages, developed in the United States of America, are also used in Italy by a lot of firms, giving the possibility to an increasing number of employees to work at home through the most up-to-date communication technology equipment.

In 1997 the Technical Industrial Institute "G.B.Pentasuglia" in Matera, aware of the continuous changes in the working world, in cooperation with CineTV Institute in Rome, I.P.S.S.C.T. "Salvemini" in Palermo, I.T.C.S. "Serra" in Naples, I.T.C.S. "Serra" in Cosenza, I.T.G. "Righi" in Reggio Calabria, the University of Calabria in Arcavacata di Rende (CS), I.F.O.A. in Reggio Emilia, K.E.A. in Rethymno - Greece, Pekkala Software O.y. in Orivesi - Finland and Dewsbury College in Dewsbury-United Kingdom, submitted to the European Union a Leonardo Pilot Project on the theme: "Telecommuting: promotion and development"

The ambitious idea was successful and the project was considered one of the best, getting a funding of 250 million of Lira from E.U.

After some initial difficulties, perhaps, due to the lack of a solid experience in carrying out activities which have involved schools, a university, firms and training centers at the same time, and to the shift of three headmasters as managers of the above Institute, an adequate working pace has been found and proved to be very effective during this school year.

The tempting objective, consisting in showing -- ourselves before all -- to have not only professional competence in handling working world issues but also organizational and management competence, after three years of job, has been reached.

This work is not the first and surely it will not be the last one on teleworking, but it is important to point out that the reached result is due to the abilities of teachers that often operate with very few facilities and means and work in schools situated in the south of Italy.

The ability of the teachers in our schools has been surely increased and strengthened from a technical, professional and organizational point of view. Technical and Vocational Institutes of regions like Basilicata, Calabria, Sicily and Campania, that could seem at the margins in the new economic process of industrial development, have shown to have qualified competence and professionality.

The prize of our work consists in the satisfaction to produce a course that other schools and training centers might use in training experts of the teleworking promotion.

Francesco Mazzitelli
Headmaster of I.T.I.S. “G. B. Pentasuglia” - Matera

1. 1. 1 PREMISES

The concept of teleworking began to spread in Italy and in Europe during the mid-eighties. This was the time when PCs, modems and digital lines were not in widespread use in the home, nor in many workplaces. The globalisation of the market and the rapid change in working conditions worldwide gave rise to the need for professionals who were able to respond quickly to the requirements of a constantly evolving market.

Before then, no 'serious' manager would have considered teleworking as a business opportunity or as an instrument for streamlining the organisation. More likely, it was a question of doing a favour to a disadvantaged employee or perhaps allowing an industrious and enthusiastic manager to have access to his or her work at home during illness or outside office hours. Teleworking arrived from the United States accompanied by a succession of stereotypes which were difficult to modify: firstly, that teleworking was particularly adapted for women with young children, secondly, teleworking meant working from home – naturally with the correct equipment.

Throughout the 80s attempts were made to justify teleworking economically to companies. They in turn centred their thinking along the following lines – saving space and increasing productivity.

What happens when an experiment in teleworking does not give the expected results? Usually the blame is laid at the door of the personalities of the workers involved. But personality is one, but not the determining factor of teleworking. There does not exist a 'right' or 'wrong' personality to be able to undertake teleworking. Personality, habits and other variables typical of an individual can only be assessed in an organisational context. Thus, it is preferable to treat individual differences and attitudes from three principal standpoints: the total workload, the organisational context and the domestic ambience.

The stereotype of teleworking as a home-based activity was demonstrated from 1985 onwards by the rapid spread of particular structures such as telecottages and telecentres, designed for collective teleworking on a more or less large scale in many countries (particularly in Europe). In other words, telecottages and telecentres can be defined as structures, either independent, public or company owned, equipped with IT equipment, telecommunications and which grow in relation to the specific requirements of a community, a company or a geographical area.

Although often used as synonyms, the terms telecottage, telecentre and teleworking centre have assumed different meanings.

The telecottage is usually a "public organisation or structure" in the sense that it is open for use by the community, but does not necessarily benefit from public funds even though it came into being in partnership with a local authority or organisation or with money from public sources. It was created to facilitate training in the use of computers and telematics, provide access to advanced technology and possibly provide work for a local community often in a rural or high unemployment area. The movement began in Sweden and was subsequently taken up by the U.K.

The telecottages tend to emphasise "local support" for their users. Many of these will work there full time, others for brief periods, for example, if they wish to use fairly advanced or expensive equipment, to attend courses or to join together from home where they may have their main work place. Telecottages are converted country cottages, sometimes parts of farms or school buildings.

They seek to play a role in economic development, for instance, helping people to find 'distance work'. The concept of telecottaging quite often involves a 'socialisation' element in the sense that it provides local people who are mainly house bound with their work, a base for personal contacts – just as in a conventional workplace staff meet at the copying machine. The telecentre offers a more commercially orientated structure, created with specific ends in mind. Typically, they provide work places for people who often telework full time but who do not wish to work from home. In this sense, telecentres are like business centres which have existed for years but place greater emphasis on providing work places, IT equipment and the capability of networking. Telecentres place more emphasis on providing a well organised, safe work environment for people who need a place to work and be easily connected to their employees, colleagues, clients etc.

Traditionally, each company department brings together its personnel of different ranks into separate work places which, thanks to computers and telecommunications, allow each 'team' to work all together but independently of the fact that they are in the same office, in the same town or even in the same country. Teleworking centres reflect this innovation: each employee attends the office which is most convenient – either because it is nearer or easily accessible e.g. on public transport. The 'work group' then operates through a communication network. The telecentres can be owned by a single company or the company can lease office space for multi-company teleworking use. An extension of the telecottage concept can be found in Cabled Villages or Teleworking Villages.

The idea is to develop an entire community that is equipped to a high standard for telematic working and spends its working life – and often social life – in communication networks. The whole village is cabled up and everything is connected via a network within the village and via broadband to the global village. This kind of

working can be very pleasant for certain people who are decisive and who wish to link a country life style with excellent access to the 'information highway'.

The services offered by the above structures discussed can be subdivided into four categories:

- training services
- basic services
- connectivity services
- accessory or supplementary services

This does not imply that each 'centre' must offer all these services at the same time. Many services, apart from the entrepreneuralism of the managers and the requirements of the market, depend on the centre; for example, not all buildings will have a suitable classroom for training or for video-conferences.

With regard to training, it can involve either technical, computer or normal 'content' training. The courses can take place in the centre, with a teacher; by using a personal computer with various applications or by using distance learning.

Information and communication technology would involve, for example, programming, applications – both basic and professional, a knowledge of telecommunication equipment and networks, all from a software and hardware point of view. Other subjects would be mainly linked to economics, languages and graphics.

Basic services are often utilised, either in the initial stages of the centre or when funding runs out, to generate a small flow of income to help manage the centre as a small commercially orientated service centre. This would include:

- access to a telephone network
- hiring of PCs and mobile 'phones
- use of printers, scanners, fax. photocopiers
- access to office applications
- access to a database

Often telecentres will put at a clients' disposal secretarial help with binding, desk top publishing, creation of Home Pages, all of inestimable value for the workers who need additional help.

Connectivity services: the main aspect which should characterise a telecentre is connection with the rest of the world thereby offering the possibility of networking, ignoring geographical distance. These services include:

- email facilities and address

- access to the Internet and browsers
- ISDN
- use of video-conferencing, either with a personal monitor or in a purpose-built room
- access to other available resources using a LAN in the centre
- use of teleconferencing, video 'phones and other networking equipment

In addition, some telecentres offer other 'accessories' or supplementary services, including:

- demonstration rooms
- sales support
- accommodation addresses or representation
- baby clubs
- Internet cafés
- local authority information centre
- job club
- consultancy

So, up until now, the innovations in the exchange of information resulting from the new digital systems and communication technology, have modified the concept of 'distance' and 'time' reducing at the same time the time lapse in exchanges and commercial transactions.

In the light of the above, the need to research new methodologies is self-evident so that we can face the many variables which, of necessity, must be able to interact with such a complex marketplace.

The introduction of Teleworking undoubtedly responds to important socio-economic needs; a good example of this is the regeneration of small centres of population. Teleworking is therefore put forward as an effective solution to such problems as the environment, the quality of life, the management of working time and, lastly, the integration of the most vulnerable into work.

Let us take a look at the future of work and of teleworking. The proposition that office workers can work from home instead of commuting is attractive but nonetheless extremely limited. Information technology and communication technology not only make it possible to compete in the production of goods and services at a distance from where the goods are actually produced or marketed, but also the great innovation nowadays which confronts us head on is the creation of jobs and professions which can only be carried out at a distance. This implies, and will stimulate, the birth of new services and new work practices.

No-one can guarantee however that these new jobs will necessarily go to one country rather than another. Until a few years ago, when an Italian company invested money in a new project, they generated jobs locally.

This no longer happens. Work will go wherever the best skills are found. This process – globalisation of the work market – is growing apace all the time around the world. The challenge of job creation is global and the hunt for work is becoming the same. No longer is it sufficient to be excellent professionals; one needs to be able to communicate in different languages, using the most appropriate technology.

There is a need then to get teleworking out of the present constricting framework, offering new paradigms for organisational structures within the firm, economic democracy and cooperative networking between companies and workers. The very term teleworking risks becoming restrictive in an economy where the immateriality of the product overtakes that of work itself.

It will be necessary to begin to argue for telecommerce (an advanced form of electronic commerce) or for telecooperation. These are terms which we need to keep apart if only for clarity but which tomorrow will merge into working in network.

We shall then have effected the post-industrial modification of work, i.e. its redistribution, its location, the choice of working hours, the treatment of the product from planning through to servicing, and the virtual and physical relationship between the various players involved.

1. 1. 2 THE WORLD OF WORK: THE CURRENT SITUATION

From data published by the European Telework Development it appears that, in 1998, in the USA about 15,700,000 productive units were employed whilst in Europe about 9,000,000 people were employed in teleworking.

The following table will help to understand this:

TELEWORKERS IN EUROPE	
Great Britain	630,000
Germany	538,000
Italy	315,000
Netherlands	295,000
France	272,000
Sweden	207,000
Spain	162,000
Finland	142,000
Denmark	121,000
Ireland	14,000

Source : Ecatt

Let us analyse this phenomenon which indeed links the partnership between company and teleworking, the latter having come through the first experimental stage and now being, for some companies, already a reality which has brought with it significant advantages within their own organisations.

One can deduce that modifications of working practices go hand in hand with changes within the company. Now that we have the Internet, companies are destined to become very different from how we know them today. In the company based on apodictic control and inflexibility, there has been substituted a networking structure.

Then the network becomes elastic, expanding and shrinking according to necessity and succeeds in accepting new opportunities with unprecedented speed. The Japanese model as we know tends to create a network – as far as possible in close proximity to the mother firm – of companies in a tight configuration: the subcontracting companies are in the same 'pen' as the 'mother firm'.

It is one of the essential conditions to guarantee Total Quality Management. Proximity is synonymous with control, acceptance of standards and quality.

With the Internet, the company becomes tele-controlled and can be ubiquitous and virtual: using information and communication technology, it can create an internal network that connects workers wherever they may be and can enter into a close

relationship with suppliers and clients. Exchange of information precedes exchange of goods and thus goods are produced only when they are required.

From existing experience, one can draw up profiles of workers and tasks which can lead to greater diffusion and development of teleworking. Let us analyse some ideas for tele services which can be delegated by a company to its workers:

- Office services: company in-house services e.g. delegating secretarial services, postal deliveries. Secretarial staff, accounting staff and staff who can complete forms and other complex documents.
- Drafting of documents, editing, correcting drafts, advertising
- Company intelligence: almost all sectors of the economy need to know facts of some kind or another. Information 'brokers' are experts who have access to sources of information either on paper or on-line and are able to translate information into a product to sell. The majority of brokers are specialists who have a thorough knowledge of a given product or technique and who also have excellent personal contacts. Charges are calculated on an hourly or daily rate.
- Audio typing, distance typing, printing, formatting of documents: work arriving by fax or audio cassette is transcribed on to the computer and retrieved as a diskette, printout, email or as all three.
- Computer programming / software assistance
- Conferences: a growing area here is tele meetings.
- Data conversion
- Data entry: companies and public authorities are decentralising the entry of large quantities of data on to the computer, especially mailing lists and other specialised services.
- Call centres: where large volumes of telephone calls are involved. They are widely used in the commercial sector to provide services which fall into two main categories:
  - Telemarketing: central services for hotel bookings, airlines, car hire, help lines for computer hardware and software, telephone marketing and sales, ordering, consumer information centre, market research.
  - Data compilation: research into errors and index ratings, management of health and safety, bank administration, financial analysis, subscription management, medical transcripts, VAT recovery, central management of ordering.
- Fax and Photocopying services

- Information services / booking agencies / tourist information
- Editing, design and multimedia: the drafting of diagrams on computer, test results, video paginating, amendment of drafts and graphic design, computerised presentations.
- Specialist registers: management of work opportunities and human resources.
- Distance Learning: various courses in education and training to enable students / trainees to get to know specific software packages or particular specialisations and professional qualifications. Another activity could be the production of training courses.
- Translation services: this work is rapidly being linked to reception of text by email. It can also be linked to word processing services and desk top publishing.

1. 1. 3 THE PROJECT BASES

Most of the initiatives destined for education and training require the active participation of a University or other Institution to provide post-graduate courses for the training of consultants in the management of people at a distance. We now have a European Community programme designed for small to medium enterprises, thereby including telecottages and telecentres, whose name is 'Leonardo da Vinci'. It is a transnational programme launched in 1995 in the vocational training sector and includes:

- Transnational pilot projects aimed at improving vocational training systems.
- Transnational training and placements.
- Exchange of information between trainers.
- Innovative actions in the field of training, such as distance learning.
- Projects demonstrating the use of new technologies in training and job creation.
- Language training.
- Research and studies in the field of vocational training.

Access to funding is granted to all organisations involved in vocational training (including companies offering work opportunities). The procedure requires the presentation of a project to the Commission in Brussels.

Indications emanating from the European social policy adopted indicate an improvement in the rate of updating of skills and in vocational training, so that

homogenous and innovative work profiles can be created. This will contribute to the new methods of working and e-commerce as well as facilitating the introduction into the work market of youngsters seeking their first job.

Thanks to financing by the European Union via the 'Leonardo da Vinci Programme' we are able to instigate the pilot project, 'NIKE: telecommuting, promotion and development', with the aim of providing a course of training for a professional person who would fit into this new vision of the workplace market i.e. a telework promoter.

The 'Telework Promoter' would be a highly professional figure, well qualified with specific skills, able to make a worthwhile contribution to the optimisation of company resources and suggest conclusive solutions to the company management of work.

The training course for a 'Telework Promoter' would consist of a useful teaching tool on which would be built possible training elements devised by teaching institutions and/or training agencies, companies and also any individual capable of foreseeing a fusion with teleworking (One might imagine new institutions arising which can offer consultancy and specialised services).

1. 1. 4 ACTIVATING THE NIKE PROJECT

The project activated in the last three years has enjoyed the participation of numerous academic institutions and companies in the member states of the E.U.

The first phase was concerned with the drafting and administering of part-structured questionnaires to invited firms and to potential and actual users of teleworking; the results of which were processed in order to identify the training needs of a professional person.

In the second phase, the Training Profile was defined and research undertaken to gain more specific information (see 'Training Profile').

This phase of development and processing of the training modules has been carried out in meetings and seminars with all the partners who collectively identified three 'macro-areas' of specialisation:

- company organisation and marketing
- computing
- electronics and telecommunications.

The various strands are broken down into sub-sections which in turn are broken down into further sections.

Each section defines an organisational structuring of the strand or theme in question, in order to bring the product to fruition.

In every text there is a column which carries bibliographical references and links connected with the text.

1. 1. 5 THE TRAINING PROFILE

The 'Promoter' normally stands outside the company structure rather like an external consultant who, having analysed the production organisation, will be able to put forward alternatives to the work model so as to attain the strategic objectives required by the management and propose a partial modification in the organisation of the workload by introducing 'teleworking'.

These modifications will be accompanied by the adoption of innovative modern technology.

The knowledge acquired will be detailed enough to allow him/her to report, with some authority, the findings to the management of a small-to-medium sized company whether regarding the company organisation or matters of a technical nature.

It is obvious that jobs of a purely technical or specialist nature are not relevant for the Promoter and should be referred to specialists in the various technical and professional fields. Preferably, however, such a role would suit post-diploma students or graduates in scientific or technical disciplines who, at the end of their training course, will have the knowledge and skills required in the areas of computing, telecommunications, marketing and company organisation.

Thus the work of the Promoter, who will be required to demonstrate an ability to be responsible for – and the organisation of – his/her own knowledge and abilities, will highlight in several respects the analogy with the organisation of the work of any self-employed professional. The Promoter must also know how to identify, manage and anticipate every training need within the appropriate context, using all the means at his/her disposal to obtain the necessary information: e.g. courses, exchange of information with colleagues and companies, recourse to technical assistance, services etc.

This professional - whatever the nature of the company, manufacturing or service and the type of manufacturing process – must possess:

- Knowledge (know-how): to understand the micro and macro economy, understand the fundamentals of mathematics and finance, the main elements of statistics, commercial law, accounts, to know foreign languages, know the problems of managing local networks and their geographic connections, understand the operating of multi-user systems,

understand network technology. Be familiar with communication protocols and programming.

- Skills (savoir faire): to utilise market research techniques; techniques for analysing the relevant business sector; strategic business planning to apply the operating structure of marketing; company communications; the principles of financial budgeting; to keep clients informed of the type of services; information available on the wide area networks (WANs); to manage the links between local area networks (LANs) and wide area networks (WANs). To guarantee the security and confidentiality of data in the network; improve the communication flow within the network, minimise costs and maximise benefits to the company; to introduce applications so those using computers will want to use them; to install networks; to consult files and transfer data.
- Abilities (savoir être): Operational and relational – precision; attitude in problem solving; autonomy; ability to work in a group and towards goals; creativity; ease in interpersonal relationships.
- Techniques: able to listen to problems and grievances of users; readily available in team work; interested in computer innovations and advances; able to maintain a dialogue with clients and suppliers; trustworthy; capable of stress management; able to work on big projects; have the right attitude to the use of computing equipment, to precision and availability for continuing education and training and updating.

In particular, a 'promoter of teleworking', in a business environment, must be able to analyse the organisation of the company in question in order to understand how the company is structured and what its organisational processes are.

The objective of this phase is to identify and evaluate the relationship between the kind of organisation and the communication systems; to examine and evaluate the impact and the implications of the technology on the administrative systems; to make suggestions for the improvement across the board for the company. In addition, it will provide the means for the company to take a wider view of its structure and of management problems inherent within its human resources. It attempts also to study the firm and its organisation as a key to results. In particular, it will attempt to analyse the organisational implications of Internationalisation.

To do this, the Promoter must clarify for each company:

- the means of communication – communication models; formal and informal, advantages and disadvantages: communication channels and networks, control of communication systems; the process and communication technology; criteria of effectiveness and uneffectiveness in communication.

- the organisational factors which influence decision making.
- the system – resources; functions; development phases; variables in this scenario; technical variables; social variables.
- financial resources
- the organisational structure and organisation chart
- Staff-line relationships

The next phase is that of working out and proposing to the companies plans which are technically and financially feasible, foreseeing alternative organisational solutions and the development of other activities with the use of teleworking.

Finally, he/she must support the company with adequate consultancy both in the implementation phase and the management phase of teleworking.

1. 1. 6 USEFUL LINKS

Sources of information and updating material

- EcaTT – Benchmarking Progress on Electronic Commerce and New Methods of Work: http://www.ecatt.com/ecatt/
- European Telework Development Project – Italia http://www.eto.org.uk/nat/it/
- II MIRTI project: http://www.telework-mirti.org
- Telelavoro Italia Web http://www.telelavoro.rassegna.it/
- Centro di Telelavoro Roma Nexus / Telecom Italia http://www.telenexus.telecomitalia.it/

1. 2. 1 ITALIAN SITES

- Associazione Lavoro & Tecnologia: http://www.telelavoro.rassegna.it/
- Pagina di documentazione dell'Università di Torino a cura di Alessandro Minelli: http://www.cisi.unito.it/progetti/telelavoro/

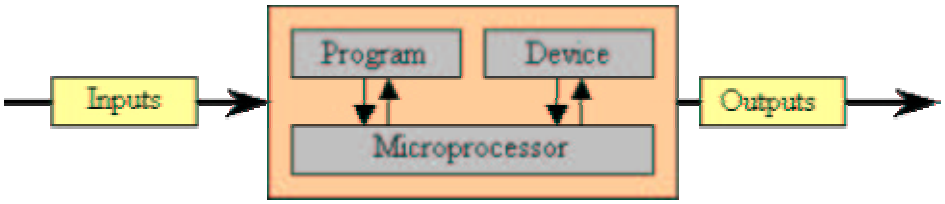
1. 2. 2 ENGLISH SITES

- The Telework Telecottage and Telecentre Association: http://www.tca.org.uk/
- Telecottages Wales: http://www.telecottages.org/
- Telework Ireland: http://www.telework.ie/newsite/index.html
- Gil Gordon-telecommuting (USA): http://www.gilgordon.com/
- European Telework on-line: http://www.eto.org.uk/
- Teleprompt: http://www.icbl.hw.ac.uk/telep/telework/telework.html
- DPA Telecommuting: http://www.dpa.ca.gov/home.shtm
- Information Society disability Challenge: http://www.isdac.org/
- Cyberworkers: http://www.cyberworkers.com/
- Telework in Finland: http://www.uta.fi/telework/english/
- Telecommuting and Telework resources: http://www.telework.com/
- Euro-Telework: http://www.euro-telework.org/

2. 1. 1 HARDWARE

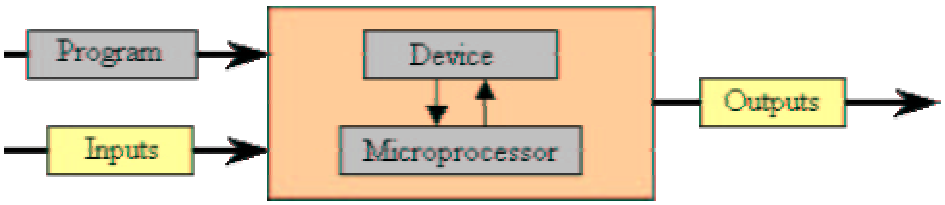
The development of electronics in the last few years has been significant, so that nowadays we are accustomed to the use of this new technology. In fact, most of the electronic appliances makes use of one particular component: the microprocessor.

A microprocessor is a device which is able to carry out instructions and therefore, it is able to determine the function of the appliance in which it is inserted and of which it is a vital part. The series of instructions that the microprocessor executes is always the same, and if controlled by the microprocessor the devices always carry out the same work; there is no way of changing the inserted instructions the microprocessor executes, similarly the devices always carries out the same procedures.



There is an exception to this - a computer. In fact, a computer can change the way it works. You only need to change the instructions if you want it to carry out different functions and it becomes a programmable device.

Such a device can be represented in the diagram below:

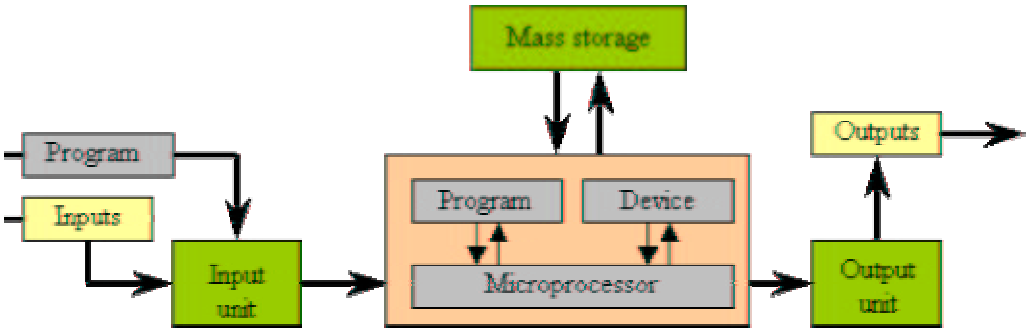


In a computer the programmes can be changed. The inserted programme will determine, together with the data, its functions and therefore the resulting output.

Needless to say, an "instruction" implies the existence of an executor i.e. an appliance able to read it, interpret and carry out the instruction itself.

Obviously, programmes and data must be stored to be used when necessary: this is the concept of memory. Therefore, there will have to be an electronic device, which all computers must have in order to store, read and write data and programmes:

- While processing, data, programmes and intermediate results are memorized in devices characterized by high speed, medium capacity, volatility and direct access. We shall call these devices RAM (Random Access Memory).
- Between one processing operation and another or when the computer is switched off , data, programmes and results are memorized on devices characterized by low speed, high capacity sequential access, and non-volatility. We call these devices large-scale memory devices.
- There also exist non-large scale memory devices that are characterized by non-volatility. Depending on their peculiarities, these devices are called ROM, PROM, EPROM, EEPROM. They are characterized by average speed, low capacity and are designed to contain very specialized programmes aimed at the management and functioning of the computer.



This diagram shows the input and output unit used for data entry and result output. The data and the instructions are transferred from one unit to another via data bus and addresses bus.

Then, the data are handed on to the user via output peripherals or stored on memory devices. The memories used by modern computers can be classified depending on their functional use.

2. 1. 2 SOFTWARE

A complex structure like a computer system needs to be managed, hence the question – who or what should manage it? The answer to this question is that there is a whole series of software modules whose purpose is twofold: on the one hand, it is the management of the computer, and on the other it is to provide an interface enabling communication between man and machine . The software modules make up the Operating System.

Since an operating system is a manager of resources, very different one from another, (cpu, memory, disks and printers), we can refer to an operating system as a collection of management functions, each of which managing a different device/ resource. Apart from the basic modules (kernel) used by all management systems, we can identify the memory management system, the processing manager, the file system and the peripherals manager.

We must point out that the operating system is a software (system) and therefore programmes; the execution of these programmes occurs simultaneously, and in some respects, in competition with the programmes the users have made for their needs. The whole of the programmes is called applications software.

In addition to the operating system and the applications software, we must consider another type of software: programming languages, meaning compilers and interpreters whose purpose is to enable programmes to be written in a programming language.

The final software family to be considered are the utilities. They include all those programmes which are used to manage or utilise the system (e.g. the programmes to format the floppy disk or Internet Explorer). The whole of the operating system, utilities and programming languages are called basic software.

It can be said that a computer only runs software applications for a very short time; the rest of the time is involved in running operating system modules or processes arising from them.

2. 1. 3 HISTORY

Computers were not a casual invention, but were the result of academic studies, and inventive applications often of great innovation considering the technology available at the time. The first calculator, a remote precursor of the digital computer was invented in 1642 by Blaise Pascal, a French philosopher and scientist. In 1670 the German philosopher and mathematician Gottfried Wilhelm Leibniz improved Pascal's machine, developing its ability to make not only additions but also multiplications.

Also the French inventor Joseph-Marie Jacquard made an unwitting contribution to the invention of the computer by creating an automatic loom.

In the late 19th century the U.S. engineer Herman Hollerith developed the idea to process data using punched cards. Still in the 19th century, the British mathematician and inventor Charles Babbage invented some machines, including a differentiating machine and an analysing machine, capable to work out complex mathematical problems according to functionary principles quite similar to those of modern digital computers.

The development of analogue computers began in the early 20th century. During the two World Wars mechanical analogue calculating machines, and later electric machines, were used to plan torpedo trajectories in submarines and as ranging devices for artillery.

During the Second World War a team of scientists and mathematicians, working at Bletchley Park, north of London, invented a machine named Colossus, containing 1500 tubes and considered to be the first completely electronic computer. In December 1943 Colossus was operative and was used by the group led by the British mathematician Alan Turing, a computer theoretician, to decode messages transmitted by Germans. Further research led to the development of the ENIAC computer (Electronic Numerical Integrator and Computer). The next type of electronic processor was developed thanks to the studies of the American-Hungarian mathematician John Neumann.

The use of the silicon transistors developed by W. H. Brattain and W. Shockley in the computers of the late 50's made possible the creation of smaller, faster and more versatile logical elements than those with valves. The first integrated circuits appeared at the end of the 60's and their use brought further reductions in both price and size of the machines and a big increase in their functionality. In Italy the first electronic processor was installed in 1954 at the Poltytechnic of Milan and it was only in 1957 that it was used in a company.

In 1958 about ten processors were installed in Italy and 700 computer staff employed. The microprocessor made its appearance during the mid 70's.

In the late 70's and early 80's, micro computers were developed. They were simplified hardware platforms, based on various processors, e.g. Apple_II and CP/M machines. One of the milestones in the rapid diffusion of computing can be attributed without doubt to the Personal Computer, presented to the public in the early 80's with MS-DOS operating system.

In August 1981, in fact, Microsoft, then in its infancy produced the first version of what, in the following years was to be the most widely used operating

system – MS-DOS. This consisted of approximately 4000 lines of assembler code contained in 8Kb. of RAM.

In the first few months of 1982 IBM informed Microsoft they were going to install a data memorising device in a PC, which until then had only been used in large computers: the Winchester disk. This disk had the capacity of managing thousands of data organized in a systematic and convenient system of files. Microsoft began to manage the new hardware.

Version 3.0 was introduced in 1984 to support the new IBM product, PC-AT, which used a new type of INTEL processor, the 80286. New developments in both hardware and software were taking place in the personal computer world. In 1987, together with the birth of the IBM-PS2, the first personal computer, which was not compatible with the accepted industrial standard (ISA), DOS 3.3 was introduced.

Then, version 4 DOS was introduced. It provided the operating system not only with greater power, but also a graphical user interface; this was followed by version 5. At the same time even faster and more powerful processors had been developed.

The time was ripe for Windows to become an operating system in its own right with its 95 version, though it had been originally produced only as an extension to the MS-DOS operating system.

2. 1. 4 TYPES OF COMPUTERS

With the term Personal Computer we mean the possibility for everyone to have on his/her own desk an adequately powered processing system capable of processing texts; -word processor, spreadsheet, data base, as required by any modern work organisation.

The availability of low price computers came firstly from semi-conductor electronics, then from integrated circuits. Nevertheless, PCs are only a part of the computers available today.

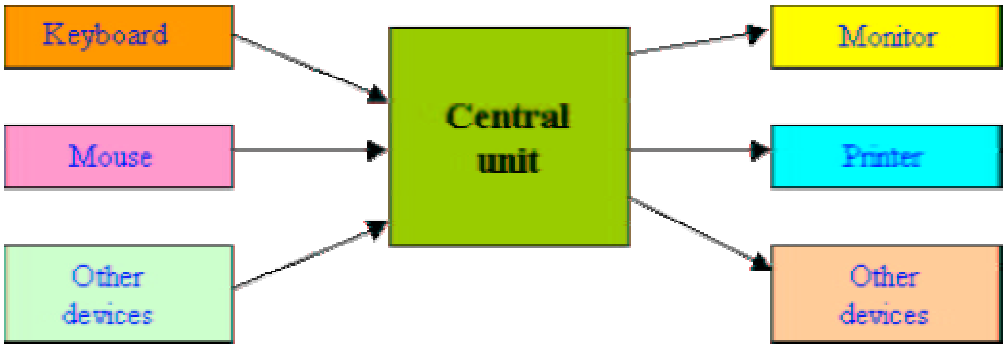
If we wish to classify the computers currently available, we can subdivide them into 3 families according to their processing capabilities:

- Personal computer
- Mini computer
- Mainframe

It is interesting to understand correctly what the components making up a PC are and how they relate to its use, their cost and the market conditions.

Here is a diagram of various components of a workstation:

- input units: keyboard, mouse, scanner
- output units: printer, monitor, plotter
- central units: microprocessor, hard disk, floppy disk reader, CD ROM, RAM, ROM, EPROM, video card, audio card, networking card, internal modem.



By "central unit" we mean the whole of those devices that are physically near, i.e. that are contained with the microprocessor and the motherboard.

The principal characteristics of the above devices are:

KEYBOARD

Nowadays, basically all keyboards consist of 105 keys plus keys for Windows' functions and extensions for multimedia applications.

MOUSE

A pointing device which generally works in an optomechanical way. The movement of the mouse is translated into electrical impulses by means of a small ball, a system of rotating axes and photocells. Nowadays there are mouses interfacing with a specialized port , serial RS232 or USB

PRINTER

Used for printing the documents produced on paper. The main features which differentiate printers, are their speed and resolution of the printing. Connection with the computer is achieved with either a parallel, serial, or USB interface. For networking environment printers with an Ethernet interface are available. Printers can be either ink jet, laser or impact. There are also other printing technologies, which are not easily available on the market yet.

MONITOR

Used to display the results of data processing. The parameters characterizing monitors are the vertical resolution and the horizontal resolution measured in pixels, followed by the screen dimensions measured in inches and the frequency in horizontal and vertical refresh. Basically, there are at least two types of monitor: the CRT monitor (traditional) and the LCD monitor (used for laptops and now also for desktops).

MICROPROCESSOR

Also known as the CPU or central processing unit. It is a device which processes instructions. There are only a few producers of commercial CPUs: Intel, Amd, Cyrix, and Motorola. Microprocessors (chips) can be classified in families, according to their set of instructions. For example the family 80xx indicates all the compatible Intel chips from 80/86 to the Pentium. The main feature characterizing chips is their clock speed expressed in Mhz.

HARD DISK

The principal memory device. Nowadays the average capacity of hard disk is about 20 Gb. The following standards can be identified for connection to the motherboard of these devices : Eide and SCSI. Many parameters distinguish hard disks, including speed of rotation, seek time, latency time, data transfer rate, all of which combine to determine the average access time which today is about 10 msec.

FLOPPY DISK

A removable magnetic memory device with 1.44 Mb capacity and 3.5 inches in diameter. There are also floppy disks with reduced specifications e.g. from 180 Kb, 360Kb, 720Kb and 5 and 8 inches diameter. Other floppies are with 2.88Mb and

memory support comparable in function to floppies with a capacity of up to 1 Gb, although they are not in widespread use.

CD-ROM

Optical read-only memory support with a capacity of 650 Mb and average access time of about 80 msec. Currently there exist also re-writable optical supports, called CD-RW with similar specifications and capacity. There are also DVD or CD-I capable of memorizing filmed material of high quality. One parameter for evaluating these devices is the speed of rotation of the disk and consequently the average access time to the data expressed as a multiple of the speed of rotation of a normal audio CD.

RAM

Random Access Memory is the central memory processing unit organized in bytes in which programmes and data are stored temporarily during processing. Today the storage capacity of a PC is around 128 Mb. The parameter for evaluating memory is the access time, which today is about 80ns. RAM is available as plug-in modules on the motherboard. Various types of slots are available. Today RAM used commercially is of the DIMM type, in the past, SIMM and SIP types were used.

VIDEO CARD

It is the interface between the central unit and the monitor. Today, video cards with the SVGA standard are on the market, giving resolutions up to 1280x1024 pixel. These cards are connected to the motherboard with BUS PCI and AGP. The parameters for evaluating a video card are the processing speed, the presence or absence of a graphic accelerator, the amount of RAM on the card (today is about 16 Mb or 32Mb) and the number of colours or bit density, which can all be managed simultaneously.

AUDIO CARD

Aimed at the management of digital audio and working either through sound reproducers or sound recorders. Parameters for evaluating it are the number of the sampling bytes, the speed of sampling and the quality of reproduction.

NETWORK CARD

Dedicated to the connection of a local computer network. These cards are differentiated according to the media of transmission, usually a cable, and the transfer speed of the data. Currently the most commonly used method is UTP cable with a speed of 100 Mbit/sec. There are also cards, which employ co-axial cable, biaxial cable, and optic fibre cable with varying speeds. Currently these cards interface to the motherboard using BUS PCI.

MODEM

These devices are needed to connect a normal analogue telephone line to a computer, since a modulation and demodulation of the digital signal is necessary. Parameters for evaluating the performance of modems are the transmission speed (today 56.6 Kbit /sec) and the functional standard (today about V90). However, if connection is made using digital lines such as ISDN or ADSL, devices called adaptors are required because the conversion analogue – digital – analogue is no longer required. Today internal modems interfacing with the motherboard using PCI bus and external modems connected to the computer via a communications port RS-232 or USB are available.

2. 2. 1 NATURAL AND FORMAL LANGUAGES

A computer is an automatic 'performer' with limited abilities. Consequently, if it has to execute a given operation, there must be a programmer to instruct it what to do.

This involves a communication problem. The performer and the programmer must share a common language; not a natural language but a formal artificial one which will make it easier for the performer to interpret the instructions.

As said above, the abilities of the performer are very limited: reading, writing, calculating, working out logical operations and memorizing.

Considering that, you will never be able to say to a computer "print that bill", or "work out that pay packet", unless a programmer has already made a programme for both operations.

Therefore, one needs to: understand the problem, express it in terms of the abilities of the performer (algorithm) and express this algorithm in a programming language designed for that particular computer. To write the algorithm which can solve the problem, one must be able to understand the concept of variable and assignment, the instruction to select, an iterative cycle and the concept of input and output of data. These are the basic concepts, which are needed to write any algorithm.

Then, the algorithm will have to be translated into the programming language chosen beforehand, e.g. Pascal or C language, rigidly following the appropriate grammatical and syntactical rules.

Once written, the programme will pass to the compilation phase, to the link stage and the locate stage to be able to obtain an executable program.

Obviously, the use of correct syntax and grammar will not ensure that the programme will work perfectly nor will necessarily give the expected results. Logical mistakes can occur and the programmer is responsible for clearing them.

An automatic tool like a compiler can identify syntactical and grammatical errors, but as to semantic errors only the most obvious ones can be identified.

2. 2. 2 LEVEL

With reference to programming languages, we can divide them into low level or high level languages, depending on whether the language in question is closer to the machine language of the microprocessor or closer to human language.

Assembly types are low level languages, whereas Pascal or Fortran are high level languages.

Among the low level languages we distinguish between assembly and macro-assembly. The former are those whose symbolic instructions correspond 'one-to-one' within the set of instructions of the microprocessor; the latter are those where one instruction can correspond to one or more instructions of the assembler of the microprocessor.

Among the high level languages one can single out those of general use, that are acceptable for any kind of application, and those aimed at one particular type of application.

2. 2. 3 PROCEDURAL AND NON-PROCEDURAL LANGUAGES

Another distinction among high level languages is between procedural and non-procedural languages. The majority of traditional languages, such as Basic, C, Cobol, Fortran and Pascal are considered to be procedural languages.

That means that the programme specifies step by step the sequence of all the operations. The logic of the programme determines the next instruction to follow, in reply to the user's request.

More recent languages such as C++ and Visual Basic use a different approach; programming orientated to objects (OOP, Object Oriented Programming), and programming based on events.

In the model based on events, the programmes are not procedural because they do not follow a logical sequence. The programmer does not keep control and does not determine the execution sequence of the code.

Instead, every action of the user, be it pressing a key or clicking a mouse, can start an event which determines the carrying out of a routine or procedure that the programmer has written. In this way, the order in which the code is activated depends on the identifiable events, which in their turn depend on the operations carried out by the user.

The term 'visual programming' means the development of software based on the use of a graphic interface (windows, buttons, icons). An environment of graphic

development supports the work of the programmer so that he/she can see immediately the aspect of the application as it will appear to the final user.

All modern development environments for creating software utilize the visual interface for the programmer and create applications for the final user which present the typical objects of visual programming; windows, command buttons, drop-down boxes.

Among the most important visual software environments are: Visual Basic, Visual C++, Delphi. But the principles of visual programming are also the basis of other software products orientated to the creation of Hypertexts, such as ToolBook, or dynamic web pages for the Web, via HTML modules, the functions of Javascript, Java applet or ASP (Active Server Page).

2. 2. 4 CASE

Nowadays the programmer is helped in his/her work by additional software tools. They are called CASE (Compiler Aided Software Engineering) and are a kind of programme generator. Roughly speaking, the programmer describes the problem to be solved and the CASE tool writes the programme. In general, programmes generated by a CASE tool are not easily read, not very efficient, but reliable.

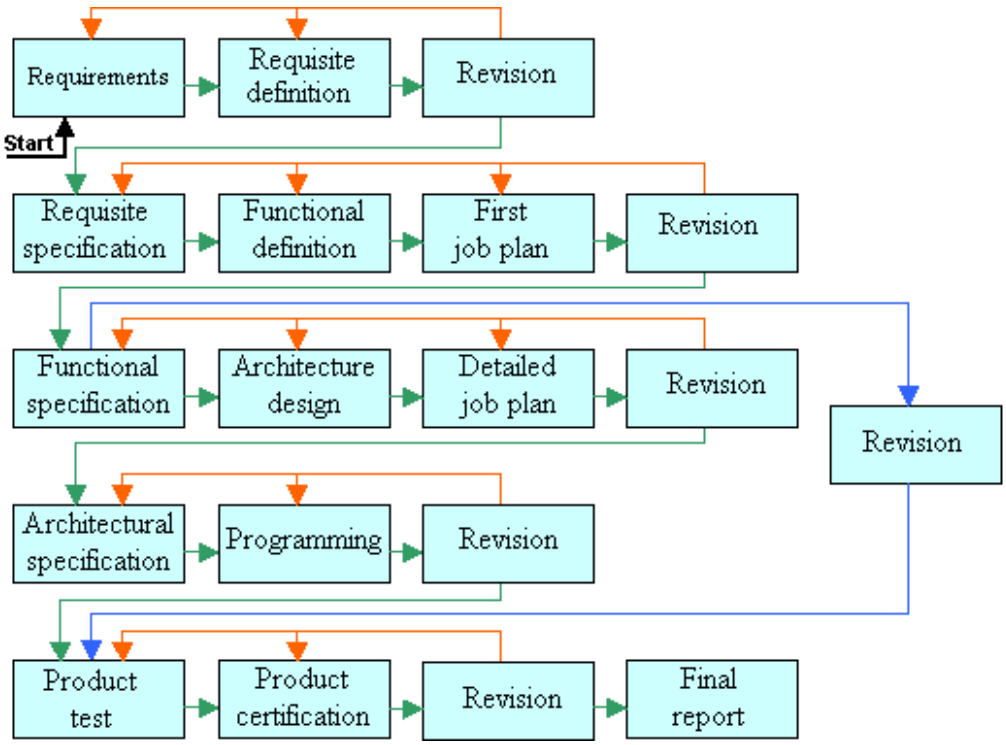
2. 3. 1 NEEDS

The cost of hardware components for a computer system has enormously gone down in recent years whilst the price of software has increasingly risen. To understand why, one should consider the nature of software, the methods used in its production, its characteristics and the cost of the personnel employed in its preparation. In fact:

- The availability of very powerful hardware at lower and lower prices and the fact that information technology is increasingly interacting with everyday life, makes software become more complicated and therefore more difficult to produce.
- The high level of individualism in software development and the not-always-satisfactory technical training of IT users, make software production even more problematical.

It follows that there is a need to use really effective working methods and control tools, in order to prevent problems between specialists and users, not to mention difficulty in identifying the planning objectives.

In the 70s, thanks to the efforts of numerous researchers, the term software engineering was introduced. They proposed a scheme of work guidelines, for what we can call software development cycle - a series of operations leading to a software product of good quality.



Software development cycle

Let us look in detail at the above boxes.

The needs and the definition of the requirements (with subsequent revision) start from the work undertaken by people who are experts in the field of the problem to be dealt with, and by systems analysts. In this phase the aim of the final software product must be clearly defined.

At the end of this phase, the specific requirements must be stated in a very clear way for the clients and the producers of this product. The next step is to arrive at the functional definition, i.e. "the what?".

This involves drawing up the first work plan, with revisions, and enables a document of specific functions to be prepared. This document outlines the project objectives, i.e. the functional characteristics of the desired product, its main performance features, its hardware and software environment, and the eventual completion date.

During the preceding development phases, the preparation begins with an estimate of costs, which can be amended as the work plan unfolds.

The document of functional specifications is of enormous importance in the development cycle of a software product and one must continually refer to it as the work progresses.

From this document, the test preparation phase can be launched , which will be completed just before the final revision of the product. "The how?" phase, i.e. the planning of the product architecture, starts from the functional specifications.

This phase includes the structure of the program modules, the sub-programs, the interaction with the operating system and with possible databases, files and communication between program modules. Besides, the implementation plan in the chosen language, or the subdivision of several modules among more languages, must be defined.

At this point a detailed work plan can be drawn up, with allocation of tasks to various employees and the estimated costs to complete. Everything is again revised until the preparation of a series of documents representing the specification of the architecture; these documents form the necessary preliminary statements to the programming work.

The detailed programming work highlights the various implementation phases and the expected completion dates, usually expressed in relation to the starting date of the project, the human resources to be employed, the equipment required to bring the project to fruition, the number of machine hours to be made available during the various phases, the controls that can be used to check the progress of the work, possible links with other projects simultaneously proceeding, and all other information useful to improve and monitor tasks and development schedule.

The programming phases, with consequent revision, should be represented by a number of boxes, one for every program or module; the revisions include the testing of each module or sub-program and testing of the modules that interact with them.

At the end of the programming phase the software is ready and the sign-off phase must be completed. This consists of checking that the product is correct and corresponds to the functional specification. The end product of this phase must be a report on the quality of the product and must include statements of errors encountered. During the sign-off phase program, tests are carried out, but they do not constitute the final test. The final test, that is the product test, is the final revision and must be carried out with test cases prepared during the development of the project.

In the end, the final report must be prepared. It consists of the total number of documents produced during the project development presented in an integrated form and also documentation for the user, i.e. the operating manual.

The latter is essential if the product is to be used successfully by non-specialists in that field; it must be written in simple terms and foresee all the possible

actions and procedures for the users, in case the system does not work. The final check should also include an acceptance test by the client.

In the process chart, the boxes relating to the revision are placed at the end of every phase and before the next one; in fact, the revision is undertaken in a more fragmented manner, sometimes in parallel to the actions represented by the preceding boxes. In addition, having checked the conditions, amendments to the work plan may be needed if problems are to be avoided in the final stage.

Having reached the final phase and after the client has accepted the product, the product itself is not abandoned. Indeed software is not a static product; it has a life cycle, which depends on various factors.

New needs may arise, independently of the client's wishes; for example, when changes in the law involve management changes in certain areas. Moreover, the client must be helped during the installation phase, especially in the case of software, which requires tailoring to the hardware system configuration of the client.

Needless to say, the later a software error is found out, the more expensive it will become when it is finally corrected. This means that you must proceed only if you are sure you have overcome each preceding phase.

The work scheme consists of a series of methods and techniques used to make software development more like engineering rather than a craft.

To prepare the implementation plan of a project, one needs to identify the resources required and the development time scale. To this end, one must make use of existing daily or monthly productivity standards and comparison with other similar projects.

The daily productivity standards are obviously based on an average, which reflects not only the personal characteristics of the team members, but external conditions or the technical characteristics of the project.

There is a ratio between the number of instructions making up a software product once it is accepted as a project and the number of man-days employed totally in the project, including the business analysis, the actual implementation, the documentation and quality control. Such a standard is expressed in instructions/ activity.

The sub-division in the successive steps of the activities envisaged can also be very useful for keeping the time schedule for the completion of the project under control. In the case of projects that are particularly complex, one can refer to a methodology, PERT (Performance and Review Technique) that is quite detailed and emphasises the dependencies and external conditions by means of diagrams of various types to highlight the scheduled use of dependencies.

The implementation plan drawn up by the person responsible for the project provides a basic tool for fulfilling it. However, continuous and systematic checking, made with the most objective criteria, between the plan and its effective progress is essential.

Indeed, in this context experience has often shown that the control methods for software projects, based on a percentage estimate of progress made, are unsatisfactory. However, even an imperfect control system is still indispensable for highlighting the need to modify the plans, the objectives, to increase the resources, or replace staff who are not performing well.

In this regard, it is important to realise that excessive human resources poured into a project, can lead to a great increase in the flow of information between team members and consequently an increase in the man-day costs of the project. Furthermore, putting additional resources into already up and running projects, particularly if they are not well trained for the specific topic in mind, does not necessarily guarantee an acceleration in the rate of development -- thereby making up for the time lost -- but may also increase the delays and slow up the development.

2. 3. 2 DOCUMENTATION

The preparation of documentation relating to a project is not viewed as very important by people working in the field and, therefore, its usefulness is not perceived immediately. Consequently, there is a tendency to confine this operation to the end of the project.

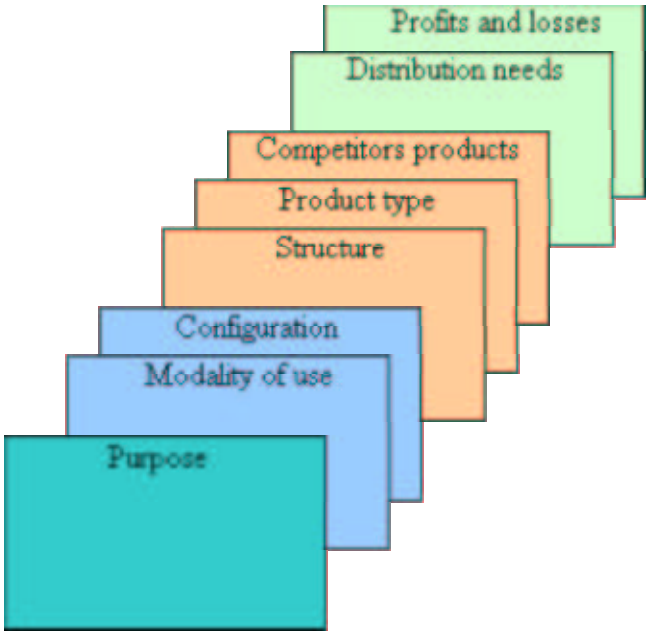
This tendency is dangerous, as when the project is completed the motivation for the documentation diminishes and this could lead to a risk of frustration of effort. In fact, if documentation is missing, the possibility of working on the software for the inevitable maintenance operations is practically zero.

It is, therefore, essential that the preparation of the documentation proceed in parallel with the development of the software, not only the product documentation but also the one for the user.

The term “product documentation” refers to the total number of documents describing in detail the completed product, with the aim of allowing work to be done on it, whether by those responsible for its development, or by third parties. This work can take place during development or later.

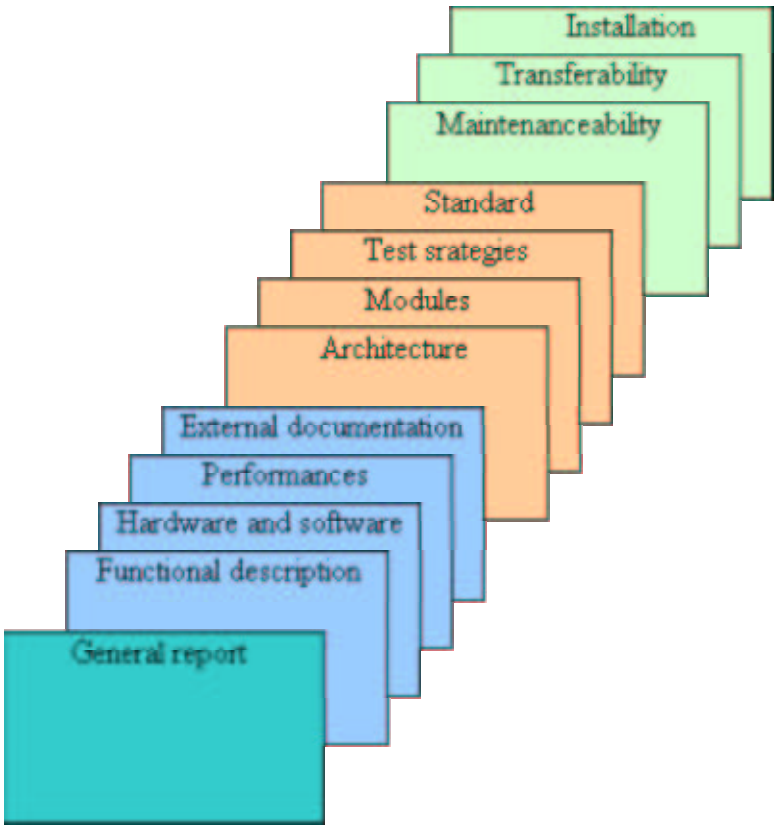
The first case is when new personnel may have to be inserted into the project to replace team members who have left or to augment parallel resources. The second case may occur because of the inevitable maintenance operations, which cannot always be undertaken by those implementing the software.

In this case, it is well to remember that a software product is usually something which evolves over time for various reasons, such as changes in the functional specifications, hardware modifications, external changes as well as the possibility that bugs still present when the software is handed over -- but not evident at that time -- need to be corrected.



We are talking about software maintenance. The importance of correctly and completely documenting a software product is therefore essential, especially in consideration that because of the high turnover of personnel in this sector, the maintenance is often carried out by staff who was not involved in the original development. To increase productivity more easily, certain documentation standards have been proposed. There follows an example of the requisite specification standards.

This is an example of specific functional standards.



The two examples refer to products of a standardised type to be put on the market; rival products and their characteristics are also taken into consideration.

It must be underlined that when the user is equipped with unclear, ambiguous, or worse, error-strewn manuals, it follows that such a documented software will be used erroneously.

This will have consequences comparable to those brought about by real bugs in the software, with the result of time lost by the user and credibility lost by the person responsible for creating the software.

To rationalise the development procedures in a piece of software, one must identify a certain number of modules into which the project can be sub-divided, in the development (detailed analysis, coding debugging) of each module separately, and in their later integration, until the completion of the whole product.

The identification of the modules does not present particular difficulties, nevertheless it is advisable to proceed with caution so as to guarantee sufficient functional independence of the modules.

This is aimed at enabling possible later modifications to be made, without severe repercussions in many other modules.

Nevertheless, this method of working, modular programming, raises the problem of the definition of the interface between modules, that is the transfer of data between modules or more generally the local connections between a module and the rest of the project.

Modular programming is a working procedure still in use, mainly because it allows a high level of parallelism in the implementation phases following the business analysis.

Whilst modular programming involves, after the business analysis, an implementation phase carried out in a bottom-up way, i.e. using the successive interactions of modules created separately, it is always recommended not to lose sight of the overall vision done in a top-down way.

Experience has amply demonstrated that it is very convenient both making a disciplined use of control structures and proceeding in top-down mode while implementing, if possible, using a formal language to describe the details of the implementation.

Top-down implementation and the restrained use of control structures must be accompanied by a hierarchical organisation of the data (e.g. files, records, fields, characters, bits) and by a series of rules regulating access with the appropriate techniques.

It must be pointed out that the test phase of programs is simplified with the technique of modular programming. Indeed, a short programme is more easily tested, and once the results have been ascertained, the small modules can be put together to obtain a more consistent module without the risk of finding an error and not knowing where to check it.

2. 3. 3 SUCCESS

It is a widely held, but erroneous, belief that a software project needs only human resources with a pencil and paper.

In reality, hardware of a sufficient size, reliable and easily available is required. Such equipment, which can be set up as a real software factory, is important not only for the program debugging process but also for the implementation phase,

documentation and maintenance. Indeed the use of a computer, which might not be the one for which the software is being created, allows:

- An efficient program manager for both sources and object programs that, as they are created, facilitates error correction and modifications via programs operating as a librarian.
- A rational management of the documentation developed. This can only be achieved if the system is interactive and equipped with a print unit able to send text directly to the printer.
- The management of development plans, with necessary updates, and the application of network techniques.
- The management of test data. Management of this nature is particularly important for repeating the tests on the data used previously, after modifications have been made to the software release
- Program compilation. This can be done on the computer destined to use the software being developed, if it is equipped with a compiler with sufficient compilation speed, or on a host computer.
- The possible simulation of object programs if the computer using the software is not available or has attributes which make perfecting the software difficult.

One can reintroduce the implementation language, whose the choice can be determined by the conditions under which the development takes place.

The development of a reasonably sized software project is usually carried out by a team that in the business analysis phase, is by necessity restricted in size. In the implementation phase, it includes more people with different levels of experience and capabilities.

Therefore, the implementation team besides the team leader, includes a number of analysts, program analysts and programmers and it is very important that all of them have a clear understanding of the general lines of the project, so that each participant may contribute his/her activities in an aware and cooperative way.

It is useful here to sum up some of the criteria, which must be taken into account during the development of a project, if a good result is to be obtained.

- Validity of the specification. The performance required of the software product must be within the capabilities of the hardware system on which it will be implemented, so as to avoid critical points in the realization of the project, which are often responsible for delays and failures. Moreover, it is advisable to limit requests for inserts into the functions. Similarly, the temptation to achieve perfection must be ignored, which is a very dangerous idea both when drawing up the functional specifications

in the detailing of the project specifications and in the actual implementation.

- A realistic plan. Very often the technical staff who draw up the implementation plans are subjected to psychological pressure from the end users or from their superiors and are thus forced to promise completion dates or development costs which do not correspond to the reality. In an attempt to keep faith with undertakings pledged, one can be pushed into making very dangerous decisions, such as an excessive parallelism of resources, a too-hurried detailed analysis, an inaccurate de-bugging, adding staff after the start of the project. Generally speaking, such decisions are counterproductive, as the result may well be a later slippage in the delivery date or a further increase in costs. It is much better to make a realistic initial appraisal even if it is fairly unpleasant (which is often the case when compared with the dream!) rather than being saddled with a series of difficult situations for the whole team. Obviously, one must avoid quoting too high for a project, or a lengthy delivery date, since this may force the client to abandon the project and turn to other suppliers.
- Control of Changes. As the proverb says "Appetite increases as you eat". Even in the software field this is appropriate, both during the development phase of a project and during the maintenance phase, following proposals for modifications. These can be requested by the final user to improve the product functionality, or by the project team who realise that the specifications must be improved or that a modification could improve the product performance. During this maintenance phase the modifications can be effected without causing too many problems, in fact it means launching a new product for which a new implementation phase can be planned as well as a re-estimate of costs. On the contrary, acceptance of modifications in the implementation phase must be undertaken with great care. In particular the cost of the modifications required and the repercussion arising from missed deadlines must be accurately costed and made acceptable to the client. It is advisable to shelve the not strictly indispensable modifications and postpone them until the project is complete, introducing them in the maintenance phase.
- Phased Implementation. It can be useful here to make note of a simple strategy that can be employed with excellent results in the development of big software projects. It consists of establishing a series of levels in the final product and in the planning of the project starting from the most elementary level right through to completion, via successive steps. Every step corresponds to an intermediate level of the product and is seen as an extension of the preceding step. For instance, if we think of creating a

compiler in this way, differentiated implementation can make available successive language sub-sets.

Naturally, the general analysis of the project can be included in the first step of implementation and very probably the detailed analysis, and the coding of some modules, must be anticipated, but this is not a problem for the application of the procedure.

The intended objective is to have a functional product, even if with a limited performance, in great advance of the final delivery, which is very convenient. Obviously, each new level of implementation must be subjected to all the tests undergone in the previous level, as well as a new series of tests verifying the new specifications. Indeed, it is necessary to check that the insertion of new modules does not generate new problems in those already functioning.

Nevertheless, this must not be considered a disadvantage as it ensures a systematic approach to testing the whole system.

The procedure described has the considerable advantage of providing indications and objectives in good time on the validity of the project and the productivity of the working group in charge of its development.

This may be of particular importance whether the project contains notable innovations or employs new implementation techniques, or whether one has to check the practicabilities of the group responsible for its development, who can be affected by an excessive desire for perfection.

2. 3. 4 SECURITY

The final consideration which must be made concerns the data security. The computer with its ability to store huge amounts of data, access them rapidly and manipulate them at high speed to derive information, is the piece of equipment which is bringing about the information society, just as engineering and electricity did in the modern industrial society.

It is reasonable to ask at this point whether the computer cannot but influence the evolution of society, or can be used by individuals and organisations to intrude into the private life of citizens.

This danger undoubtedly exists and in these days the right to privacy is a question widely discussed. In fact the collection of data on disks that can be easily and rapidly accessed, relating to citizens (private, fiscal, medical, political) can lead to abuses which are not difficult to imagine.

2. 4. 1 WHAT A DATA BASE IS

A database can be defined as a collection of information that is closely interrelated, stored with the support of a large capacity memory, making up a single entity and which can be processed by a data processing system.

It is thus composed of data. In order to manage it, a modern data processing system provides a whole series of functions which together make up a DBMS. A DBMS is concerned with updating, maintaining, consulting, and with the integrity of the total record contained in the large capacity memory.

A DBMS can receive commands:

- directly from the user in interactive mode, via a query language
- via a program written in a programming language
- via a program written in an algorithmic language which interfaces with the routines of the DBMS.
- For the communication between the database and the user, various specific languages are used depending on the function required.
  - DDL,- data description language. This language allows us to define the overall structure, the schema of the system. It is a declarative language.
  - DML, - data manipulation language. When the structure is defined, one can proceed to insert data. DML is a very powerful language which, from the schema, is able to carry out operations of data manipulation. This is also a declarative and non-procedural language. With procedural languages one needs to indicate how to get to a desired result step by step; in this case it is sufficient to state in a clear, complete and unambiguous manner the required results.
  - QL – query language – or interrogation language with an interactive structure.
  - Host Language. Often data manipulation is obtained via an application programme written to perform certain tasks. The programmes to manipulate the database are written in high level languages, which are called ‘host languages’. They are used for operations which are not concerned with the database

e.g. visualisation, the input from the keyboard and both numerical and logical calculations.

2. 4. 2 LEVELS

The DBMS controls all access operations to the database whether they are for updating, searches in files or requests for other operations performed simultaneously from different users.

It can be considered as a series of levels of abstraction which offers the user levels of views of data that are less and less connected to their physical representation.

Three levels of abstraction are usually considered:

- The first one is the physical level of the database. This is represented by the large capacity memory used for storing data and allowing rapid access. In this respect, one must distinguish between true data and the structures suitable to allow access to the data. At this level a user should interact with the links connecting one record to another record with links starting from the secondary key to a data file.
- The conceptual level is inherent in the definition of the logical structure of the database through an abstract data model. Such a model enables us to group the information of all the files stored at the physical level and view them as a coherent whole. The description is obtained via the DDL which defines the description of the model and the instructions of how to implement it via the physical schema. The global model is made up of entities, each of which will have data - named attributes – located in it. When planning a database, the actual work involves defining the conceptual model, meaning the logical schema assumed by the data. The conceptual schema, used in the planning phase, tells us which are the entities, which are the attributes referring to them and which are the links existing between entities and attributes. Such a schema must not be confused with the contents of the database which we shall call instances or active database. For example:

  EMPLOYEE (name, type of role, length of service)

  Entity: STUDENT
  Attributes: name, role, length of service
  Domain of definition: Name: string
  Type of role: integer from 1 to 5
  Length of service: integer from 0 to 50;

- The conceptual level determines the overall structure of the database; having defined the conceptual schema, each user can access the database. This is made possible by the functions of the DBMS in relation to the external level. These functions give any user the impression to be the only one using the database. Access and surfing are effected via schemas called logical data views. A view is the extraction of a part of this conceptual database. This includes the data of the database limited to that part which is of interest.

2. 4. 3 DBMS

DBMSs give a centralized and controlled management of the database, whose main areas can be synthesized as follows:

- A drop in the redundancy of data. By redundancy, we mean that data may be frequently met in the database, which requires repetition for the functions of insertion, updating, maintenance etc. as well.
- Elimination of incongruency between related data which are in separate files.
- Sharing of data by all the applications requesting them.
- Security and privacy of data.
- Optimisation of the structure of the database, allowing easier access and maintenance.
- Data Independence

All the functions described above derive from the fact that a DBMS displays:

- Efficient access. That is to say, the use of a method of accessing data which is excellent in so far as the relationship between the results obtained and the hardware involved is concerned.
- Physical independence. That is to say, the ability of the conceptual model to be completely detached from the physical one which displays it, or the applications which use it, in such a way that the physical organisation of the data may be changed without modification of the logical organisation or of the applications.
- Logical independence of the data which is the ability of the database to adapt itself in dynamic mode to the user's requests without corrupting the conceptual model. All the logical structures of the data can be varied without changing the applications which use them

2. 4. 4 MODELS

The logical schemas used to organise data inside a database can refer to different models.

These trace the path in which the user of the database sees the relationships between the various data contained in the files. A model of the data is a schema capable of representing reality described using a formal method.

The data model must meet several fundamental requirements and must therefore be:

- Formal: or at least respecting a definite form without accepting ambiguous or insufficient definition.
- Complete: must describe every aspect of reality in depth .
- Simple: allowing easy use of the structures.
- Infological: or at least not linked to a contingent reality but able to describe reality regardless of the software used.

2. 4. 4. 1 ENTITY - RELATIONSHIP

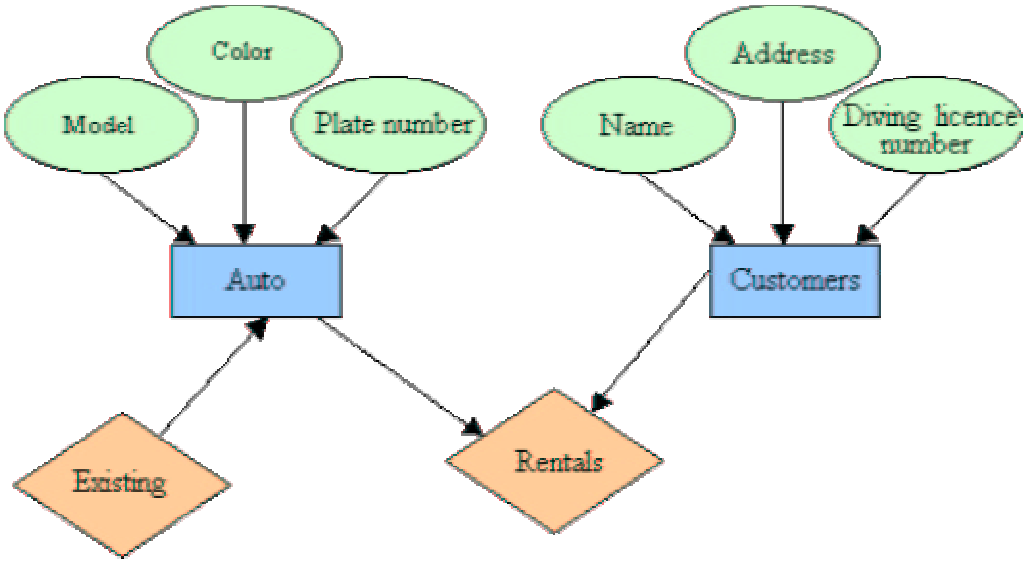
One of the models is called ‘entity-relationship’. It is a conceptual model able to describe the conceptual level of a database using essential components such as entity, attributes and relationships.

In the entity-relationship model, each entity possesses only some of the all attributes which identify it uniquely.

Each of these attributes is named "primary key". The entity-relationship model involves graphic symbols through which it is possible to represent the basic structures of the model and the relationships existing between them:

- The entity – a rectangle;
- Relationships – a rhombus ;
- The attributes – an ellipse;
- The existing relationships between the structures – the arrows.

It will therefore be possible to represent the database graphically, relating the entity to each of the attributes which characterise it and the relationships between the entities.



The entity relationship model is a conceptual model par excellence and possesses the desired fundamental requirements; it is formal, simple, and complete but above all it is infological.

The logical model comes from the conceptual model and constitutes the basis of the management and design of the database. The logical models bring us to the main categories: hierarchical, network and relational.

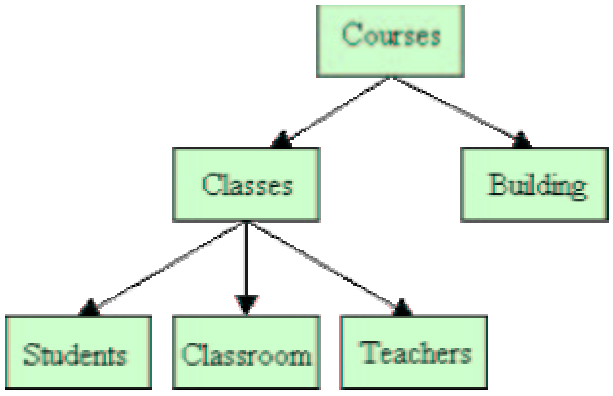
2. 4. 4. 2. HIERARCHICAL MODEL

The hierarchical model is a collection of files whose logical content can be seen as a tree made up of recurring different types of records, more correctly known as segments, which are in a hierarchical relationship amongst themselves via links of the father-son kind; i.e. 1:n.

Therefore, the basic elements making up the hierarchical model are:

- The files or rather the record groupings which are not necessarily homogenous.
- The recurrencies, or rather the different ways of presenting data within the structure.
- The segments or rather the different kinds of records
- The hierarchical relationship linking the structures of the file type, this link running exclusively from parents to children.

The hierarchical model is thus based on a main segment, the so-called root, on which the children depend, who in turn become the parents to other children. For example, a model for a school can be represented as follows:

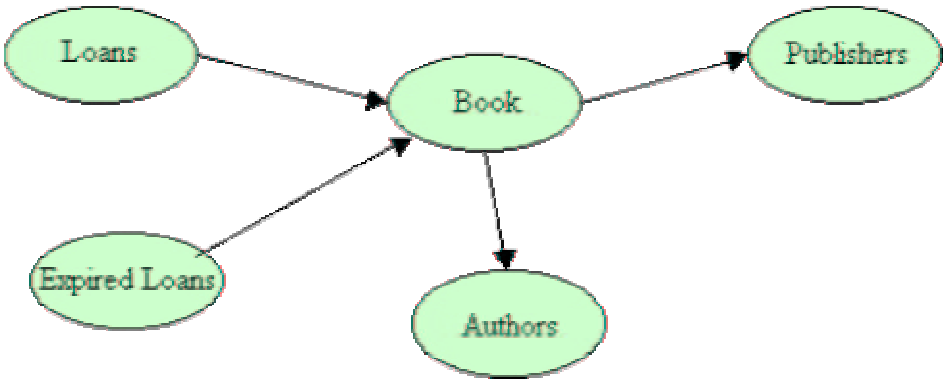


2. 4. 4. 3 RETICULAR MODEL

The reticular model can be viewed as an extension of the hierarchical model to which improvements have been added, which in some respects, revolutionize the very structure of the model.

In a hierarchical structure, a child segment can only have one father, whereas in the network model every record can have any number of subordinate records. All previous records and the relationships occur through a particular kind of record called connecting or linking records.

To represent such a complex structure a graphic description is needed. For example, the situation in a library can be represented as follows:



2. 4. 4. 4 RELATIONAL MODEL

The relational model is the definitive solution to the problems relating to the organisation and management of the data within DBMS. It is an abstract model able to describe every situation and to eliminate redundancy.

The relationship model is based on the mathematical concept of relations between sets, understood to be subsets of the Cartesian product.

As to relational databases, the following definitions are valid:

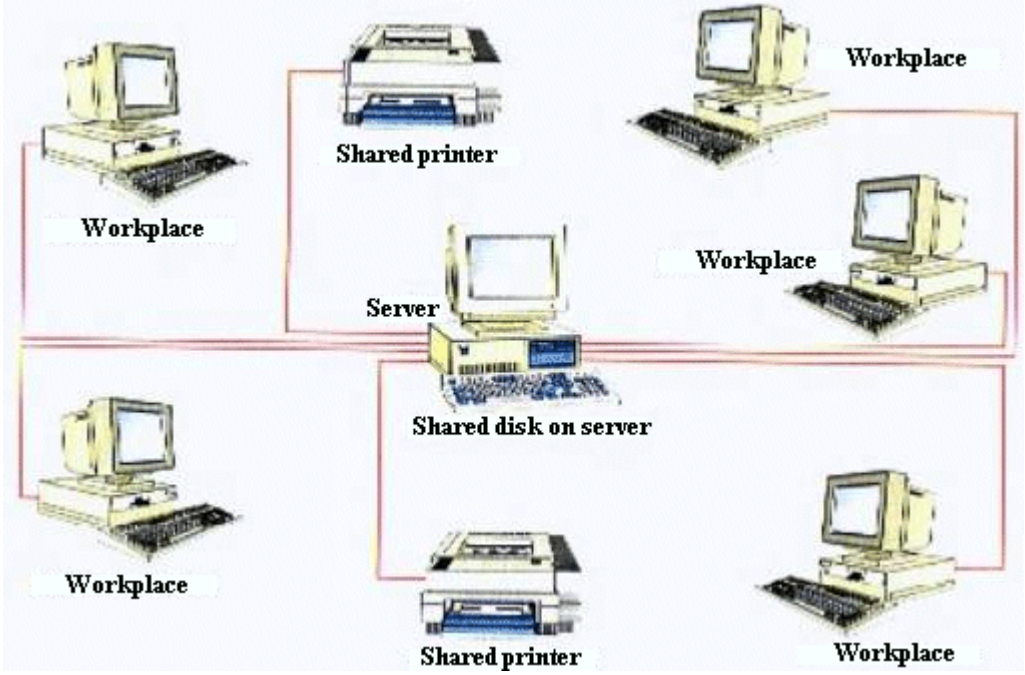
- The names identifying the sets (name, address, etc.) are called domains.
- The table displaying the relationships is called a formal extension of the relationship itself.
- A row in the table, called an occurrence, represents one element of the relationship; the assumed value of the table is called tuple.
- The number of rows in the table is called cardinality of the relationship and varies with time.
- The number of columns, i.e. the number of attributes, in the table is called degree of the relationship and cannot vary with time. The name of the relationship followed by those of its attributes is called 'scheme' of the relationship.

When planning a relation it is necessary to choose one or more attributes for every entity – called key attributes.

A key is a unity made up of one or more attributes whose values enable us to identify uniquely the tuples forming the relationship.

2. 5. 1 GENERALITIES

After having concerned ourselves with producing and managing data in a local environment - that is to say on our own computer or one put at our disposal - let us now focus on a system that can share data, in other words which enables us to work from different places. Such a system is called a network, i.e. a system of several computers located in different places and capable of sharing data and resources.



A network consists of hardware components, i.e. the devices and physical media that enable transmission, and a software component, that is programs created for transmission management.

Let us take an example: two computers

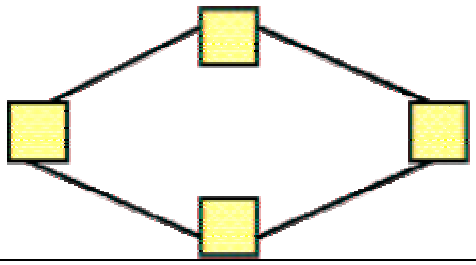
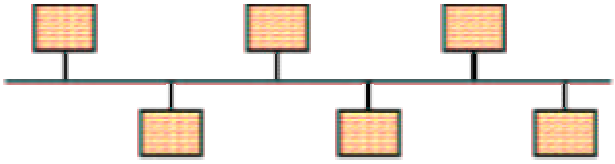
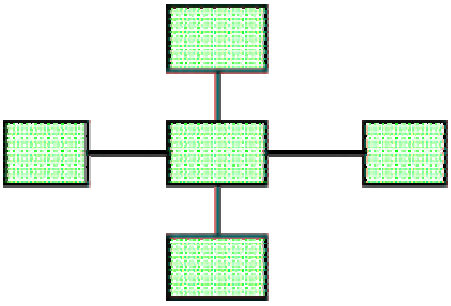
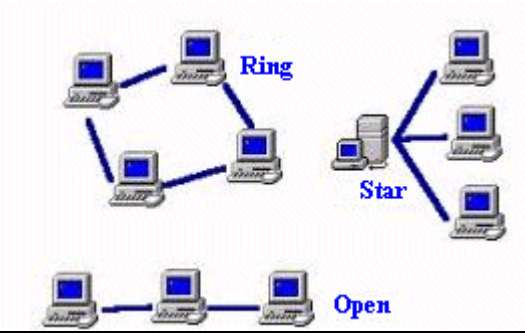
One of the computers of the picture will be the sender and the other the receiver. In order for them to share information, a transmission line, or means of transmission, is required. It can be a coaxial cable, a twisted pair cable or a fibre optic cable or also radio waves. In addition, software to manage communication, a protocol, that is a series of rules enabling computers, even if dissimilar, to communicate with each other is needed.

The most widespread network in the world today is the telephone network, which transmits analogue information. Computers work with digital data, so how can we transmit them on an analogue system, the normal duplex cable? Modems can solve this problem. A modem is a hardware device that transforms the digital signal to analogue (D/A) and vice-versa (A/D).

To exchange data between two computers set widely apart we use a modem. Such a system is called WAN, Wide Area Network.

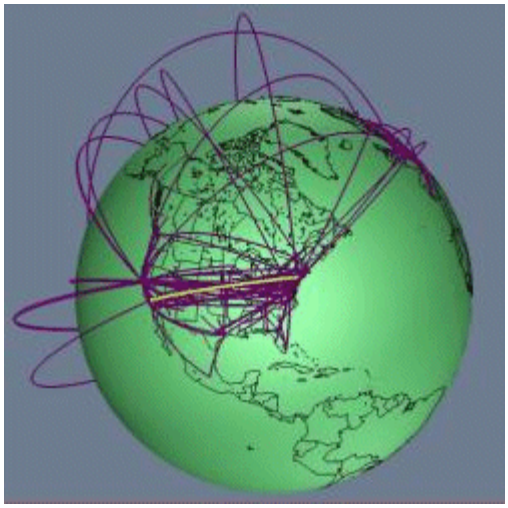
If the two computers are in the same building, the transmission method used can be co-axial cable or UTP cable, connected to a network card, also called a NIC, inserted into the motherboard. The transmission will be digital. Such a network is called a LAN, Local Area Network. The networks can be of the following types:

2. 5. 2 TOPOLOGIES

Ring Network 	Each communication node communicates with others via a bus in the form of a ring. If a node breaks down, part of the network is blocked.
Bus Network 	Similar to a ring net, the data is carried in a single bi-directional bus to which all terminals are connected. If one terminal is blocked, the whole network is blocked.
Star Network 	Each node is connected to the central node, i.e. the server via the hub, which manages the inputs and outputs from the server to the other nodes. This network only fails when the server is out of commission.
To summarise : 	

2. 5. 3 INTERNET

An example of a WAN is the Internet, known as the net of all nets and made up of many interconnected networks.



The rise of Internet technology has thrown up a series of neologisms, including:

- Intranet
- Extranet

both like the Internet, using the same protocol of TCP/IP (Transmission Control Protocol/Internet Protocol) to communicate.

This protocol is independent of the network used. The technology involved is packet switching, which means sub-dividing the message to be sent into discrete packets; each packet can follow a different route within the network to reach its destination, where the message will be reconstituted thanks to them being numbered.

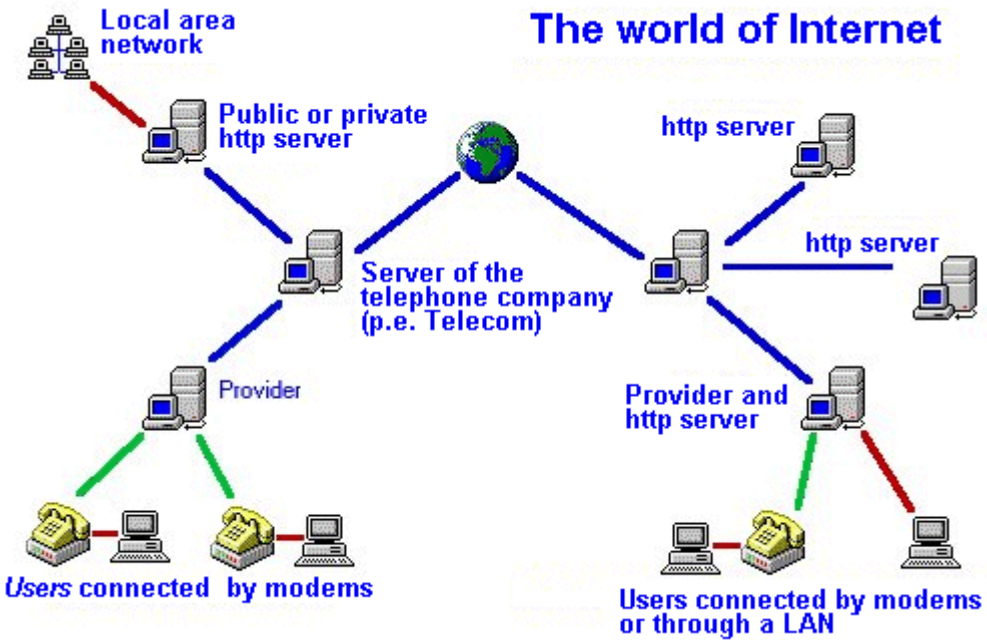
Each node of the network is made up of a host with which is associated a unique address, i.e. IP address, formed by a sequence of four numbers, all between 0 and 255, e.g. 192.17.30.12 indicating computer.sub-net.net.zone.

When the TCP/IP has to send data, it checks the left side of the address indicating the sub-net whilst the last part refers to the computer. The packets of data pass across hardware apparatus, which enables the various networks to be connected with each other. In particular, bridges connect networks of the same type, routers and

gateways different ones, and each of these devices checks the destination address to re-direct it.

An alphanumeric number can substitute the address number, for simplicity. It will then be up to an Internet service, the DNS, to associate the alphanumeric address with the numerical one. In the IP, the last number shows the area, or even the country – it. for Italy, fr. for France, uk. for Great Britain, us. for the USA etc. But this section can also identify a company or an organisation, e.g.

Com	Commercial organisations
Com	Commercial organisations
Org	Non-commercial organisations
Edu	Schools and universities
Gov	Governments
Mil	Military
Int	International organisations
Net	Net resources



The most important part of the Internet is undoubtedly the Word Wide Web, known as www. which consists of data organised in hypertext, i.e. passing from one document to another, a document that can also be located on a remote server.

The fundamental language used to write these hypertext pages is a formatting language called HTML.

All the data organised in an associated manner, or hyper- textually, are available in a computer and form a web-site

The computer becomes a host to which the users (clients) can connect, to consult the data. A site can be represented totally by one server or host, or itself be on a host that has sub-let part of its hard disk to an organisation that wishes to create a web-site. The protocol used for the transmission of hyper textual data is called http, i.e. Hypertext Transfer Protocol.

To view the pages on the screen, navigation software capable of reading pages written in HTML is required, called http. The most widely used browsers are Microsoft Explorer and Netscape.

But before one can join this global network, also called the global village, an ISP (Internet Service Provider) must be called via the modem. This allows access to the Internet for the user. The ISP is connected to the Internet 24 hours a day via dedicated lines and represents one node in the global network.

2. 5. 3. 1 INTERNET SERVICES

Let us look now at the services the Internet offers.

- The Internet is a mine of information and to make the information available we use a search engine, i.e. a site that behaves like a massive database by storing data and the terms used in the global network sites. When instructed to carry out the required search, it sends back all the sites relevant to the subject matter or topics concerned or containing the significant words requested by the user.
- Electronic Mail (e_mail) is the most widely used service on the Internet. Both the sender and the receiver must be on-line on the Internet if messages are to be exchanged and each must have an address (e_mail address). The ISP assigns the address to users, it is similar to a post box stored in the computer, which we dial when we connect to the Internet; in other words, messages addressed to us are stored automatically on a hard disk. Of course, there is no need for our computer to be connected permanently to the Internet waiting for any messages which may arrive. It is the ISP computer that takes on this role for us. For our part, whenever we connect we can check to see if there are any messages

waiting in our post box. In fact, the computer providing access to the Internet acts somewhat like an answering machine, receiving messages for us while we are absent (or rather when we are not connected) and informing us as soon as we connect. Let us see how an e_mail address is made up. The normal format is as follows: username@hostname.computer. The part of the address to the left of the symbol @ identifies the user uniquely within the system to which he/she subscribes (host), often a surname is used, or a code, or a nickname we have chosen.

- FTP (File Transfer Protocol) is used to transfer files from one computer to another. This operation is called 'downloading' when a file is released to us from a remote site, and 'uploading' when our files are sent to a server.
- The term chat indicates a discussion group, the conversation taking place on-line between several users, the most frequently used protocol being IRC.
- E_commerce, or networked commerce. This facility has developed in the past few years allowing products and goods to be bought and sold on the net, with an obvious reduction in management costs, since business is conducted 24 hours a day.

2. 6. 1 WHAT O. A. IS

Office automation is referred to as the equipment and applications that allow to automatise conventional office activities.

The office is a well-localized place where many people, performing different, interrelated skilled tasks, work in order to supply goods or services.

Offices are usually rationalized and specialized to meet the new society needs or to tackle the management problems due to the great deal of information to be dealt with.

Therefore, office automation concerns company's activities but also services pertaining to administrations and government bodies.

Despite offices have different sizes and aims four different professionals are always required:

- the manager who manages and coordinates resources (He/she does not work in the office but he/she can be found in all hierarchical structures);
- the skilled worker who carries out activities requiring specialization meant as a skill, discretionary power and as the ability to suit the standard to the needs;
- the office employee who carries out more repetitive and deterministic activities according to explicit standards. Whenever he/she has to tackle those situations that do not involve any procedure he/she refers to the manager or to the skilled worker;
- the support staff (secretaries, filing clerks) who make the work of the other employees more productive. They carry out low standard skilled and less repetitive works.

Office automation brings about the reduction in the operative work which is mostly carried out by machines as well as the development of the skilled work.

Three types of activities are mainly carried out within the office:

- structured activities such as receiving or paying the supplier's invoices;
- activities demanding discretionary powers that are integrated with the activities carried out in the same office or in other offices; for example the procedures of granting a loan require information supporting the decision

and change according to the customer, the amount required and the guarantees offered;
- highly- subjective activities such as the drawing up of the enclosure to the budget.

2. 6. 2 INFORMATICS AND O.A.

Since the 60s thanks to the successive development of technologies, the activities and the procedures of the offices have been automatised by application packages whose functions are increasingly complete and integrated with the several office activities and deadlines.

Offices have improved their efficiency by transferring the most repetitive activities to machines. With the passage of time, new information applications have characterized the working of modern offices.

According to users' automatisation requests, computer science can be distinguished into:

- organization computer science: aiming to replace man with the computer in all programmable activities and at the same time to find solutions that make the greatest number of activities programmable;
- individual Computer Science: aiming to supply information tools that users can employ without constraints to increase work efficiency; each user can opt for a tool he/she intends to work.
- the first category, namely the organization computer science, includes the following applications.
- file automation: lists of companies, local bodies and banks;
- automatisation of manual operations: accounting, invoicing, salaries and wages;
- counter procedures: bank transactions, trading stocks, reservations;
- guide to the carrying out of procedures: forms, procedures to grant loans;
- planning automation: production plans, resource exploitation;
- management control systems: periodic reports, forecasts and balances.

The main applications of individual computer science to make office work productive are:

- Word Processing: to write letters and reports;
- DTP Desk Top Publishing: to lay out technical manuals, news bulletins and price lists within the company;
- Electronic file handlers: to create and manage office files such as personal or group telephone books, price lists, address books;

- Spreadsheet: to enter data and recalculation formulas in computational tables by means of statistic graphs
- Personal agenda to plan time and appointments. The several personal agendas can be integrated with group agendas to find the dates of a meeting or to make a reservation;
- Project Management to define the plan to achieve the final project goal and all the necessary resources to accomplish each activity.

The relentless increase in documents handled in modern offices has required the arrangement of automatic tools for filing and searching texts and images.

Paper is an expensive, cumbersome and perishable material. Therefore, the filing in the supports managed by the peripherals of the personal computer allows to achieve the objective of a paperless office. The use of terminals directly linked to the files or networked gives the opportunity to avail oneself of all the documents.

The equipment and the products required to process documents allow to insert the images of a document on the magnetic or optical mass-storage of the computer by means of a scanner. The attributes (protocol activities) can be related to the document for further research and for the print out of the documents collected.

The image of a document, a drawing or a photograph is filed as a set of points with the relative attributes thus occupying much storage. Large storage capacity devices are required with optical disks.

For further applications it can be necessary to use a software for the optical character recognition (OCR) that allows to rapidly and accurately convert the printed characters into a computer processable text. OCR avoids to use expensive and difficult redigitisation and allows to insert a text, available on paper, in applications such as word processing programmes or electronic mail systems.

Thanks to the fast development of office networks and of the Internet the information is received, handled and disseminated in a different way. The amount of generated information is increasing and it is necessary to find high-efficient solutions to manage the work.

Modern offices are changing the way of sharing and handling information by:

- a greater use of networks;
- using the scanner to convert paper documents in a digital form;
- a wide use of the Internet, namely of an infrastructure that allows to exchange information on a global scale.

these aspects lead to a change of the workstation, to the increase in productivity and to the use of new systems to face the increasing amount of data and different information.

2. 6. 3 INFORMATICS SOLUTIONS

In order to satisfy technological and company needs information architectures made up of interconnected nodes have been designed to exchange services and data.

The advantages that can be taken by using these structures are:

- lower telecommunications costs due to the local processing capacity which requires only periodic exchange of data;
- shorter loggin times and closer data;
- the functioning of many nodes that allows one node to stop if any fault of the computer occurs.

Moreover, after solving organizational and designing problems the company system should be adapted more rapidly and with lower costs to the changing needs and to the organizational of the company.

The greater difficulty is to find the best way to assemble data and exchange them between decentralized offices and the necessary central control. In case of a holding made up of two similar companies that are located far apart, two solutions can be adopted:

- a central computer to be installed at the company with a greater transaction volume to be connected to remote computers installed at the other companies thus sharing files and bearing high communication costs.
- each unit has its own computers with its own data and works autonomously . The computers are networked and the data can periodically be exchanged between the companies and the holding.

Engineering a new information system within a company or reengineering the existing one means to provide the company with an information solution that meets the company managements' needs in an efficient way. The solution shall suit the current needs but it shall also foresee the future developments.

Since the technological development is very fast, information solutions are based on open systems, namely on processing systems that are able to integrate different technologies thus ensuring compatibility between new and less recent systems or between systems having different hardware platforms or different operative systems.

It is thus necessary to use consolidated standards as for the hardware, the software and telecommunications fields to safeguard the company's investments, to lower costs due to heterogeneous products and to foster future developments.

Moreover, the applications shall have two fundamental requisites:

- the interoperability, namely the possibility to communicate with other local and remote applications;
- the portability, namely the possibility to work on different hardware platforms.

2. 6. 4 MICROSOFT OFFICE

One of the application packages meeting the office needs and improving the office work productivity is Microsoft Office, a group of applications including:

- WORD: for word processing;
- EXCEL: for spreadsheet management;
- ACCESS: for data management;
- POWER POINT: for presentation management;
- OUTLOOK: for the management of appointments and e-mail

The information handled in the several Office applications can be integrated in several ways. In fact, it is possible to "cut and paste" the information or to link information or objects.

The objects that are embedded in or linked to a document can be modified in the document itself. If the object is linked the source application is open to make the necessary changes. If the object is embedded it can be directly modified in the document.

When a link is created, it is possible to decide whether the information shall always be saved automatically at the opening of the file and each time the source information is modified or whether the information shall be saved when required.

In each document created it is possible to:

- Insert formatted texts and tables in a multimedia presentation,
- Log into database files to obtain the data included in other documents or tables;
- Enter data obtained by database files and create a document by "merge to printer";
- Insert tables the user can consult and handle on the Web pages;
- Convert any Office document into HTML format.

- Although all the applications include demonstrations it is also possible to customize the documents created.

2. 6. 4. 1 WORD

Word is a video processing programme allowing to type, modify or print texts.

This programme enables to check the layout of the text thus changing the font, the style and the size of the characters. It is also possible to set up returns, line feeds, tabs and margins and to check spelling and grammar errors thanks to the spell checker embedded in the software. A new automatic tool called "IntelliSense" enables to check spelling and grammar errors according to the context of the sentence type. It is a great advantage for the users working on texts that are written in several languages.

The insertion of tables in any point chosen in the document is a very recent Word's tool. It also enables to change the position of the tables according to the user's needs. It is also possible to insert a table inside another one so as to highlight the data included in the tables.

As for the print out of a document it is possible to reduce the size of the characters created so as to print the several pages of the document on one sheet.

Word is an editor of WEB pages that allows to create, by demonstrations, Web pages, to save them, to display a preview of the Web page so as to launch the reference browser , to see how the document will be displayed on the Web and to choose the title of the page to be displayed on the browser.

2. 6. 4. 2 EXCEL

Excel is a powerful spreadsheet programme that allows to perform mathematical computations of data arranged in a table. Excel enables to highlight more numerical sets of data in an intuitive graphical environment and to handle the data arranged in a database.

One of the most widespread uses of a spreadsheet is the creation of a computational model. Financial, scientific and statistical models can also be created. Excel creates xls files arranged with labels, "constant" values and suitable formulas that allow to change input data and obtain different results that conform to a specific application.

Excel documents are compatible with other programmes. In particular, it is possible to link Excel to other Office programmes. For instance an Excel table or a graph can be imported in a Word document.

Excel enables to save files as HTML pages and to edit them on a WEB server, so that the documents created are available for the users having a browser.

An important Excel function is to extract data of a Web page. By logging into the Internet and displaying a web page including tables on the browser it is possible to import this page in Excel.

A form of interactivity can be included in the xls file which has been saved as HTML file. This interactivity is guaranteed by the Office web components , namely by the extensions that are compatible with Internet Explorer and allow to manipulate the content of the Web page. This interactivity can be added by selecting the option "add interactivity" of the save box and by clicking the button "publish". In this way, the web page looks like an Excel page: it is possible to surf the cells, to modify their content and the formatting, to insert new formulas without modifyng the Web page. As a result, the changes made in the paper are not saved and by reloading the page it is possible to obtain the paper in its original form.

Excel includes analysis tools: Pivot tables are utilities that allow to display different data aggregations according to several criteria. Thanks to such tables it is possible to sort, filter, group data in rows or columns and obtain combined totals on different data sources. A Pivot graph is obtained by the data included in the Pivot table to which it is associated. If a datum is changed the table and the graph will be modified.

2. 6. 4. 3 ACCESS

Access is a database programme. The interface of such a programme is represented by a display divided into two completely customized panes to insert new icons and reorganize the database object in a personal way.

The Access is the only Office application having a new file format since it has to conform to the UNICODE standard, namely to the extended character format that allows to represent all the characters in the several world alphabets.

In this programme the databases are automatically compressed when they are closed by selecting the "compacted box" of the option menu. Access modifies most of the properties of the masks and objects also during the carrying out of the operation. The changes can be directly made when the screen is displayed. It is thus possible to directly change the alignment or the colour of a field while analysing the data so as to see the final result immediately.

Access allows to quickly format a data module or a report according to the data included in a database. It is thus possible to change the type of the character or the colour of a writing in the presence of a negative value or to view a new mask only if

specific results are obtained. Hierarchical formats can be created during the analysis of data on a table, thus displaying the data of the linked tables.

By using Access it is possible to print the relations among the tables, all the objects included in the database and the existing relations and linkings.

Access runs the programming language called Visual Basic for Application (VBA).

The programme uses a technology called Data Access Pages that allows to convert normal masks or reports into HTML documents. Consequently, demonstrations can help create masks and reports.

These HTML pages can automatically interface with the data stored in the database. Therefore, the HTML pages created by Access can be displayed by means of a browser.

Access creates links to move from one forum to the other or from one report to the other. The hyperlink allows to highlight the file or the page to link to.

Data Access Pages allow to create dynamic Web pages without necessarily having a Web server. The several access tools or the demonstrations help format Data access pages.

Access and Internet are integrated since any table or query can be imported in HTML format.

2. 6. 4. 4. POWER POINT

Power Point is a programme that allows to draw up several kinds of presentations.

It is possible to create automatic numbered and bulleted lists in the slides created with this programme. Therefore, any image can be adopted as a bulleted list and the order of the numbered lists is automatically arranged by following the logical sequence.

The program allows to completely display the so-called GIF animations which make a text original. After being inserted in a presentation each animation can be modified and resized in a personal way.

As for the text it suits the relative bookmark without expanding over the display field so as to automatically adjust the line feed and the size of the characters.

PowerPoint allows to create tables in a presentation without referring to Word o to Excel.

It is possible to synchronize the voice of the speaker in the paper. The registered text is synchronized with the original presentation including any transition and animation. It is likewise possible to record a new text for only one slide.

An automatic option hides the cursor and the icon of the paper after a period of inactivity while starting the presentation.

The cursor can change into a coloured pencil to underline and highlight some words or topics during the presentation drawing the public attention to some important concepts. Some hardwares enable to use two monitors, thus projecting the presentation on one monitor and the slides with the relative texts on the other.

The spell checker in several languages is also available.

It is possible to use a demonstration or a model, namely a special document with a predefined format and placeholder. The automatic layout allows to arrange the objects in a coherent way. It is sufficient to use one of the 24 available lay-outs and to apply it to each new slide created or to any existing slide.

Power Point is the essential tool to create presentations, including multimedia elements, that can be exported along the communication system channels.

2. 6. 4. 5 OUTLOOK

Outlook allows to centralize the organization and the handling of all the information ranging from the e-mail to the agenda, the contacts up to the list of activities.

Outlook meets the increasing needs of those who want a single product having fundamental characteristics such as:

- e-mail;
- personal agenda and group planning;
- personal information such as contacts and activities;
- customized applications to share the information.

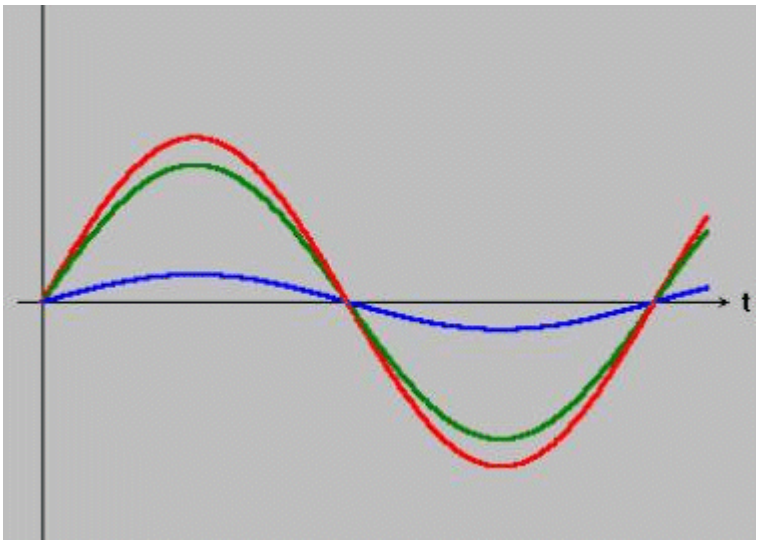
It supports the Internet standards and different collaboration applications since it is an easy to use programme. By using Outlook with the Internet-based message services it will be possible to use the e-mail and the collaboration applications

2. 6. 5 USEFUL LINKS

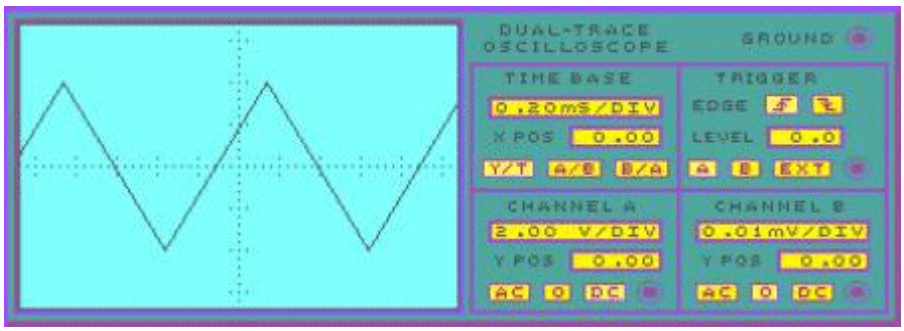
http://ww.microsoft.com/uk/office/depthinfo.html
http://www.microsoft.com/uk/office/word.htm
http://www.microsoft.com/uk/office/excel.htm
http://www.microsoft.com/uk/office/access.htm
http://www.microsoft.com/uk/office/powerpoint.htm

3. 1. 1 SIGNALS AND INFORMATION

Any physic quantity variable in time, which by nature or by convention, carries information is called "signal". The signal can be of varied nature, for example: acoustic, chemical, thermal, optical, electric etc. The treatment of the information produced involves uncountable sectors of modern technologies.



We consider signal of electric nature the information (or message) of any origin (sound, visual, etc), which by appropriate devices, called transducers, is converted into an electric unit: the tension, the current, the intensity of the electric field, the intensity of the magnetic field. Typical signals are: the telegraphic signal which codifies the alphabetic symbols with a series of impulses of tension, the telephonic signal consisting of a complex combination of sinusoidal waves at audio frequency, the radio signal which is made up of electromagnetic waves, the television signal of a very complex form made up of time intervals during which details of an image are broadcasted, the radar signal, constituted by



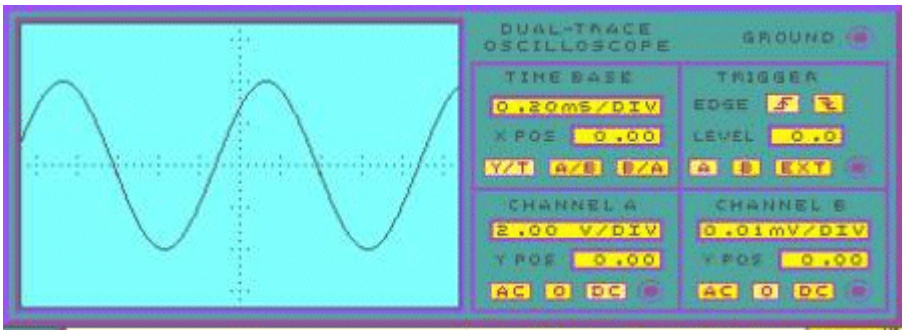
a periodic sequence of impulses, binary digital signal, used in the electronic circuits of computers and by the systems of transmission of bit -codified information.

The restriction is justified, as the electric signals, or more properly electromagnetic, could be easily regenerated and amplified by means of electronic devices.

These signals are used in long distance communications, since their propagation speed is almost the same as the light speed, they reduce the delays of propagation to a nearly negligible one. The light signals propagating on optical fiber can be also used in long distance transmission at a high speed, without interferences and with the maximum discretion.

A signal existing only in the time domain, could be studied in the frequency domain by means of a description called spectrum.

The spectrum highlights all harmonic components of the signal in the different frequencies. This analysis can be practically carried out with the spectrum analyser and in Mathematics can be calculated by means of Fourier 's law, according to which any signal wave form can be reconstructed as a sum of elementary components at different frequencies,.

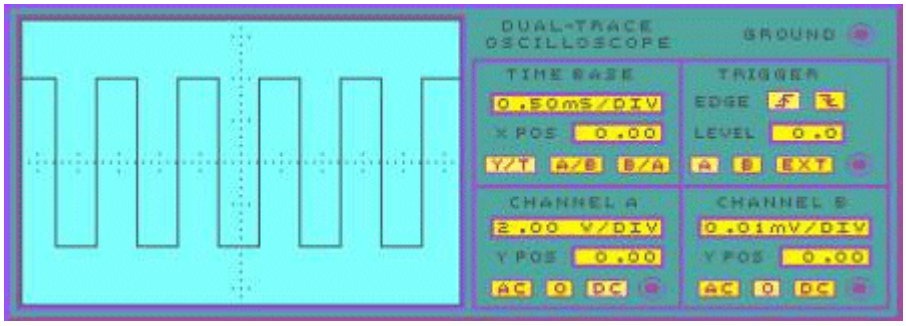


The representation of signals in the frequency domain enables us to classify them according to the spectral occupation; more precisely, the signals can be divided

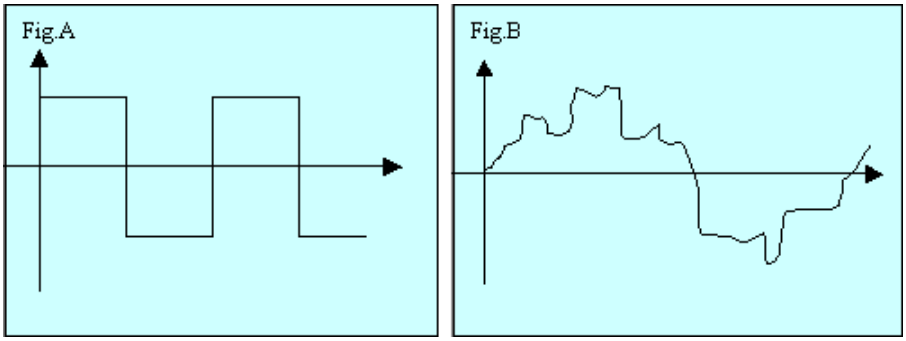
into two categories: the base band ones and the translated band ones that is displaced in high frequency. The signals in base band, which can have a continuous component, have difficulties in the transmission because of the attenuation of Joule's effect; they are rarely employed in telecommunication. The signals in translated band are produced by treatment operated on base band signals (modulation) with the aim of obtaining a new "spectrum" placed on higher frequency value, therefore maximizing the transmitting medium.

3. 1. 2 TYPES OF SIGNALS

Electric signals are generally variable in time. They can be periodical whenever they are repeated identically after intervals called "periods". The number of periods repeated in the unit is called "frequency" and is measured in Hertz (Hz). A periodic signal is also said to be "deterministic", as the behaviour through all its duration is described by a mathematical function. Another periodic signal is the harmonic sinusoidal one, present in the electric distribution network, in radio transmittors at band modulation of frequency and phase.



A signal is defined uncertain when its time behaviour is partially or totally unknown; it cannot be represented with a mathematical function of time but with statistical descriptions of probability. The signal in fig.B is uncertain and could represent the tension at the output of a microphone.



Depending on the meaning given to wave forms, signals can be divided into analogical and discreet or digital. The signal is analogical when its instant value can adopt one of the infinite values of amplitude, called levels, included in a field said of variability. Whenever there are two levels, the digital signal is said binary or numerical and a binary digit can be associated to each of the levels, said "bit " short for binary digit. Signals of binary type are: the recording of a compact disc, a DVD recording, the information flux in PCs, the telephone PCM transmission.

A digital signal can be easily memorized and processed in modern electronic calculators; moreover, it is insensitive to disturbance in transmission as long as the deformation overpasses the decision threshold.

3. 2. 1 MICROPROCESSOR

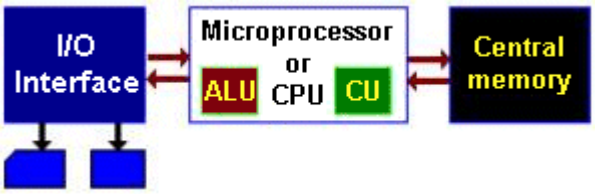
The microprocessor is an integrated monolithic circuit, in ULSI scale, realized in a minuscule chip of silicon or mono crystal of silicon, into which modern technology has succeeded to implant million of transistors. It must be considered that the width of each transistor is equal to a hundredth of a hair.

Nowadays the use of components smaller than a micron gives the possibility of locating more than 3m of transistors on a sole chip. In this way, components like mathematical co-processors and cache memories are integrated directly on a CPU, dramatically reducing processing time and therefore making computers faster.

Since the 80s with the appearance of the first micro calculators, the term microprocessor has increasingly become of common use.

By such a term we identify the integrated component that is put in a system, like a PC, to process data and generate signals needed to control all activities that the system can carry out. Another way to call the microprocessor is Central Processing Unit, CPU.

An essential characteristic of the microprocessor, considered as nucleus of the system, micro calculator, is that of being programmable, in other words being able to manage the transfer and processing of data stored into an external memory, whose content is partially modifiable according to the user's needs. In a micro calculator the microprocessor carries out the information exchange, representing data and instruction with memory and peripherals through interfaces of input and output.



The characteristics describing a microprocessor are the following:

hardware:

- Length of word
- Speed
- Electric characteristics
- Architecture

software:

- Set of available instructions
- methods of addressing

By “length of word” we mean the number of bits the microprocessor can treat in parallel, which coincides with the number of pins of the chip, corresponding to the data.

In relation to the length of word we divide microprocessors into:

Numero di bit	Costruttore e modello
8	8080,8085,8088 INTEL, Z80 by ZILOG, 6800 by MOTOROLA, etc.
16	8086,80286 by INTEL, 68000 by MOTOROLA etc.
32	80386,80486 by INTEL,68020 by MOTOROLA etc.
64	Pentium by INTEL

The word is divided into groups of 8 bits-a byte-; a byte is the shortest group of bits processed simultaneously by the processor.

The speed of a microprocessor is linked to the time needed to execute an instruction and, since we are talking about a synchronous machine -- whose functioning is therefore linked to a clock-- to the number of periods that the clock needs for the operation. For a microprocessor, a given frequency of clock is therefore an index of the speed.

The electric characteristics of a microprocessor specify the type of technology used for the realisation of the integrated, the type and value of the feed –normally 5 volts- plus the type of container – at 40,68,132 pins-, with the meaning the pins have and the type of negative or positive logic which makes them active, the value of the clock.

The architecture of the microprocessor defines the structure and the internal organisation of the components, together with their connection, and the modalities of connection to each other. By internal component we mean the minimum block the microprocessor needs and that allows even complex functions to be carried out.

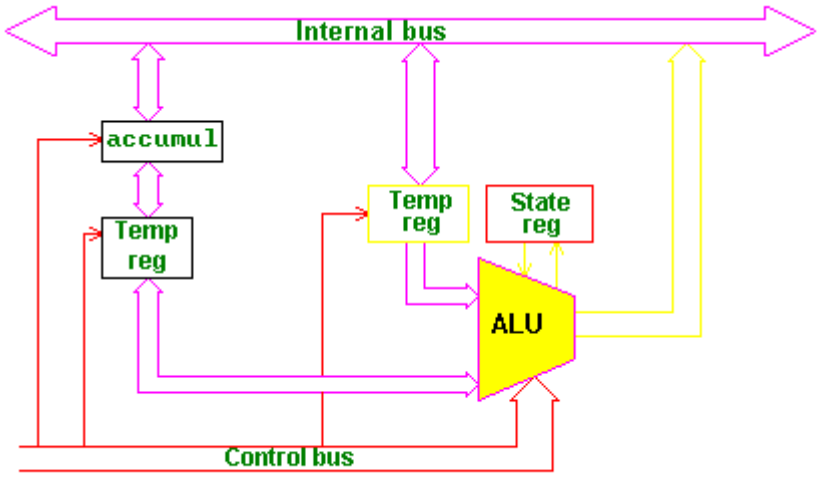
The elementary blocks making up a generic CPU are:

- ALU (Arithmetic Logic Unit)
- CCU (Central Control Unit)
- A certain number of Registers of memory
- The link amongst the previous blocks and toward the outside, organised with a BUS structure

ALU is a complex of logic circuits, capable of carrying out the arithmetic operations of sum, subtraction, increasing, decreasing, complement, plus logic operations AND, OR, NOT, EXOR,…, it deals with data of 8,16,or 32 bits, it has two inputs, normally containing the operands and an output which will correspond to the result of the selected operation.

The CCU consists of a group of circuits able to interpret the operational codes of the instructions and to activate, on the basis of this decodification, all the signals in order to execute the instruction itself. These codes are normally not expressed in binary or hexadecimal form, but in alphabetic code; this representation (which is the most convenient way to give instructions to the microprocessor) is called assembly language and it is translated into machine language (binary) by a software called assembler.

We call REGISTRY a static memory, whose dimensions are equal to the length of the data managed by CPU, for example a byte, or multiple of this. Therefore in 8 bits CPUs there will be a given number of 8 bits registries, needed to manage the data, called general use registries. There will also be 16 bits registries for managing addressing (which are characterised by 16 bits). In the 16 and 32 bits CPUs, the general use registries will have 16 and 32 bits dimensions, while the registries for addresses management will have the dimension of , say, 32 bits, if the addresses are identified by 32 bits. One of the general use registries is called Accumulator (A) and has generally the capacity of containing, in arithmetic and logic operations, one of the operators and the result of the operations.

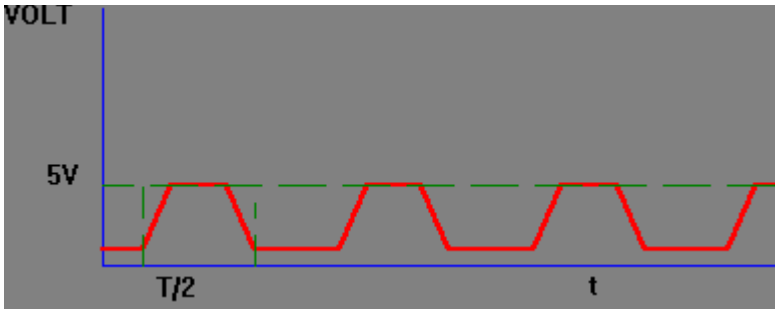


A BUS is a group of wires, transmitting information, to which are linked in parallel the related devices for the exchanging of information. Basically, we can distinguish between internal and external CPU's BUSes. Internal BUSes are concerned with the transfer or information amongst the different components of the CPUs, external BUSes on the other hand, deal with transferring information between the CPUs and the outside world. (memories or other necessary devices for the functioning of the system, generally peripheral).

Any exchange of data with the CPU happens involving the 3 BUSes:

- DATA BUS: where the data are put
- ADDRESSES BUS: where the device code with which is going to exchange data is put
- CONTROL BUS: which transports the whole of signals of synchronism and control, needed to determine the interval of validity of the data and the direction of their flux.

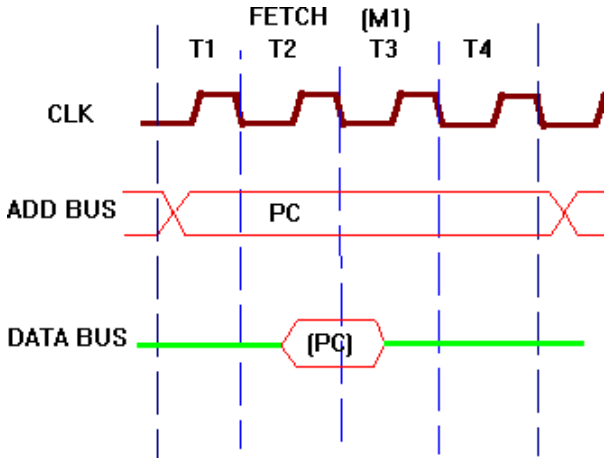
We have already said that the microprocessor is a sequential synchronous machine, where a clock articulates the single operations; a device outside the CPU generates the clock signal. The form of wave will be, in a first approximation, a square wave, but considering the times of raising and lowering of the signal, more correctly we shall talk of a trapezoid wave with a duty-cycle of for example 33%.



Typical clock frequencies are 4,8,16,20,33,40,50,60,100MHz, to the order of GHz. For the moment, because of the generality of the subject, we are not specifying a particular frequency of clock, but we rather talk of periods, or cycles T, necessary to the accomplishment of a given operation.

Each operation carried out by the CPU is basically a cycle of reading or writing of a cell of memory or I/O port, we call micro cycle an elementary step of access to the BUS carried out in a fixed and determined number of periods of clock, determining a sequence of states of the system, the whole of one or more micro cycles makes a cycle instruction.

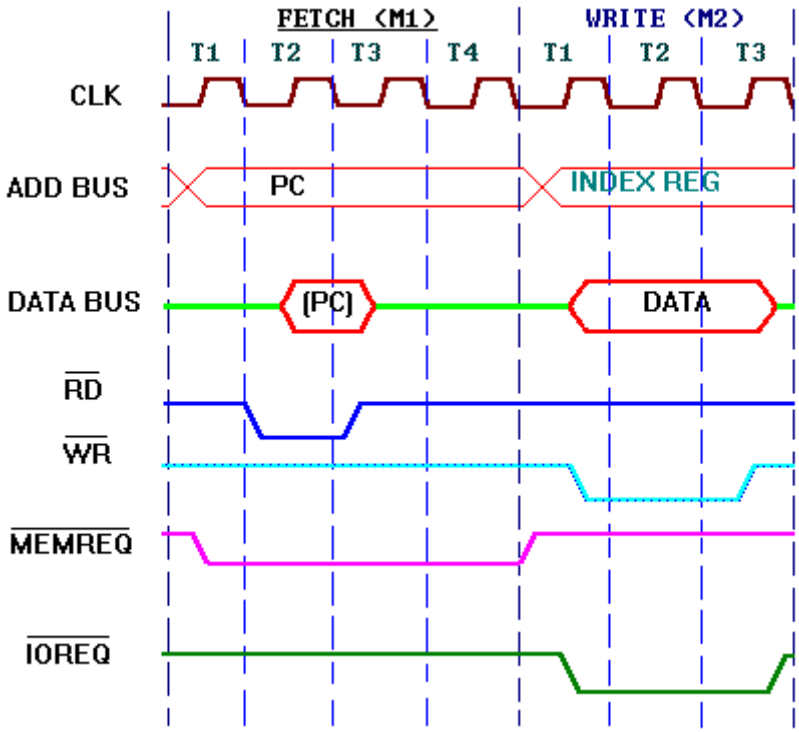
We identify several types of micro cycles: fetch, reading in memory, writing in memory. Reading/writing of a I/0 port, etc. The micro cycle fetch is always the first micro cycle of an instruction and corresponds to the reading of the operational code: the address bus has the current value of the PC (Program Counter), while the content of the data bus, directed by the chip of memory selected, is transferred to the Instruction Registry (IR).



During the reading cycle in memory READ, the address bus has the content of the internal pointer registry while on the data bus the data are present in stable way, as long as both the signal of RD (READ) and the signal of request of access to memory MEMREQ are active.

The situation for the cycle of writing in memory is similar with the exception of the active signals which are now WR (WRITE) and MEMREQ. In the same way, during the operations of reading and writing to or from an external port, the signals of WR & RD will be active, together with a IOREQ (Request of reading or writing on an external port)

Sometimes during an operation of access to memory or more frequently, during operations of reading and writing toward or a port, it is possible to insert WAIT states, if the time of access to the memory on to the port is too long compared with the moment when the CUP makes the data available.

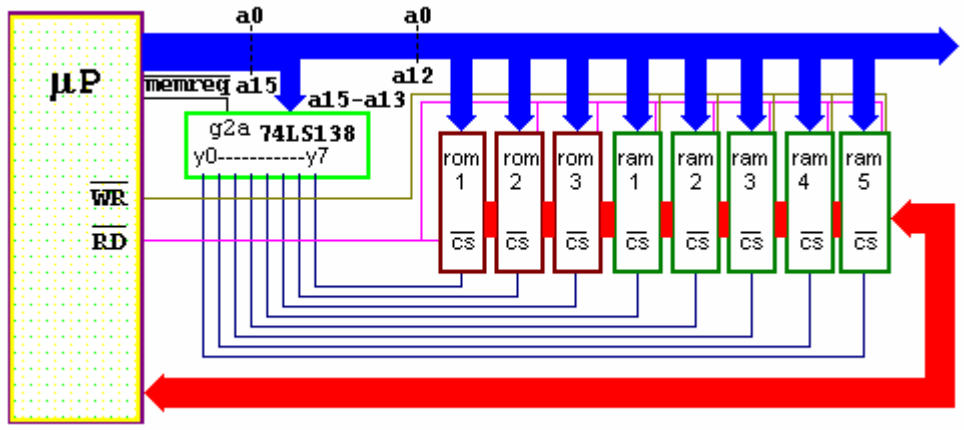


The way the CPU can exchange data with the memory to insert them into temporary internal memory (registry), as it has already been said, involves the three

buses of the system: let us see the sequence of the commands the CPU will consequently execute; the operational codes written in assembly language for the hypothetical CPU; the operational codes are expressed in hexadecimals representing the machine language .

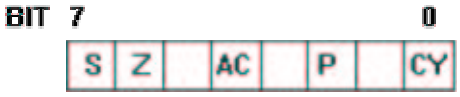
To clarify the hardware aspects regarding the addressing we refer to a generic 8 bit microprocessor with 16 bit ADDRESS BUS; such a microprocessor is capable of supplying 2/16 different binary values corresponding to as many (65536) different addresses. If we have a memory of 64 Kbytes, organised in 256 rows and as many columns, the problem of identifying the n/th cell will be delegated to the decoding circuit of the same memory. On the contrary -- as it often happens -- if the memory chips are smaller than 64 Kbytes, for example 8 Kbytes, 8 chips of this type will be needed to cover the addressable area; the need will therefore arise of individualising on what chip the n/th cell is located and inside this, in which address. To identify the 8 individual addresses of this chip, 3 bits are needed, therefore 3 rows of the addresses bus, while the remaining 13 rows are needed to find the 8 Kbytes of cells of each chip and will be decodified by the decoding circuits of the single memories.

To decode the 3 rows, the decoder 74LSI38 at 3 entries and 8 exits can be used, following this scheme:



STATE REGISTRY at 8 bits, flags, which depending on their value 0 (reset) or 1 (set) supply information about the state of the machine following the events connected with the execution of programmes.

A possible configuration of the flags registry can be the following.



- S Flag (sign, bit 7) repeats the state of the most significant bit of the accumulator after arithmetic and logic operations; represents the sign of the operation result .
- Z Flag (Zero, bit 6) has value 1 if, after the execution of certain instructions, the result is 0.
- CY Flag (carry, bit 0) represents the hypothetical remainder in an arithmetic operation.
- AC Flag (Auxiliary carry, bit 4) represents a remainder over the first 4 bits in accumulator after an arithmetic operation; it is used when operations in BCD are performed.
- P Flag (Eventy, bit 2) represents the content of the accumulator, it is 1 if the number of bits equivalent to 1 in the accumulator is even, it equals 0 if that number is odd.

ADDRESS REGISTRY contains the address allowing to select locations of memory, peripherals, I/O ports.

PROGRAM COUNTER (PC) which has the dimension of the address bus, is increased by one each time the microprocessor needs data (instruction) of the program from memory and which therefore contains the address of the instruction following the executing one.

STACK POINTER (SP) contains the latest occupied address within a reserved memory (STACK). The STACK is an area of memory set to contain information about the machine state in correspondence of interruptions or subroutine calls, following procedures activated by UCC, it can be realised through a “logic” set of registries, physically located in any RAM area, but addressed in particular way by the stack pointer.

This modality of addressing has some characteristics::

- The addressing is not random, but of sequential type so that the data fetch happens in the opposite order to the loading; the stack is therefore a buffer of LIFO type (last in first out)
- The data reading from the stack is destructive; each data can therefore be read just once.

The DATA REGISTER is a registry where incoming or outgoing on data bus are memorised.

The INDEX REGISTER which has the dimension of the address bus, is used to facilitate the memory addressing operations.

INSTRUCTION REGISTER stores the initial part of each instruction, the one that contains the operational code.

These registries do not limit the ones which may be in a given CPU, but they define a general set capable to make the generic CPU, we are talking about, work.

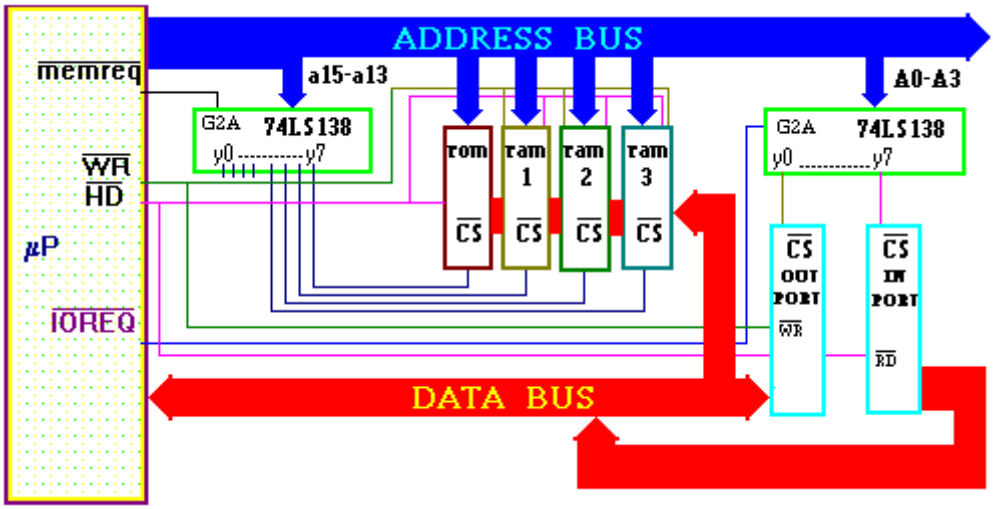
As regards the I/O ports, they are connected with the data bus and the link therefore needs to be of the three-state type to avoid conflict on the bus. The input ports can be simple three-state buffer, while the outputs need to be three-state latch. Two chips normally used are the latch buffer 74LS373 which can be used both as input and output, the 74LS244 buffer three-state at 8 outputs and 8 inputs.

We cannot list all the possible interface circuits, the above mentioned systems though they are commonly used, have been considered here only to deal with the problem of the interfacing.

This aspect of the problem is similar to the one of addressing a memory cell.

If the CPU has the output pin IOREQ (I/O Request, similar to the request of access to memory), means that we have the one called I/O dedicated, for which reserved instructions and address exist: we are refining to I/O instructions not available on microprocessors. We suppose they will be there, an I/O instruction sends low the IOREQ signal which can be used with a RD or WR to activate the CE pin of the input or output port. This type of solution would allow to enable only an input or output port. Apart this limitation the solution is not practicable because the I/O instructions expressly ask for the address of the interested port to exchange data.

If we think about I/O instruction relative, for example to 256 ports, to find them with certainty it will be necessary to decodify $2^8 = 256$ possible addresses, they will be therefore necessary only 8 rows of the address bus, for example 8 it will be possible to identify them with the first 3 bits of the address buss, while the other 5 can be decodified (said absolute decodification) or not (partial decodification**).**

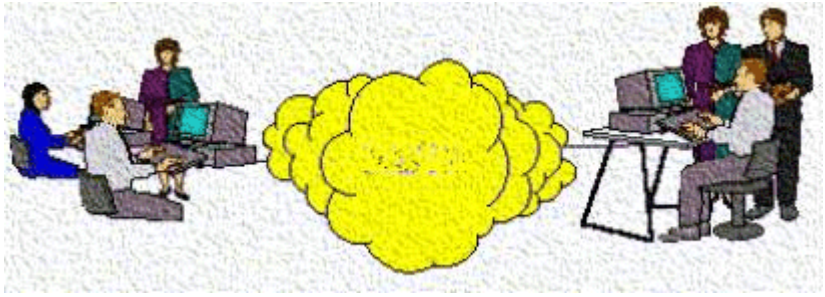

ADDRESS BUS
memreq
a15-a13
A0-A3
G2A
74LS138
y0
y7
WR
HD
µP
IOREQ
rom
ram 1
ram 2
ram 3
CS
OUT PORT
IN PORT
WR
RD
DATA BUS

3. 3. 1 GENERALITIES

In the field of Telecommunications, the information signal (frequently expressed as electric signal in analogical or digital form) having to cover the distance between the transmitter and the receiver, will necessarily be manipulated for different reasons:

- To make it more suitable to overtake the resistance of the means in order to have effective transmission;
- To make it compatible with the transmitting means;
- To make it mixable with other signals without loosing its identity.

This manipulation, common to all types of Telecommunications even if developed with different techniques, is generally defined modulation.



there are different types of modulation depending on:

- The field (telegraphy, telephony etc)
- The type of signal to be manipulated (analogical, digital)
- The transmitting means (cable, air, optic fibre etc)

Modulation is an operation made on elementary electrical signals (trigonometric or impulsive) with the aim of making them more appropriate to distance communication. In fact, the fundamental problem of a communication

system consists of the transmission of a given information (message) from a station or transmitting terminal (source) to a station or receiving terminal (user), through a non-ideal physical medium (channel) with disturbance and noise, so that the information received by the user will reproduce the original message with adequate accuracy. The message can be of different nature (written text, word, music, drawing, photography, moving scene, electric signal) and unless it is already in the form of electric signal, is transformed into that by an appropriate transducer at the transmitting terminal. It is then reconstructed into its original form by an inverse transducer at the receiving terminal.

The transmission channel can be constituted of different transmitting media such as lines, co-axial cable waves guide, optical fibres and free space (radio and satellite communication)

The properties of used transmitting media are different. The transmitter has to generate an electrical signal to be sent to the communication channel with characteristics suitable to the used transmitting medium; at the receiving terminal the receiver carries out the opposite operations.

Therefore, one of the main operations the transmitter must carry out is modulation, which consists in transmitting the electric signal to be sent in appropriate frequency bands.

The opposite operation, called demodulation, is carried out by the receiver. This procedure is necessary for two reasons:

- As transmitting media are not generally capable of transmitting low frequencies, modulation is used to transfer the signal into a band of frequencies more appropriate to the transmission on the communication channel.
- Modulation allows transmitting more signals (messages) on the same channel, transferring each of them in bands of different frequency.

In other words, modulation offers the following four advantages:

- Transferred band: the signal to be transmitted is adapted to more appropriate frequencies to cover large distances, transferring the spectrum of the signal from the base-band to the high quality frequency; for example, the telephone signal is translated from the base band (300/3400 Hz) to a field of higher frequencies.
- Multiple action at division of frequency: this technique enables to transmit more signals on the same channel simultaneously, locating each signal in a proper band of frequency, not superimposed by other signals.

- Immunity to disturbance of electromagnetic type: in high frequency the signal is immune from noises of electromagnetic type of low frequency.
- Reduced dimensions of aerial: in case of transmitting with electromagnetic waves, the aerials are reduced while increasing the frequency of transmission.

3. 3. 2 MODULATING, CARRIER AND MODULATED SIGNAL

In the process of modulation two signals can be identified:

- A signal called carrier, which carries in frequency the electric signal representing info through the transmitting medium on the best conditions and fidelity.
- A signal called modulating signal which contains the information itself, but which does not have the necessary characteristics (generally in term of frequency) to be transmitted as it is, since it would not provide the reliability requested by receiving set.

The whole of these signals interacting between them appropriately through the process of modulation, constitutes the modulated signal containing the information together with the carrier signal and guarantees an effective transmission in the medium and an effective reception.

3. 3. 3 TYPES OF MODULATION

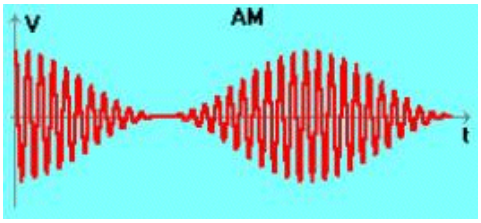
Depending on the nature of the information signal (which can be analogical or digital) and on the nature of the modulated signal to be transmitted, (which can be analogical or impulsive) the process of modulation can be classified in the following ways:

- By the type of carrier signal used.
- By the type of modulating signal needing to be modulated.

According to the nature of the carrier signal, the techniques of modulation can be divided into:

- Modulation at continuous carrier; so called since it uses as carrier a continuous signal generally constituted of a sinusoidal wave.
- Modulation at impulsive carrier; so called because it uses as carrier a discrete signal, generally constituted of a square or impulsive wave.
- Analysing the nature of the modulating signal, the modulation techniques can be divided into:

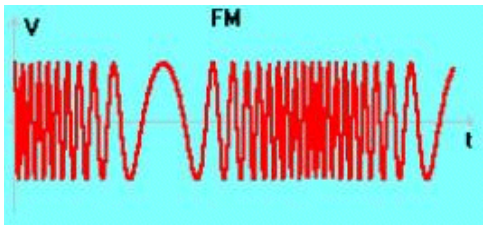
- Analogical modulation, so called because the parameter of the carrier is modified continuously by the modulating spiral and it is called modulation AM (Amplitude Modulation), FM (Frequency Modulation), PM (Phase Modulation) on continuous carrier or slow on PAM (Pulse Amplitude Modulation), PWM (Pulse width Modulation) PPM (Pulse Position Modulation) on impulsive carrier.
- Numerical modulation: so called because a parameter of the carrier is modified in discreet way by the modulating signal, it is called modulation ASK (Amplitude Shift keying), FSK (Frequency Shift keying), PSK (Phase shift keying), QAM (Quad Amplitude Modulation), on continuous carrier, on also PCM (Pulse Code Modulation) on digital carrier.



Generally, it can be said that the modulation process modifies both the spectrum of frequency occupied by the information signal and its position in the domain of frequency, in a more or less consistent way, depending on the technique type used. Therefore, it changes the characteristics of the original information signal, just for the aim of transmission, so the medium will see a completely new signal (modulated signal).

Analogical modulation consists in having a sinusoidal carrier modulated by the information signal of analogical type. The amplitude, the frequency or the phase of the carrier is modified . The frequency value of the carrier is generally much higher than the maximum frequency of the spectrum, which forms the composition of the modulating signal.

This is a process of transformation of the signal information typically used in radio transmissions, for example radio broadcasting, television broadcasting etc. for which the transmitting medium is mainly ether.



The modulation in that case has the function of transferring the signal information, using different frequency carriers with the aim of separating the different transmitting stations. In this way it is possible for more pieces of information to coexist in the same transmitting medium simultaneously while transmitting. In the same way, thanks to the demodularisation it is possible to separate the different pieces of information on receiving them, realizing the listening of one signal at a time.

Analogical modulation, always using a simultaneous signal as carrier, can be realized with three different techniques, depending if it refers to the AMPLITUDE (AM), to the frequency (FM), to the phase (PM) of the carrier signal.

In all techniques the aim is always to be able to transfer the field of frequencies occupied by the information signal to another field on higher frequencies, more appropriate for the transmission and separated from the field occupied by other signals present simultaneously on the same transmitting medium. This operation is possible thanks to the introduction of an appropriate carrier frequency, this phenomenon, used both on cable and air transmissions, is called multiplication division of frequency (FDM).

The digital modulation means having a sinusoidal carrier modulated by the l information signal of digital type. It is a common technique for the transmission of numerical data between computers installed even in remote distances. A digital signal, being defined at broadband, will certainly produce some problems any time we shall transmit it via a telephone line typically defined at narrow band, whose standard value is fixed at 4 KH. In order to solve the band incompatibility, in terms of width, a transmission of the digital signal is operated in a corresponding analogical signal. In other words, the digital modulation is the process of realizing a compression of the band of frequencies occupied by the digital signal within the standard value of 4 KHz.

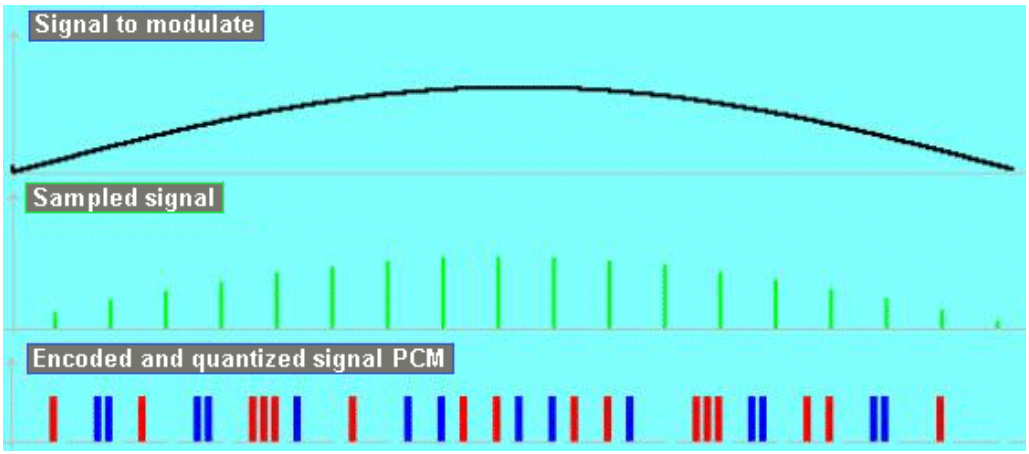
There are several techniques of digital modulation, from the simplest to the most sophisticated one, as with the passing of time transmission of bits has become a priority. To be able to transmit at a higher speed, expressed in bit per second, implies transferring on the connection line a bigger number of info in a second, which means reducing connection times between the two linked terminals.

Since great-distance computer connection is nowadays represented mainly by telephone network which is subject to time rating, it follows that longer communication times mean higher transmission costs. Increasing the transmission speed of bits means increasing the complexity of the digital signal and therefore increasing the width of the corresponding spectrum. Consequently, as the transmitting speed increases the techniques of modulation must be changed, in order to allow the corresponding spectrum to be always kept within the limit of band of 4 KHz imposed by international agreement.

The principal techniques of modulation used consist in associating to each logic level of the digital signal a variation of the carrier frequency, system at displacement of frequency (FSK), or a variation of the phase corner of the carrier signal, at displacement of AMPLITUDE (ASK), or to have a higher speed a mixed modulation of phase and amplitude (QAM).

The modulation of impulses consists in having an impulse carrier modulated by the information signal of analogical type. This modulation can adopt the technique of variation of the impulse of amplitude (PAM), of the duration of impulse (PWM), of the position of impulse (PPM).

The modulation PCM consists in transforming the signal information, of analogical type, in an equivalent digital signal with an analogical – digital conversion, in serializing single bits and transmit them along the transmitting line.



3. 3. 3. 1 BASE BAND AND TRANSLATED BAND

In the technique of signal modulation the concepts of base band and translated band are very important. Base band means the band of frequencies occupied by the information signal, which ranges from the value 0 Hz to the value of a higher frequency established by the wave form of the signal, or by the characteristics of the transmitting medium inside which the signal is transmitted.

By translated band we mean the possibility of moving the field of frequencies occupied by the information signal (base band), toward higher values of frequency more appropriate for the transmission of the same signal, without modifying the information content of the given signal.

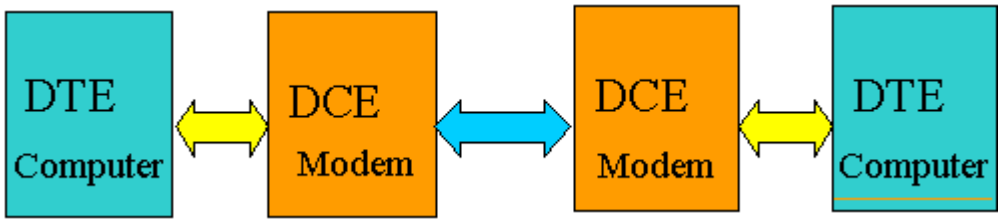
The transmission process is convenient when:

- We want to transfer a signal of characteristics not suitable for distance transmission -- like for example an acoustic signal which occupies a field of frequencies rather low -- toward a more effective field of frequencies, as it is the case with the radio-frequencies, which can transport an acoustic signal to impossible distances for the sound.
- We want to mix more information signals on the same transmitting medium, which is called multiplexing process.

3. 4. 1 GENERALITIES

A modem is a device of interface between the world of data processing, represented by computers and the outside world, represented by the transmitting medium.

In the scheme of data transmission the modem, indicated with the acronym DCE (Data Communication Equipment) communicates with the computer, indicated with DTE (Data Terminal Equipment) through serial interface - RS-232c.



The DTE elaborator can be seen as constituted by a processing unity, which is the true source of data and information (messages, texts, drawings etc) and a control unity of the line, which deals with information and ensures that the processed data are transmitted correctly to the address via the available transmitting line, according to appropriate dialogue procedures.

Obviously the receiving DTE must carry out the opposite operation to be able to operate with the information in the same form it was originally transmitted.

To be able to connect the DTE to the transmitting medium which has got different characteristics, it is necessary to interpose an adapter of appropriate features. Just as it happens with the adapter used to connect two pipes of different diameters , in other words the modem or DCE, which has the task of modifying the information signal into another, more appropriate to the nature of the transmitting medium.

Nowadays the DTE equipment can be represented by:

- Personal Computer, in its commercial configurations

- Mini Computer, a more flexible and sophisticated version of the previous one
- Font End Processor, line control unit
- Host, large processor
- Cluster Controller, terminal control unit
- TTY, Teletype, teletype terminal

On the other hand, the DCE unities are mainly represented by modems, which interface the digital numerical world of computer with the outside world represented by the transmitting medium, often of analogical nature; in fact, there are transmitting media able to directly accept the data to be transmitted, such as co-axial cable and optic fiber, on the other hand there are other media which, because of the networking structure they are inserted in, dedicated telephone line, packet switching network , as well as of the network project conditions, switched telephone network, cannot directly accept data coming from computers.

The word MODEM derives from " modulation", operation carried out by the transmitting DCE, and "demodulation", operation executed by the receiving DCE.

The connection between the DTEs via the DCEs can be of point to point type, when the network only connects two terminals, set at the ends of the network itself, such as in the switched telephone networks, in dedicated lines, in package switch lines, in ISDN network, or of multi-point type, when a DTE, called master, is able to connect and dialogue with more secure terminals, called slaves, such as in dedicated line in LAN network.

Modems are already in use in switched telephone network, which is the most commonly used transmitting medium, as thanks to its capability it enables users to reach any destination in any country.

The link between DTE and DCE takes place through the serial interface standardized by the EIA RS-232C and the CC1TT V24 recommendation, for the naming of signals, and V28, for the electric characteristic, while the mechanic characteristics of the connector are established by the ISO2110 regulation. (International Standard Office).

3. 4. 2 TYPES OF MODEM

In the field of data transmission the most usual line is mainly the public telephone one which can be at limited or unlimited band.

In the first case, we are dealing with a switched line, which, realized usually to transmit vocal signals (human voice), allows the transmission of signals included inside the phonic band of 4 KHz. In other terms, telephone channels constituting the capacity of the transmitting medium present a neat bandwidth of 2100 Hz, ranging from 300 to 3400 Hz; consequently, the information signals in binary form need to be converted into analogical signals, as they have frequencies included in the phonic band of the channel. With this aim DCEs called Phonic Modems are used; they perform the translation of data signals, at wide band, inside phonic band and precisely between 300 and 3400Hz.

In the second case, we are talking about private or physical lines, which allow direct connection between two DTEs and do not have a limited band. In this case the DCEs used are WIDE BAND MODEMS, which develop a band translation but not at level of phonic channel, rather at level of groups of phonic channels (from 6 to 60), produced for sending large volumes of data and operating with speeds included between 19.2 Kbps and 230 Kbps.

DCEs called base-band mode may also be used; they do not execute translation of the frequencies band of data signal, but they operate a coding on the digital signal to reduce and control the spectrum.

Differences between different types of modem can be rather remarkable in terms of:

- Functioning principle
- Used carrier frequency
- Technique of used modulation
- Transmission speed
- Constructive complexity
- Costs.

Therefore, the factors which can affect the choice of a modem are many. A careful evaluation of the following is necessary:

- Type of available network
- Distance between the terminals TX and RX
- Quantity of data to be transmitted
- Installation and connection costs.

Phonic modems perform on the signal a digital modulation according to ASK, FSK, PSK and QAM, to compress the spectrum and to obtain an eventual translation in frequency. Since the data transmission in this case takes place using the telephone switched network, the physical link of modems on the line must be constituted time by time through the call operation of the remote system. Therefore, the link is of temporary type and it is on until one of the two users decides to interrupt it. These modems are now all of intelligent type because they include an appropriate microprocessor and are able to carry out the following fundamental functions:

- Dialogue with their own DTE to which they are physically connected.
- Data modulation transforming digital in analogue signals while transmitting
- Data demodulation transforming analogue in digital signals while receiving.
- Managing the telephone line in various calling function of the remote user, answer to a call and creation of the physical line connection; command mode, for the calling and replying functions and link mode, for the connection.

Phonic commercial modems are generally available in two possible revisions:

- Internal on card, to insert inside the PC in an expansion slot
- External in a container to set beside the PC

The advantages of the internal modem are represented by the fact that:

- It does not use the serial connection RS-232C, which is therefore available for other peripherals.
- It does not increase the space occupied by the system
- it is generally less expensive
- it is less subject to the typical malfunctions of connections and cables, un-wielding and wires interruption.
- It does not require external alimentation.
- On the other hand it has not light indicators.

The advantages of the external modem are:

- It does not occupy an expansion slot in the PC.
- It can be provided with light indicators useful for checking the functioning
- It can be disconnected and reconnected on different computers easily.
- On the other hand it occupies the serial interface RS-232C and takes more space.

There are many types of modems available on the market which differ from each other:

- Transmission speed from 300 Kbp to 56 Kbps.
- Type of adopted modulation
- Type of connection, half-duplex or full-duplex
- Type of transmission, asynchronous and synchronous.
- Type of call and reply, manual or automatic.
- Type of data transmission, error corrections, data compression.

Modems for limited transmission speed use a FSK modulation; modems for medium speed use PSK modulation; modems for higher speed use mixed amplitude and phase modulation, known as QAM, very high speed modems – so called fast-modems – use particular modulation techniques , such as trellis not yet standardised combined to a data compressing system (56 Kbps).

BASE BAND MODEMS are so called because, unlikely phonic modems, are not subject to frequency band limitation, they work with encoded digital signals, and are used on lines different from the switched public network, such as dedicated lines of limited length - 10 Km maximum-, without switches, realized with good quality twisted pair telephone cable , with coaxial cable or optic fiber, quality and type of cable strongly influence:

- The type of interface
- The maximum coverable distance, before the signal quality degrade
- The maximum transmission speed achievable.

The main characteristic of these modems is that they do not operate a modulation on the digital signal, but simply they introduce a change of the relative spectrum, to make it more appropriate to long distance transmission.

Therefore, digital signal of typical rectangular form and also rich of low frequencies and continuous components, is transferred to a trapezoid signal coded with line code, In this way, the continuous components are eliminated and the value of

fundamental frequency is limited, making the signal easier to transmit and at higher speed, still remaining the limited distance/speed of transmission characteristic of each transmitting medium, with or without equalizer.

These modems generally work synchronically and the reachable transmitting speeds can be divided into 2 categories:

- 300/19200 bps, using the connection V.24/V.28 as interface
- 48K/72K bps, using as DTE/DCE interface the connector V.24/V.35.

Base band modulation is nearly comparable to a PAM modulation system, with the only difference that the modulation signal is not an analogue signal, but rather digital. The carrier is actually characterized by an impulsive signal, called clock signal. The result of this kind of modulation is still a digital signal, but with a frequency spectrum shaped differently; the aim of this manipulation is:

- Being able to mix the digital information with a clock signal, capable of developing a synchronization between the transmitting and receiving modem.
- Being able to re -sharpen the frequencies spectrum, to make the new signal more suitable to be transmitted on the transmitting medium.
- Getting the average value of the signal to 0.

The base band modem therefore modulates the signal in such a way that it can contain both the information and the clock needed for the synchronization.

The modem technology, both phonic and base band, is in continuous evolution. As new networks are becoming faster and more integrated in the services (ISDN network), more and more interconnected (INTERNET), the problem of interfacing between DTE and network implies the use of DCE of increasingly more sophisticated characteristics.

Anyway the most critical modems, technically speaking, are certainly the phonic ones because the switched telephone line still remains the most practical transmitting medium, the simplest, most widespread and cheapest for data transmission, at least concerning small users accessing ITAPAC or INTERNET.

3. 4. 3 ELECTRIC SIGNAL

Transmitting media which support an electric signal belong to the category of media at guided waves and constitute:

- Telephone network switched PSTN (Public Switched Telephone Network) or RTN (National Telephone Network), and dedicated CDA (Analogical Direct Connections), CDN (numerical Direct Connections)
- The switched package network of RCP or ITAPAC for Italy.
- ISDN Networks (Integrated Services Digital Network)
- RFD Networks (Phonic Network Data)

Local networks LAN (Local Area Network), MAN (Metropolitan Area Network) and WAN (Wide Area Network). By electric signal we mean an ordered flux of electrons through a carrier of appropriate section and material, caused by a deficiency of potential set to the ends of the carrier itself. The electric signal is variable in time with a form of ware dependents on the nature of the original same signal (vocal sound, music, bit, etc).

The ideal transmitting medium for this type of signal is the electric carrier, it succeeds in carrying the electric current even to great distances and with limited losses of energy.

In telecommunications a couple of carriers is always used which, depending on the used constructing technology, constitutes:

- ordinary telephone cable (Twisted pair)
- Coaxial cable (coax)

By Twisted Pair is meant a transmitting line made to support electric signals produced by the transducer constituted of the telephone handset. This line is made up of a couple of carriers of extra - pure – copper, of contained diameter, isolated by a polyethylene sheath and coupled on spiral, making the two carriers symmetrical in relation to the phenomena inclusive parasites and protecting the couple from the phenomena of outside interferences due to electromagnetic fields. It is a symmetric and balanced line, homogeneous on electrical capacity: in fact, the carriers constituting it result symmetrical in respect to the earth and are insulated between each other and toward mass, they therefore present the same potential respect to the earth itself. This does not apply to the co-axial cable because the external carrier generally results connected to mass and repress an unbalanced line.

The twisted pair can be normally used in the following connections:

- For the transmission on analogical modulated in FDM techniques up to the speed of some hundred Khz. frequency
- For the transmission of analogical modulated in PCM Techniques and multiplied in TDM, up to the speed of about 2 Mbps.

By increasing the frequency of the transmitted signal, or increasing the number of transmitted channels, the band of occupied frequencies increases as well making the Twisted Pair behaviour worsen, increasing its sensitivity to interferences. For higher frequencies, given the excessive in term of energy and deformation of the transmitted signal, transmitting media at broader passing band, are used much as coaxial cable and fibre optics.

Coaxial cable support electric signals and is made of a couple of non-symmetric carriers; one of the two carrier is actually located on the ex of the cable and it constitutes the core of it, while the other is located outside the coaxial location to the first one, and it is put at mass, between the two concentric in interposed an insulating material.

The main electric characteristics of the coaxial cable are:

- Considerable length of band, this allows the possibility of operating multiple actions more pushed, interims of number of transmittable channels, or the possibility of transmitting digital signals at higher speed, 565 Mbps and 7680 channels.
- Elimination of external interference and noise by electromagnetic inductions.

3. 4. 4 LIGHT SIGNAL

Needless to say, the rapid development of telecommunications has changed the world into a “global village”, virtually reducing great distances and making any piece of information accessible to everybody. The means of communication are rapidly changing the quantity and quality of services to the public. The innovative development of networks is increasingly stimulated by the combined effect of 2 factors:

- The birth of new services and applications.
- The Technological Induction of PCs and Telecommunication media.

The traffic, generated by various services increases the demand for larger transmitting capacity for the carrying network. “Telecommunication Highways”, must increase available space.

To traditional services such as the phonic ones and low speed data, a great variety of large-band services has added, such as e-mail, mailing list, news groups, World Wide Web, teleconferencing, electronic commerce, video on demand, techniques of remote demand and high resolution, tele-media, etc.

Other factors are linked to the increasing competition amongst network operators, caused by a change of reputation, which will bring a reduction of fees and increase the number of operators.

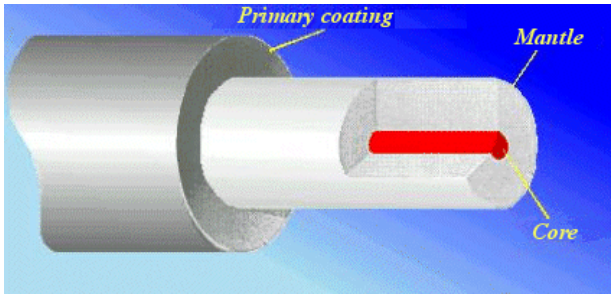
Presently, the traffic created by the Internet has become 10 times bigger than the telephone traffic and this reflects the need of using transmitting media with larger capacity of channels.

This scenario is therefore based on a fundamental assumption: the intensive use at all levels of systems of digital communications in optic fiber in different networks of Telecommunications.

Transmission on Optic Fibre only uses digital signals, that is presence or absence of light emission, the information is thus entrusted to the recognition of the illogic sequence of the bits, trying to reduce the distortion due to the intersymbolic interference.

In the place of the old Twisted Pair, the recent coaxial cable, the same radio bridge or satellite, optic fibre has become widespread as transmitting channel, both for the cost, and for intrinsic mechanic qualities and mainly for the high width of band, which guarantees high capacity connections and long distance to any type of service.

Therefore electric impulses are replaced by optical impulses, simple rays of light, electromagnetic waves with frequency of the visible field, which spread with a technique of following reflections inside the core or nucleus of the optic fibre. This is actually a cable made up of a central core of cylindrical form and a concentric coating, everything is then coated by a core of protective plastic material. The core of diameter between 10 and 50 micrometers and the coating are made of silicone material, element diffused on the earth's crust. Two are the types presently used in Telecommunications: multimodal fibre and monomodal, mostly used for the low distortion and low loss.



The advantages of translation on optic fibre components compared to the material cables or wave guide are many: mainly a capacity of transmitting a great quantity of information on the order of Gbit/s, as well as low values of signal mitigation, a few tenths of dB/Km, a high immunity to electromagnetic interferences, complete electric isolation, absence of diaphony, reduction of weight and dimension, flexibility and elasticity, resistance to high temperature and to chemical elements, limited chemical cost of the optic fibre.

In 1988, only a few years ago, TAT-8 was installed the first transatlantic cable in optic fibre at 280 Mbits/s; in 1996 TAT-13 was installed, a system at 5 Gbit/s. In 10 years optic fibre systems have replaced the traditional copper one and all the intercontinental traffic between Europe and the States is on submarine cables with light waves.

Optic fibre is now the future of telecommunications.

3. 4. 5 ELECTROMAGNETIC SIGNAL

Electromagnetic signals are represented by radio waves, mainly using ether as transmitting medium through which they can spread by irradiation of electric and magnetic fields; these are actually produced by transmitting stations, broadcasted by antenna, captured and selected by appropriate receiving stations, equipped with appropriate aerials.

The radio waves are contained within a field ranging from the low frequencies of vocal signal to the frequencies called EHF (Extremely High Frequency) of some hundred of GHz, also called microwaves, covering the field of long waves, medium waves, short waves, and VHF.

As the frequencies of this field are lower than the minimum frequency of visible light, related to red colour, these electromagnetic waves turn to be all invisible.

Electromagnetic waves spread on the layers of the earth's atmosphere; among which there are:

- A layer closer to earth, Troposphere
- A higher layer, Ionosphere

Troposphere represents the layer of ether spreading from the Earth's surface up to about 20 Km high, it is characterized by the presence of different types of obstacles such as trees, houses and mountains atmospheric precipitation, dust, thermal excursions between day and night and seasons.

The ionosphere represents the layer of air which spreads over 50 km of the Earth's surface, it is characterized by the Ionisation of the atoms which constitutes it,

the presence of positive and negative ions highly affects the propagation of electromagnetic waves in that layer, producing phenomena of reflection and refraction of variable entity depending on:

- the hour when the transmission happens, night and day hours
- the height which the electromagnetic waves reach

The transmission of electromagnetic signal happens thanks to appropriate aerials, following straight trajectories.

There are several ways to irradiate the electromagnetic waves toward the receiving waves:

- By superficial wave, exploiting the ground conductivity; acceptable only for waves included in the VLF field of frequencies (4/30 KHz).
- By direct wave, with straight and at sight propagation, acceptable for frequencies higher than HF band (over 30 MHz)
- By reflected wave, using the reflection opened by the earth's surface, by the ground conformation and the presence of obstacles.
- By ionosphere wave, using the ionosphere property of reflecting toward the earth certain electromagnetic waves
- By de-fraction or scattering, exploiting the phenomenon of re-irradiation of energy of a physical obstacle which hit by incident wave on its turn becomes source of irradiation; a particular case of physical obstacle is dust, this phenomenon is called scattering.

The transmitting media supporting an electromagnetic signal are their radio transmitting systems, television systems, radio systems and satellite communication systems.

Geo-Station Satellite, keeping rigorously constant position in relation to the earth, behaves as it were an aerial of extraordinary height capable of covering about 1/3 of the Earth's surface, and visible simultaneously from many other points of transmission or reception.

The satellite therefore behaves as an aerial for ideal microwaves, capable of receiving and transmitting with any station and at very remarkable distances. Three satellites on the same orbit, located at 120^{o} one from the other, are able of guaranteeing a system of total telecommunication covering the whole earth.

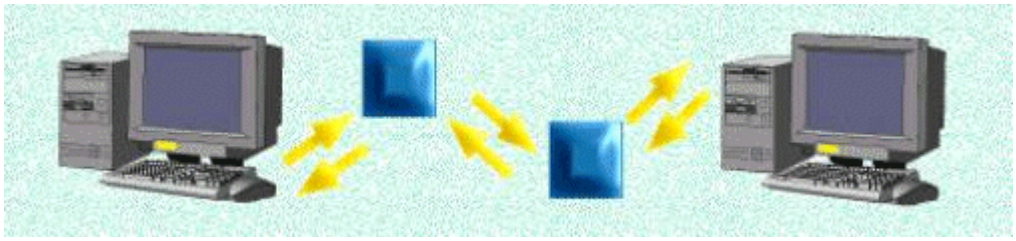
Presently there are two INTELSAT Satellites capable of serving about 35000 telephone channels and 4 TV channels.

3. 5. 1 PUBLIC NETWORKS

Public networks are managed by bodies or public bodies and can be used by citizens in a simple and direct way for the transmission of public data. They can be divided into:

- the public switched telephone network also called PSTN, or NTN, or SN;
- ITAPAC: packet switching network;
- PDN: Phone Data Network;
- ISDN: Integrated Services Digital Network;
- DAL: Direct Analog Link) and DNL (Direct Numerical Link) direct lines;
- Frame Relay network;
- ADSL: network (Asymmetric Digital Subscriber Line).

All public networks generally allow a point-to-point link, that is to say a link between only two computers placed at the end of the link.



The public switched telephone network is made up of several lines (connection network) and switchers that are placed between them. Switchers are electromechanic or numeric machines linking two users who want to communicate. They are able to choose and join several transmission trunks (links) representing the national distribution line made up of urban and interurban networks properly linked. It is an extended and capillary network because it reaches subscribers all over the world; it is public and time effective; the access to the network is easy and can also be performed at home. It is used for the INTERNET.

Initially designed to carry a voice signal, the network is nowadays advantageous since it is extremely capillary and can be used by any user owning the conventional phone jack where the plug of the telephone is inserted.

If the telephone is replaced with the phone modem data can be transmitted to:

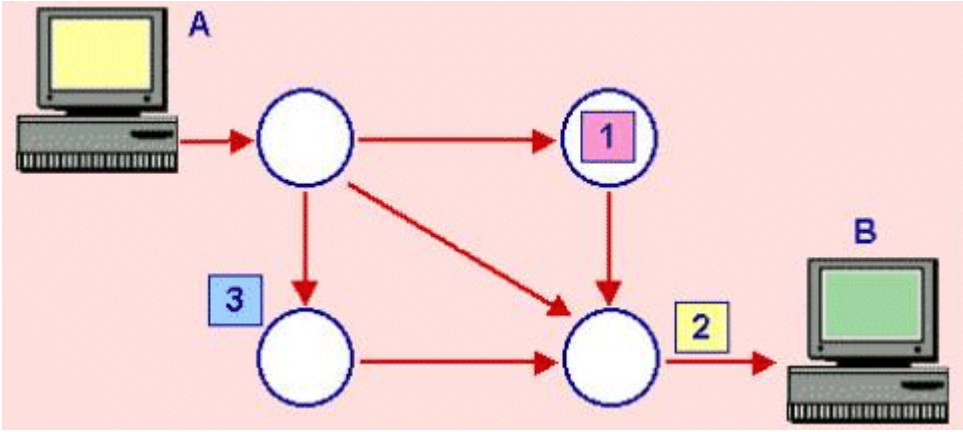
- a remote user such as a database or another PC;
- a more suitable network such as ITAPAC or the INTERNET;
- the user of any communication system such as Videotel or PT-Postel.

It is important to highlight that such a network does not require any specific bureaucratic procedure to access to it, apart from a common telephone subscription and a suitable intelligent phone modem that is to say equipped with all those typical features of a modern modem.

Therefore, the modem is required to use such a network, since it is the only very important tool that is able to guarantee the transmission of data to the remote user at a particular speed.

There are multistandard modems on the market that can autoconfigurate according to the performances required. They are equipped with MNP4 protocol to check the error of transmission and with MNP5 protocol to compress data.

ITAPAC packet switching network uses both the line switching technique and the switching technique allowing to assemble data into packets in such a way as to make the transmission more rational and rapid (this system is also used by the WAN and the INTERNET).



It is a specialized national public network realized by the Ministry of the Postal and Telecommunication services and Telecom to meet the increasing demand for data transmission services.

The switching technique allows to create the link desired with different remote users thanks to the use of remarkable line switchers abiding by the same principle of the conventional telephone network.

The packet switching technique allows to assemble data into packets in such a way as to make the transmission more rational and rapid. This system is also used by the WAN and the INTERNET. Therefore, such a network is available for only one packet for the time necessary for its transmission, thus being immediately available to send other packets to other users. Such a network takes advantage of the distributed capillarity which is typical of a switched network, not to mention the advantages resulting from a high-speed network. It is important to remark that such a network enables the user to access from anywhere not only from inside the network but also from outside by means of other network structures.

ITAPAC allows to link with the packet switching networks of other countries since the packets are structured in a standardized way at an international level according to protocol X.25.

The packets hold service information in a suitable header, such as the receiver's address and the sequence number of the packet which enable the network to route and to send each packet in a proper way.

It is a mesh-based structure, since each node is linked to any other node of the network by means of high-speed direct links called backbone links.

The numeric multiservice PDN was designed to meet the users' needs both in the phone and in data transmission fields. It is a network interconnected with the national telephone line, therefore it is possible to interexchange phone information between the two networks enabling the link with conventional users. PDN does rely on the circuit numeric switching and it is thus able to activate the direct and temporary link between two users who have a physical link at their disposal for all the time necessary. As a matter of fact, during the link the line works as a dedicated channel.

Like all the circuit switching systems the rates range according to the connection time.

Such kind of network is able to offer the user a definitely higher transmission quality compared to that offered by the conventional telephone network. It is equipped with four-wire links guaranteeing a full-duplex modality, short connection times with remote user thanks to the numeric switching, very few errors due to a better line quality as well as a higher transmission speed being equal to 64 Kbps.

The network has a mesh-based structure whose self-switching nodes are dispersed in the most important urban areas in order to guarantee the coverage of the whole national territory.

ISDN is a completely digital technology that was originally conceived of as an evolution of the telephone numeric network. It is a switched network using the twisted pair as a transmission support. It is able to use trunks at a speed of 64 Kbps.

It is still a switched network using the existing twisted pair as a transmission support but is able to allocate a telephone number to the user, thus allowing the communication between users by means of a high-speed and cost effective switched channel. It is thus a global communication network able to carry any kind of information in a digital form and guarantee the high quality of communication regardless of the distance; it fits conventional communication systems (telephone), communications systems (transmission of data and faxes) and mass communication systems (transmission of images, videoconferencing).

This new technology can be used at work, at home and in leisure time, too.

ISDN can be considered as a highway carrying a great deal of information at 64 Kbps, and therefore it enables to:

- convert a telephone call into a video telephone call
- complete a text with a picture
- telework on the same document
- broadcast television images
- interact.

This is possible because the ISDN technology relies on the digital processing of the information signal, thus transmitting bits directly rather than analog signals at a high speed and at low costs. It does not use the modem but a copper twisted pair that in the future will be replaced by the optical fiber.

DAL and DNL direct lines are private networks that are managed by a public body such as Telecom and can therefore be used by any user upon a proper request. They are made up of line trunks that are hired and privately reserved for two or more users.

They are permanent links that do not have the 4 KHz limit typical of switched networks and are called clean line trunks since there is not any switcher. Such lines allow to make the best use of the transmission capacity of the medium.

Direct networks can be both analog (DAL) or numerical (DNL). The latter allows to transmit data at a high speed with point-to-point or multipoint links connected by appropriate baseband modems.

Frame Relay public network is a broad-band switched network mainly targeted to the connection of LANs or computation centres. It allows the implementation of cost-effective virtual private networks within it enabling to meet the communication needs of modern networks within a limited geographic area adopting the best suited techniques.

The Frame Relay service provides the users with a virtual structure which is rather like the one that could be realized with a high-speed mesh-based transmission network in all the branches of a given company.

The users communicate through virtual logic channels that can be bi-directional or permanent channels: Data can be transmitted any time without dialling any number as if the network were a direct circuit a Router allows to access to.

In short, a user who wants to use Frame Relay has the following advantages:

- he/she avails himself/herself of a high-speed network between the branches, or with remote users without hiring additional circuits;
- he/she avails himself/herself of a mesh-based network that he/she will not create by himself/ herself;
- he/she affords minimum investments without modifying his/her existing system;
- he/she can open new branches activating new permanent virtual circuits without making any other investments on new networks.

Frame Relay is the answer to the future working sector.

ADSL network is offered by TIN, belonging to Telecom group to connect to the INTERNET 24 hours per day at a speed of 640 Kbps for downloading and up to 128 Kbps for sending information from a multimedia PC (upstream). It uses the twisted pair but by installing proper modems at the central base and at the user's it converts the analog line into a high speed digital line using an over 32 KHz high-frequency translation for data.

3. 5. 2 PRIVATE NETWORKS

According to the extension covered, private communication networks are classified in the following way:

- LAN: Local Area Network which can cover up to about ten Kms.;
- WAN: Wide Area Network which is made up of the interconnection of several LANs to increase the size of the network within a limited geographic area. Therefore it is no longer a mere local network. The extension can be obtained by using public or private numerical networks

such as (DNL, ITAPAC, ISDN, Frame Relay etc.), radio relay systems or even satellites;

- MAN: Metropolitan Area Network which is an intermediate form of network between LANs and WANs, that also uses proper interconnection media.

LAN guarantees the communication of hardware devices; MAN guarantees communication within a company and WAN guarantees communication at a global level.

LANs are a group of computers arranged within a rather limited geographic area, at about 10 Kms maximum far from each other and are interconnected in such a way to exchange information at a high speed up to 100Mbps, by means of star-connected, ring-based or bus-based circuits.

WANs are referred to as geographic networks since they can cover large areas and are characterized by the internetworking problem that is to say the connection between networks having different hardware and software characteristics.

Such networks guarantee:

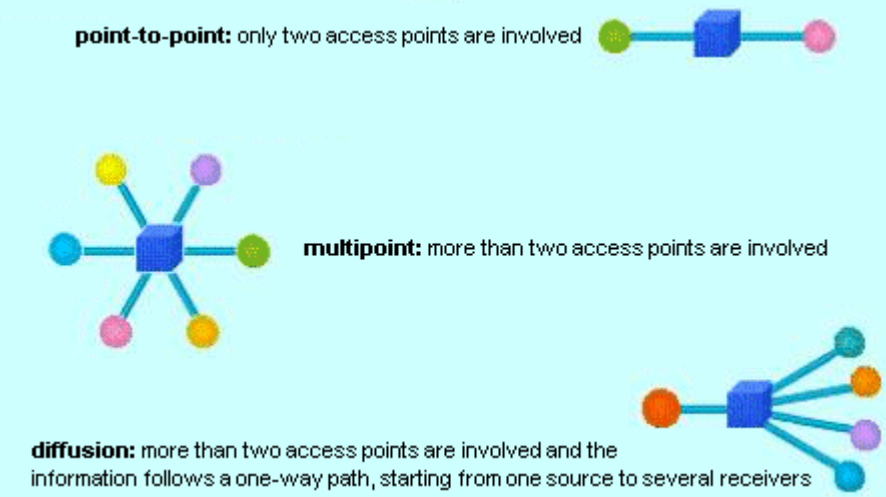
- A rapid bi-directional transmission of information;
- The sharing of information and files by several users;
- The sharing of the hardware, the printer, the hard-disk and the plotter in order to reduce costs and optimise the use;
- The sharing of the software, that is to say of application programs enabling the users to work on the same version of the same program.
- The setting up of dispersed or concentrated database which are easy to access to;
- The access of users to all the information available.

Due to the high quality of links and to transmission security, LANs fit very well the most demanding needs of a modern and dynamic company.

The nodes the computers are linked to, can be connected by wire media such as twisted pairs, coaxial cables, optical fibers or by wireless media such as radio waves and infrared rays. Twisted pairs, coaxial cables or optical fibers allow to reach the maximum speed of 1 Mbps, of 10 Mbps and of 100 Mbps respectively.

The radio waves of radio-relay systems or satellites and X-rays are electromagnetic signals using the ether as a physical medium to carry information.

LAN can be referred to as deterministic (Token Ring), or as statistic (Ethernet); according to its typology, the network can be point-to-point or multipoint; according to its architecture it can be a star-connected circuit, a ring-based (Token-Ring) or a bus-based circuit (Ethernet).



All the elements of the star-connected LAN are linked to a central node working as a master that transmits and controls data; it is a point-to-point link and the network is handled in a hierarchical way. It is cost-effective and easy to be installed and handled but has the disadvantage to depend on the Master; therefore, if the Master breaks down the network stops working.

The elements of the ring-based LAN are linked by point-to-point lines so as to form a circular link; the messages are transferred from a node to the other according to a predefined path; each node can recognize the messages sent to it and works as an

active repeater if the message crossing it is sent to another node. By means of suited control techniques on the data flow it is possible to avoid contentions in the network.

Such a network allows to cover long distances since each node is active and retransmits the message regenerating it; unfortunately it cannot be broadened in the future and if one node breaks down the whole network stops; moreover, transmission times are rather long since they depend on the number of networked terminals.

The most well-known network is the Token Ring produced by IBM, where a frame (Token) is transmitted over the network according to a precise direction.

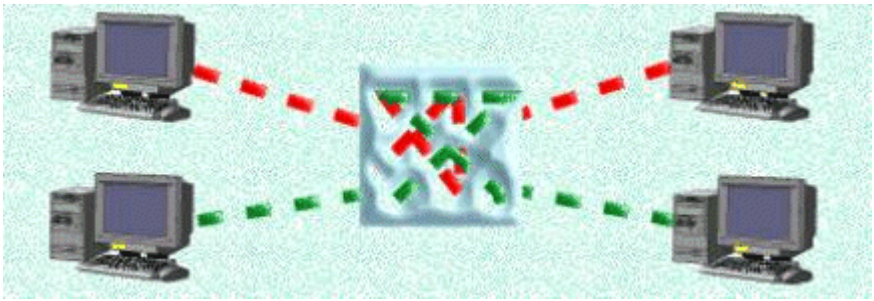
The bus-based LAN works like a multipoint system because the link is common to a certain number of nodes; it has one physical channel to which all the computers are connected; the messages are carried throughout the network reaching all nodes; each node plays a passive role since it must recognize only the messages sent to it but it must not repeat them. In order to avoid contentions appropriate control techniques of the access shall be used.

Such a network has a rather flexible configuration and is reliable; consequently, it can be difficult to be managed if there are many nodes. Ethernet, which was developed by Xerox, is the most common network whose nodes are connected by a coaxial cable.

LANs can have contention protocols that check the state of the line before transmitting data (CSMA), or centralized or dispersed scanning protocols.

The modalities to access to LANs are:

- Fixed assignment, with frequency division multiple access (FDMA), or with time division multiple access (TDMA);
- Casual assignment, like in the contention technique, carrying out the survey of the carrier (CSMA);
- assignment upon request, like in scanning techniques (Polling or Token-ring).



MANs are used to connect systems by means of a dedicated network within a town. It can be a public network or it can be managed by a telecommunications company; by interconnecting several private networks it is possible to set up a wider metropolitan network. Such a system is used to exchange information between private individuals and public structures.

Geographic WANs are made up of the interconnection of many LANs, having different hardware and software characteristics. The interconnection can be realized by directly linking several local networks like within the companies or by means of one or more public or private intermediate geographic networks like the INTERNET.

It is therefore necessary to handle very different protocols and typologies and heterogeneous physical links, ranging from twisted pairs to optical fiber systems.

As a result, interconnection is realized by using the following devices:

- Gateway to link networks having different protocols and systems whose architectures do not have points in common thus converting the data to transmit from one network to the other;
- Bridge to link two networks having the same protocol but a different wiring; the bridge operates at the second level of the OSI model (link level);
- Router to route messages between homogeneous networks operating on the OSI-model network;
- Brouter is a cross between Bridge and Router.;
- HUB is a passive repeater that interconnects a central node and the wiring segments that develop the link between the different PCs of a local network; it can therefore be referred to as a concentrator.

3. 5. 3 INTERNET

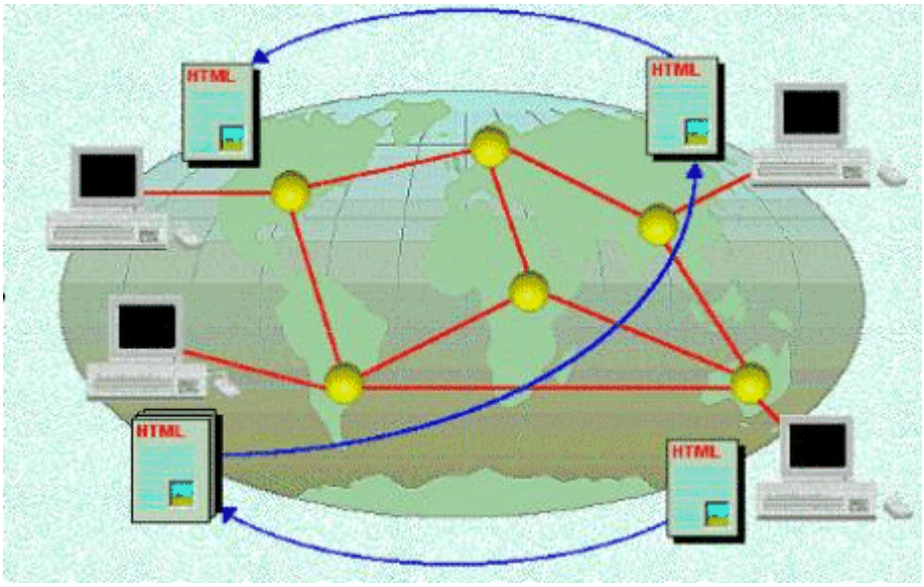
The INTERNET is not a single network but is an interconnection between several ones; therefore it can be referred to as the network of networks (INTERNET = INTERconnected - NETwork) involving millions of users.

It is a particular kind of network because it belongs to everybody and to nobody at the same time, since the bodies handling it do only have a consulting task rather than a managerial one (unlike ISDN, which is handled by Telecom - Italy).

The INTERNET is a worldwide network made up of many interconnected and intercommunicating computers assembled to exchange resources such as : data and information storage; interexchange of pictures, documents, files, interexchange of communications, opinions and knowledge.

It is a packet switching network with a communication protocol called TCP/IP (Transmission Control Protocol/Internet Protocol) and a Client/Server structure with numeric and literal addresses.

The INTERNET offers many services such as: Surfing in the World Wide Web, E-mail, Mailing-list, Newsgroup, FAQ, Conferencing, FTP file transfer, TELNET terminal emulator, OPAC on-line catalogues, CHAT, etc.



The INTERNET started in 1969 as an experimental project of the US Defense Department better known as ARPA (Advanced Research Project Agency), aimed at guaranteeing the communications between big computers also in case of nuclear attacks.

In the 80s the network was extended to University and Research Centres taking the current name of the INTERNET and using the TCP/IP protocol, that is able to interface with any kind of computer allowing the extension of the link between systems having different characteristics.

At present any user can access to such a network that has become public giving rise to appropriate companies managing different nodes referred to as Internet Server Providers, which are mainly located in big towns.

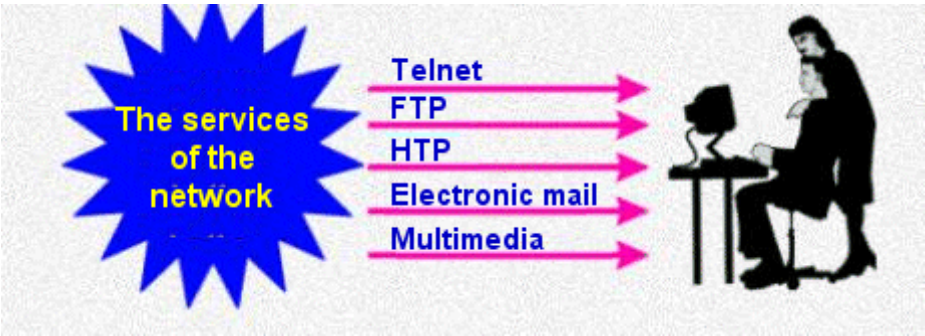
Each computer, representing a Host or the INTERNET node, is connected to the network by means of appropriate high-speed direct numerical links and is known

as the node of the network in an univocal way thanks to an address called IP (Internet Protocol) which is assigned to it.

The address is made up of a series of 4 numbers separated by a period; each number of the address can range from 0 to 255 giving such kind of sequence:

147.165.110.35

that must be univocal so that the nodes are not mixed up; therefore, IP is supplied by appropriate bodies.



To facilitate the contact with a remote user each address is associated to a meaningful name that can be easy to remember. The address is usually associated to a name, called domain, identifying the kind of body managing the node and the country of the node. As a matter of fact, suited standardized acronyms defining such domains (.EDU, .MIL, .NET, .IT) have been designed.

The user can log into the INTERNET in either of two ways :

- directly by means of dedicated links rented by managing bodies of public or private networks;
- indirectly, by means of conventional telephone networks and by means of appropriate providers which are the interface between the user and the INTERNET.

Due to the high costs deriving from hiring direct links a common user is not interested in logging into the network in a direct way; he/she would rather use the switched telephone network because it is easy to use and cost effective. In order to access to the network the user should have:

- A Personal Computer properly equipped with hardware and software;
- A high-speed phone modem;

- An appropriate communication software, that, by means of a modem connects the computer to the provider with which the access contract is subscribed; as a matter of fact the Provider is the only possible interface to access to the network.

The information circulating in the network is handled according to TCP/IP protocols which assembles data into small blocks (packet switching)

Each datum is transmitted independently of the others by the so-called Routers. When all the packets reach their destination, they are put back in the original form.

The Packets are assembled, routed and put back in the original form according to TCP/IP protocols: more exactly IP (Internet Protocol) handles the routing of data and TCP (Trasmission Control Protocol) handles the division in packets and the following assembly at the final destination.

For several reasons, among which worth mentioning are the limits of the hardware, the data sent on the INTERNET must be assembled into packets lower than 1,500 characters each.

TCP collects data and assemble them into blocks. Each of them has a header holding a great quantity of information like the order in which the packets must be assembled.

When TCP creates a packet, it calculates and adds a series of controls to the header, that is to say a number used at the final destination to find out if any error occurred during transmission. Such a number is based on the exact amount of data a packet holds.

Each packet is in its turn put in an IP "envelope" showing the address of the receiver and of the sender as well as other useful information for the delivery.

When the packets are on the INTERNET the Routers examine the IP "envelopes" along the path and read the addresses; the Routers decide the most efficient pathway to send each packet to the next station which is the closest one to the final destination. In this way, an IP "envelope" going from Milan to London will not pass through New York. After being routed, the packets reach the final destination. Since the traffic on the INTERNET constantly changes, the packets are routed on different pathways and can reach the final destination in a different order compared to the original one.

When the packets reach their destination TCP checks if any error occurred along the pathway. If any, it eliminates the packet and asks the sender to try again the transmission; in this way, the highest efficiency is guaranteed because if any error occurs it is not necessary to return all data but only those held in a particular damaged

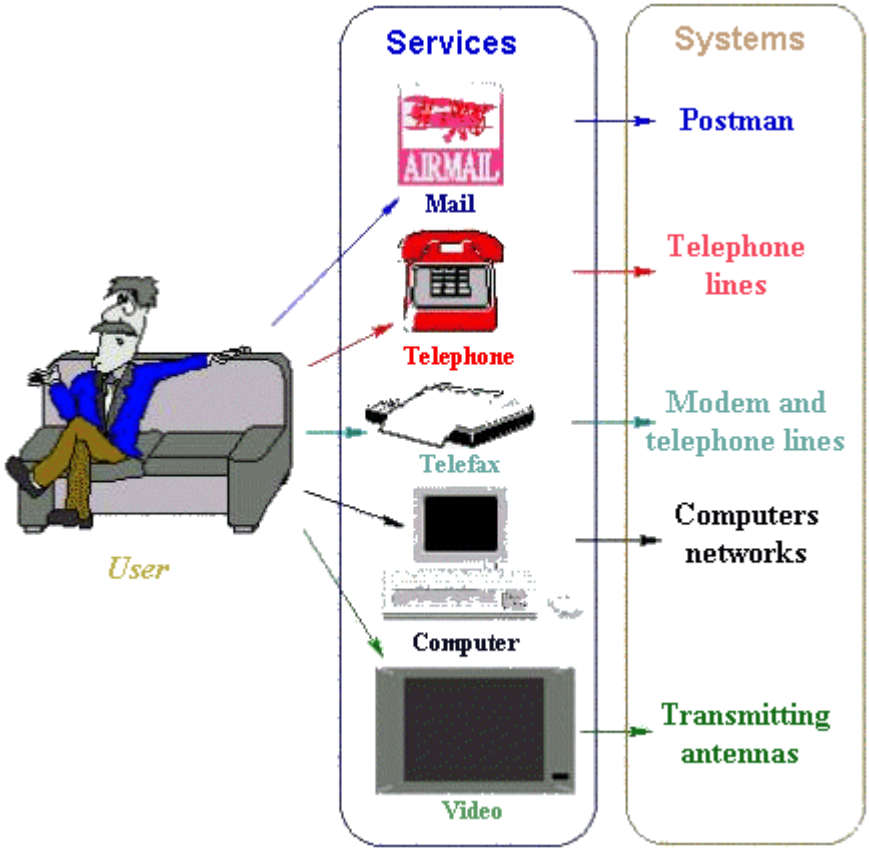
packet. When all the packets arrive in the correct way TCP assembles them in the original and unified form.

The INTERNET provides many services among which the most interesting ones are:

- Web pages that are hypertexts available for everybody;
- E-mail, that is a service of electronic mail; through the network it is possible to send messages made up of heading lines and messages written in ASCII code; the message is delivered to the server that contacts the other servers along the network up to the receiver. The e-mail address is made up of the Name of the user @ name of the server. Domain;
- Mailing-list. It is a list of E-mail addresses belonging to people sharing the same interests who have decided to regularly exchange electronic mail: it is actually a sort of journal created and exchanged among all the users registered in the list; the handler of the list sends all the messages back to the addresses of the list, sometimes under the form of “digest”, that is one message per day or per week where all the contributions have been “pasted”;
- News-group: it is a discussion group which is very similar to the mailing-list; that is to say to a "journal" where anybody can give his/her contribution sending an “article”. It is not necessary to be registered in the News-group in order to read it or to write in it; the “articles” are kept in proper servers and do not jam e-mail boxes;
- FAQs are a collection of frequently asked questions on a given subject and the relative answers so that everybody can find the answer to an urgent problem. The FAQs are often displayed in proper pages of the WWW , or in FTP sites, or in the Mailing-list or in the News-group;
- Videoconferencing is a complete real time textual, audio and video system; such a service requires a suited sound card, a microphone, a webcam, a VGA card and a high-speed line like ISDN;
- FTP allows to transmit information and softwares between different sites;
- OPAC are on-line catalogues;
- TELNET allows a remote control of the computer;
- CHAT is the round table people can participate in to “chat”.

3. 6. 1 TYPES OF COMMUNICATION

The methods of communication are verbal, non verbal, through symbols and para verbal. Verbal language takes place upon phonemes, morphemes, words and sentences, the non-verbal language is all that does not entail words. It supports, completes or substitutes the verbal communication through symbols, mime, aesthetics and semiotics (the language of signs). Para verbal language is everything used before, often, during an oral verbal message: it is the volume of the voice, the tone, the speed, the silence, the laughter.



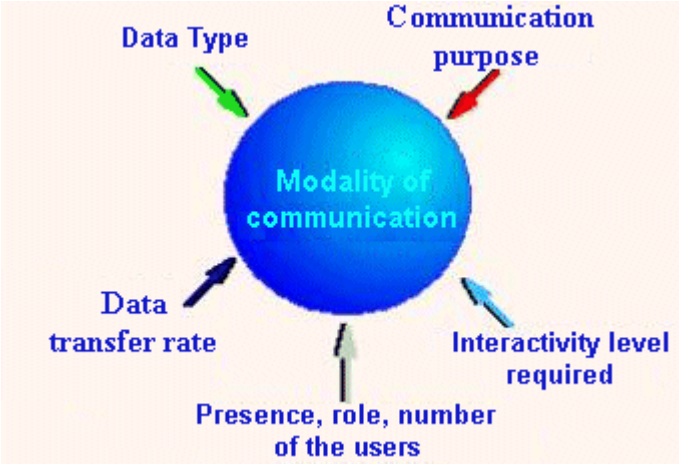
The most complete form of communication is simultaneously verbal, non-verbal and para verbal, allowed by a complex service such as video-conferencing: it requires the system to have a bandwidth and speed.

Optimal communication must be natural, independent of aim and method. The user must therefore be able to choose the method of communication, the service and use it regardless of the technology involved.

Then the exchange of information can take place via different media, such as mail, telephone, fax, computer and video. The channels implementing them are: telephone lines, modem, computer networks, communication aerials.

3. 6. 2 CLASSIFICATION OF INFORMATION

The parameters characterizing a communication and allowing its classification are the types of information, which can be audio, video and audio-video. The role, number type and presence of users, which can be simultaneous or delayed, the type of communication, being interpersonal such as a phone call, a letter, an exchange of ideas or diffused such as a television programme, a book and a poster.



Each method of communication is defined by a specific combination of these elements and it is possible through dedicated and integrated services, with different characteristics of the system of communication used.

Interpersonal communication happens between two people or groups of people and involves a feedback between the parties, characterizing aspects are actualisation

times and the possibility of dialogue. Therefore the replying time of the system is more important than its bandwidth.

The diffused communication takes place in a collective form. It is realized by one or a few people and it is addressed to a large group of users, it does not imply the possibility of an immediate exchange between the speakers. Characteristics are the unidirectionality and the capacity of the system, in terms of quantity and speed that is technically the bandwidth.

Telecommunication market offers such a great variety of services to satisfy all the requirements of the different methods of information both local and global. Integrated Information services can be both local, such as LAN Networks, or geographic such as WAN Network.

The services for the interpersonal communication are videoconferencing, electronic mail, newsgroup, workflow.

Services for diffused communication are the Web, broadcasting, cinema. The starting up of a service implies a series of competences and ability of management concerning the production of the content, the management of the service and the use of the Network. The service manager (in Italy RAI, Telecom) makes the content available in Network, cinema, and web.

The system is represented by the organized structure hardware and software, which makes feasible the realization of telematic services. It comes from precise choices about the network architecture, the type and transmitting capacity of medium, compatibility of terminals.

The present demand for complex services involves speed, quality, and information quantity, achievable just through width band communication systems, integrated amongst the media, telecommunication and informatics.

3. 6. 3 INTERPERSONAL COMMUNICATION

The interaction between two or more parties can happen in very different ways. Just think of a session of work amongst colleagues: the speakers talk with each other directly, they exchange information contained on different media, paper, magnetic and they interact with colleagues temporarily absent by leaving messages on their desks.

If we want to realize the same operational situation between people located in different places, immediately the need arises for analysing the effect that the communication system used may have on the process of information transfer.

If we want to schematise the tools used in communication, a first classification can be done between those services where the parts interact directly (synchronous communication) and services where the information and its fruition take place in different times. (asynchronous communication)

In the synchronous communication the parts interact simultaneously and directly like in an audio- videoconference, cooperative work and multi points video communication, which need high band and reduced delays.

To reduce the bandwidth requisites it is possible to use the compression of signals. The performance of the compressing techniques depend very much on the type of signal considered.

- In the case of vocal signal (telephony) it is possible to reduce the numerical flux to very few Kbps with negligible losses.
- In the case of audio signal (music) it is possible to have ratios of compression lower than the voice one, but anyway the produced flux can be reduced up to as many as ten Kbps.
- As far as video is concerned, although it adopts an extremely high ratio of connection, it is not possible to reduce flux connection lower than tens of Kbps. In the case of video application of good quality (television) the flux produced is as many as Mbps.

It can therefore be said that, albeit the considerable obtainable ratio of compression, the system used for multimedia signals transmission needs to be arranged on media with a notable bandwidth.

- **videoconference** 

- **electronic mail**
- **news group**

To reduce the delays and, therefore, to obtain a real time communication, the system must be capable of reproducing the data to destination in a synchronized way, transmission must therefore happen through real time protocol able of transferring the information in relation to their timing.

In audio/video conferencing sessions since more parties participate, the information distribution requires the use of star types, with the realization of a central node of management of the conference, or protocols with non uni-direction addressing. (multicast)

In the asynchronous communication the info generation and its function happen in different times such as the service of electronic mail and the service of multi-points messaging such as the mailing list, which allows communication amongst all the subscribers to a distributions list, the newsgroup, amongst the participants to a discussion group, groupware, to a working group.

The e_mail is typically a tool of interpersonal communication only between two parts. Replacing the individual address with a distribution list it is possible transforming the email from a one-to-one commutating tool to a one-to- many tool. In this way it is possible to reproduce techniques of communication typical of the editorial paper.

The use of mailing list is extremely diffused thanks to the speed by which information can circulate.

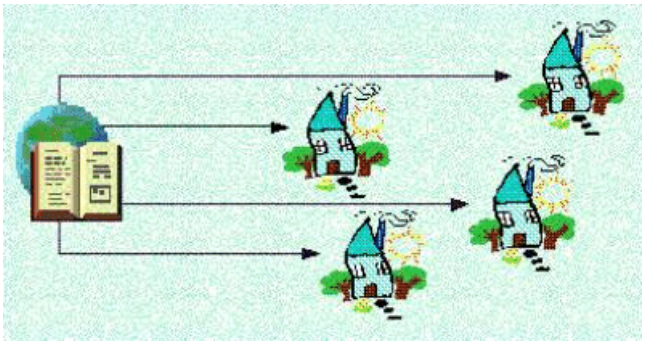
In the case of services based on email, it is possible to switch to the newsgroup by addressing messages not just to one person or a list of people, but to a public mail-box available to everyone, in this case we pass to a “many-to-many” communication.

The sharing of info within a group of interest involves a change from primitives of communication, to primitives of collaboration.

In this way it is possible to get to the group wave, being a system allowing the simultaneous use of all the communication techniques, collaboration and coordination to make the components of a group interact effectively.

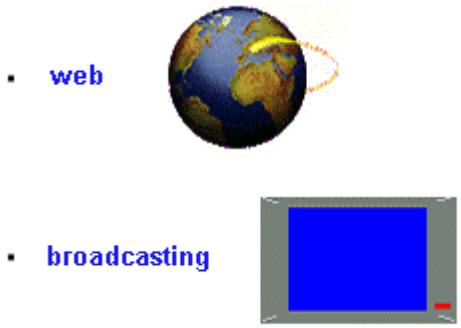
3. 6. 4 DIFFUSIVE COMMUNICATION

The diffusive communication is characterized by the distribution of the information in absence of interaction with the addressee; therefore the same information could be broadcasted to all the addressees, requiring only one trasmissive channel. Printing or television are examples of conventional services ; in this case the user can only select different sources.



As to the telematics services, we must divide them into:

- Services that require the whole transfer of the information and then subsequently, proceed to its elaboration / visualization, like the download & play.
- Services that begin to use the received information while the transfer is still in progress, like the streaming.



They are services that firstly require the complete transfer of the information and subsequently they proceed to their elaboration and visualization, like the World Wide Web, the Internet, which is a service characterized by the use of the information through a hypertextual graphic user interface. A link could connect with both resources on the same server or with others available on servers via the INTERNET network. All the pieces of information are represented in a hypertextual graphic form, that is, with a technique of presentation in which some words allow connections toward other documents, which can be texts, images, sounds, executable programs; the universal term for any application is the Web Browser.

The download & play is characterized by requisites of relaxed system, as it processes pieces of information only after they have been completely transferred, regardless of the time this operation requires. They are therefore usable on networks of any performances.

The streaming services are characterized by the possibility of using the data of the information before they are completely available, without having to wait for the whole transfer, like the audio-video on demand service.

This implies that the destination source is provided with a continuous flow of data, so to have available information while those previously acquired are being used.

3. 6. 5 COMMUNICATION SYSTEMS

The systems of communication and transfer of information are divided into: copper electric lines, like the twisted pair telephone cable and the coaxial cable; optical fibres, which are being spread in the wiring of the urban centers (FASTWEB project in Milan) improving and multiplying the ITC services, with the speed of 10Mbps in data transmission; satellite communication with wide band radio waves (in Italy Netsystem.com), which have the advantage of the ubiquity but the disadvantage of the asymmetry since they offer a speed of data transmission up to 2Mbps in download and a lower speed in upload; communication with mobile cellular phones which allow to make and receive calls either towards public telephone network or other mobile equipments, using the frequencies of the UHF band at 900 MHz and 1800 MHz.

With cellular phones an economic message system called SMS (Short Message Service) can be a activated. It is even possible a data transmission with a speed up to 9,6 Kbps for the GSM phones (Global System Mobile communication) and WAP (Wireless Application Protocol); and up to 60Kbps with the phones of new UMTS generation (Universal Mobile Telecommunication System).

3. 7. 1 PLANNING

When the realization of a telecentre is being planned, besides the ergonomic requisites, the responsibility connected to the telecentre and the satisfaction of teleworkers, the technical requisites must be considered in particular the communication needs on which the size and type of the telecentre depends.

The centres of telework are classifiable according to their size and the type of work which is carried out. These two elements are related to the quantity of data that are transmitted.

The quantity of transmitted data is really what makes a telecentre different from a normal office.

The size of a telecentre mainly involves the possibility to share the cost of the equipment among the workers and consequently to have a better standard of services at the same cost.

We can divide the telework centres into offices for one person only, for a few people and for many people. In each of these categories another classification can be done depending on wether people from different companies work in the centre.

A single person can work from home or from any other place and at different times from different places so the same hardware cannot be shared with other people.

When different or many people telework from the same place it is possible to share the equipment as it is shown in the following table:

Possibilities of different size of telework offices to share their services			
	Single person	Several persons	Large office (moreover)
Number of persons	1	2 - 15	16 – (1000)
Service to share	No services to share	Printer, copier, scanner, telecopier, computer for video conference	Lunch room, bookkeeping, mail, room for video conference, ADP-support

Telecommunication solutions represent the main differences between a telework office and a normal office. The role in teleworking determines the choice of

telecommunication solutions. If the requirements for telecommunication are reasonable, the right choice of telecommunication solution is vital to manage telework. We can distinguish three categories at least:

- The employees do not quite need telecommunication in their work. Working involves for instance independent analysing or planning.
- Contacts with company involve transferring data occasionally using files or software located in the employer's server.
- The rate of telecommunication is high and it is a considerable part of daily work. Large files like good-quality images are transferred regularly. In addition, there can be some other applications which require a large capacity of data transferring, such as regular video conferences.

So the right choice of telecommunication solution is extremely important to manage telework. We can summarize the possible choices in the following table:

Data transferring hardware depending on telecommunication requirements			
	Minor needs in telecommunication	Average needs in telecommunication	Major needs in telecommunication (moreover)
Basic equipment	Telephone, answering machine	2. telephone line [1)], telecopier	ADSL or similar
Transfer mode	Modem, GSM/Data	Modem ISDN	ADSL adapter
Special equipment		Separate computer for video conferencing	Video conferencing room Internet calls
Data transfer rate	9600 bps GSM 14.4 kbps HSCSD/GPRS 48 kbps Modem [3)]	48 kbps modem 128 kbps ISDN	< 9 Mbps ADSL [4)]
Establishment expenses	< 170 €	< 420 €	3400 – € [2)]
Monthly expenses	20 – 170 €	85 – 340 €	340 – € [2)]
1) ISDN and ADSL leave the second telephone line open 2) Expenses can be shared among several workers 3) The speed of 56 kbps modem is practically 48 kbps 4) ADSL: up to 9 Mbps downstream, 800 kbps upstream			

Let us now look at the typical connection ways of a telework centre:

The most typical telework connections (MikroPC 2/2000)					
Types of connections					
	Gsm	Modem	Isdn	Cable modem	Adsl
Applicability					
remote administration	3	3	4	5	5
remote usage	1	2	3	5	5
mobile usage	5	3	1	-	-
Speed					
receiving	9,6-38,4 kbps	56 kbps	64/128 kbps	200-1 000 kbps	1 000-4 000 kpbs
transmitting	9,6-38,4 kbps	33,6 kbps	64/128 kbps	100-700 kbps	128-512 kbps
Expenses in EURO					
at the beginning	17	125	125	45	505
monthly	17	15	17	40/modem	70 – 335
per minute	0,15 - 0,30	0,02 - 0,08	0,02 - 0,08	-	-
hardware	170 – 505	35	35	50	50
Scale 1-5; the bigger the better					
Prices are directive; depends on operator and country.					

As regards basic hardware, it is similar to a normal workplace. The special demands of telework are emphasised when choosing data transfer hardware and software.

In case of an office for various people, better services at lower cost can be expected due to the possibility to share the services among several people. Possible shared services are printing, copying, data transferring and video conference rooms.

When purchasing hardware, it is advisable to compare the solutions of various suppliers and apply for quotations. It is worthwhile to discuss with people who are already teleworking, if possible.

As to hardware, an alternative to buying is leasing.

When transfer capacity increases, expenses increase too so it is useful to choose the data transfer route considering the data transfer capacity. Quality of work and amount of people working in a telework office influences the capacity requirement. An average need of data transfer has to be considered as well as the plans for the future.

The most expensive solution is to be considered only if the data transferring quantity is exceptionally high or an uninterrupted connection is needed. In case of a

bigger telework office a choice can be made between decentralised and common transfer media.

As regards hardware, telework involves some special requirements for peripheral devices as follows:

- When working alone a slower printer than in office will do. Filing qualification of ink must be taken care of if cheaper printers are used. In larger teleworking offices a more efficient and more expensive printer can be shared.
- Often separate media are needed to backup information, because backup cannot be stored up via server. For example, tape drives, movable hard disks and writing CD-ROMs are used to store data. These are useful when we have to transfer data manually, when people are working in various places and transferring through network cannot be done.
- Video conference devices are needed if a company is using that technique. An alternative is a computer equipped with single video conference hardware. In bigger offices a whole flat can be equipped to be used as a video conference room.
- If a modem is used as a data transfer route a secondary, alternative telephone line has to be considered; a mobile phone for instance.
- Other peripheral devices may be necessary like copier, telecopier, television, video projector and UPS.

Different kinds of software are needed too: electronic mail, FTP, fax, internet, encrypt, remote access, video conference, internet phone and possible own data transfer software, which is used to process subscriptions and invoices.

Finally, company strategies in data security and special requirements in telework have to be followed. Poor safety could be very risky, the most important thing is personal data backup and security while transferring data. Solutions in information technology at home are often slight at operating system level, because only one computer is used.

To achieve a moderate data security for instance in Windows operating system, data have to be encrypted.

It has to be remembered that resources to be used in data security are properly related to possible risks and expenses or harms. Therefore, a valid insurance has to be made in a telework place

3. 7. 2 USEFUL LINKS

- ETO, European Telework Online: http://www.eto.org.uk/faq/faqtcvtc.htm
- Euro-Telework: http://www.euro-telework.org/
- Telecommuting and Telework resources: http://www.telework.com/

4. 1. 1 STATISTICS

Statistics is the scientific branch which allows to study and research some social problems of general interest by collecting data and information which are then elaborated and offered to the public in forms such as graphs and charts.

The combination and comparison of some data originates matrixes which show numerical results called factors. These represent the index of the objective phenomenon being observed. The result obtained is likely to be accurate in a directly proportional way both to the volume of the collected data (related to the area forming the object of the research, micro or macroeconomic) and to the uniformity of the information entered in the matrix itself.

Therefore, it is necessary for the analyser of the data, who also makes up the matrix, to have sufficient knowledge in order to understand the correct reading, representation and updating of the data.

The information acquired through statistical methodology - normally elaborated according to the user's cautious appreciation – must be put forward to the targeted consumer on behalf of the promoter making use of traditionally adopted marketing tools.

It is therefore useful to try qualitative 'open dialogue' tests in order to identify problematic areas and the expected items, or focus group in order to evaluate the priority and importance of each item.

The increasing markets liberalization, described with the extreme and far too abused term of "globalisation", makes the above mentioned knowledge practically indispensable to the promoter who, without them, will suffer out of the limitedness and obviousness of his offer.

4. 1. 2 STRATEGIES AND APPROACH WITH USERS

The diffusion of teleworking necessarily requires correct information in respect to its characteristics, applicability and description. Teleworking has an element which potentially involves economies of scale for the business enterprise. It is in fact undeniable that any business enterprise always tries to optimise its resources, so that there may be a balance between costs and revenues. It is therefore

possible to say that human resources too can be managed and directed towards the general objective of the business enterprise.

Thus, for the promoter having specific skills and competence in the fields of social psychology and public relations will constitute an element worth rewarding when it comes to approaching the business enterprise.

Being capable of identifying the objective target is essential in order to be able to improve the commercial situation of a business enterprise. The evaluation of the business enterprise targeted as the final user of the services, will have to take into account the composition of the customer base clients with its various aspects (dimension, geographical area, age, importance and commercial potential, trust) the buyers, the type of services being offered, etc.

4. 2. 1 CONSIDERATIONS

Teleworking does particularly interest jurists and economists due to its key innovative issues. Teleworking is different from home working, a resource that is likewise used to optimise company's activities but does not avail itself of the information technological device employed in teleworking.

The innovations due to the significant development of "office automation" and to the awareness that the conventional static concept of work is increasingly urging on a new "dynamic" concept resulting from different market needs, have allowed the evolution of the working relationships.

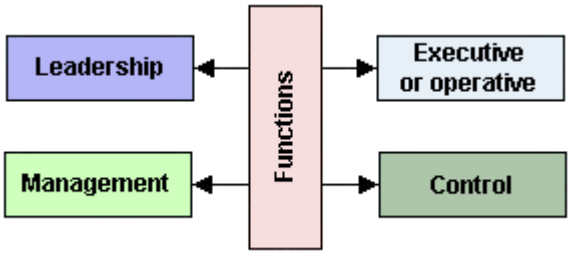
In all developing sectors many doubts arise on this kind of working relationship taking into account that the advantages to the employee also hide precarious aspects related to the duration of such a contract and the eventual possibility to reconvert it into a conventional contract.

In particular, from the Trade Unions' point of view doubts may arise on the reliability of the contract and on its suitability to public administration sectors.

This section is an overview of teleworking. More specific aspects will be thoroughly examined in the following sections.

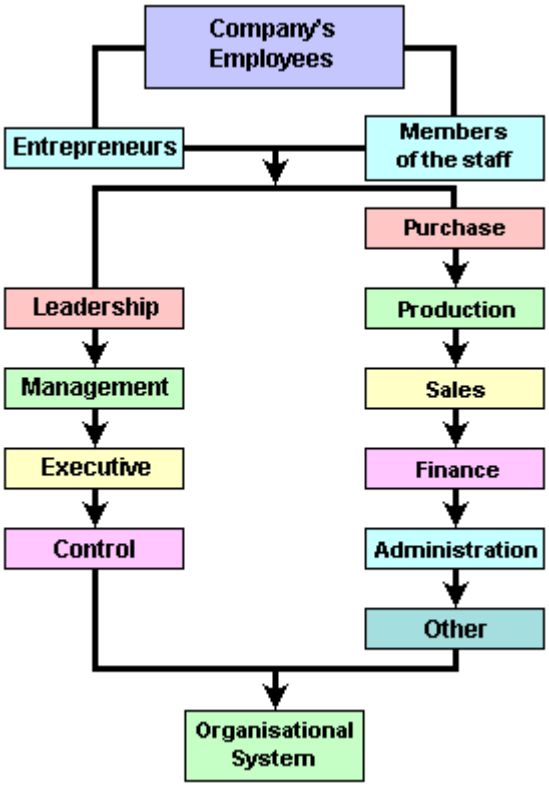
The promoter will first analyse the company structure so as to highlight the areas that can be involved in teleworking.

Any company structure designs "the company system" including functions that can be divided into four groups:



The number of employees performing these tasks depends on the company's size. It is thus necessary to create an organizational structure that meets the company's needs .

The following diagram can be useful to understand how a company can organize its structure taking into account the four functions:



The higher or lower flexibility of the organization illustrated in the diagram can influence the approach to teleworking.

After examining the company's organization, the eligibility of the infrastructures shall be assessed by checking the premises where the relative activities are carried out.

Teleworking cannot easily involve the industrial sector, especially those companies specialized in manufacturing or processing raw materials or semifinished products.

Conversely, it can involve bank, insurance, transport services and the services supporting the above ones.

After examining the sectors which best suit teleworking, it is necessary to focus on the economic-juridical issues of such contracts.

The section does not focus on those psychological aspects arising from the "isolation" of the teleworker who does not have any physical relationships with his/her colleagues, and third parties or from the "gratification" saving him/her from the stress caused by his/her working relationships.

4. 2. 2 CONTRACT PROFILES

At present, it is not possible to make evaluations of the recent phenomenon of teleworking since studies have not been carried out on this field.

It is important to take into account the typologies of remote relationship set up with teleworking. Several consequences are remarked on the structure and costs, especially if such a contract profile is applied to the whole branch of the company (that due to logistics is separate from the head office) compared to the application "uti singuli", typical of the relationship with only one employee who works at home.

It is undeniable that if teleworking is applied to a branch or to a homogeneous sector of the company (whereby production needs require it) it entails the reduction in fixed costs such as the rent.

Pursuant to law and to other principles, a developing enterprise has to move to other premises in order to avoid "compression" in narrow environments. Therefore, ergonomy imposes the realization of working environments that best suit employees' needs to avoid negative repercussions due to the narrowness of the working environments. Moreover, at least in Italy, the active and passive safety norms of the working environments fix the exact sizes of enterprises' premises.

The teleworking contract is subject to economies of scale whenever the enterprise saves transport costs if the company is very far or the area is not served by many urban or extraurban public means of transport, or if it saves the additional costs of the canteen. Such costs are higher if the enterprise is equipped with an internal structure, and are lower if it resorts to external structures supplying luncheon vouchers.

Although the enterprise can hypothetically take advantages, the employee suffers economic losses since he/she does not profit from benefits.

If the teleworking relationship is set up with a single employee supplied with remote offices at their home, the cost-benefit ratio is likely to be inverted and can be confirmed by carrying out the analysis of the single case.

The teleworker who does no longer travel to work takes a lot of advantages since he/she saves most of the time wasted to go to work and consequently transport costs, regardless of the use of a public or private means of transport. Furthermore, he/she eats what he/she thinks is better for him/her during the whole lunch break

available. On the contrary, the enterprise bears many fixed costs deriving from the installation of long-distance transmission plants in safe premises, thus bearing the variable costs for telephone and electric services. At the same time the teleworker is subject to a sort of peaceful invasion of his/her own habitat.

However, both subjects have some advantages since teleworking is targeted to particular categories of employees profiting from particular legal benefits such as women taking maternity leave, people with partial disabilities who can however do their job as well as people with total disabilities or students-workers.

Although there are not so many problems relative to security and assistance of workers who subscribe a teleworking contract concerning sectors or enterprise branches which are far apart from the office, doubts and uncertainties arise as for the particular nature of places where the job is carried out (the house). For instance the teleworker can have an accident while he/she is working. Can any objections to the lack of insurance be raised?

Such an example shows what the contract of teleworking should provide for and how confusion can hinder the development of teleworking.

Worth mentioning is the control of the teleworker. Thanks to the technological support available, the teleworker's tasks can be subject to more control compared to the traditional worker against any trade union principles.

There are some difficulties concerning the productivity of the teleworker and indirectly the quality of the service offered. As is well known, in particular within the public work, it is not possible to take into account the amount of the work carried out unless the productivity is represented by an extra benefit compared to the base salary.

It is likewise important to take into account the trade union rights of teleworkers and the fact that he/she has to be always informed about those aspects of the enterprise that can involve him/her.

The last remark concerns all the possibilities offered by the teleworking contract as for the carrier and the enterprise mobility. In short, can the teleworker, who often accepts the offer of the company for his/her interests, change his/her mind and become a traditional employee? Which kind of carrier opportunities does a teleworking contract offer considering that nowadays it is applied to the limited "static" sectors of the enterprise?

At present, it is difficult to answer to these questions since teleworking has been recently established and is not yet perfect. It is surely the consequence of the technological innovation of all the sectors allowing and promoting "office automation". However, such an aspect shall be dwelt on by other disciplines.

4. 3. 1 CLASSIFICATION

Enterprise and firm represent two sides of the economical activity of an entrepreneur. One is the subjective and the other is the objective aspect of the business.

It is not unusual to find legal and economical textbooks or publications in which an enterprise or business enterprise is described as 'the engine of an economic capitalist system'. Even at constitutional level, 'work' is described as the principal source of internal wealth, consequently, a non secondary role is reserved to the phenomenon "enterprise", given that it obviously represents the meeting point between demand and offer in the market.

Taken for granted the irreplaceable role of mankind in realizing this complex mechanism of relations, it is necessary to point out that the introduction of machines in the productive process has made all the difference. The various combination of these elements with different technologies and other resources involved, dictates the need to describe precisely what type of business an enterprise is.

However, it is just the need to give a precise description of this phenomenon characterised by the various points of view through which it is possible to observe it, that can create confusion and conflicts in the interpreter.

The fact that enterprise has been at the same time the object of legal and economic studies means that there are double definitions for it.

It is necessary to clarify from now on that what is regarded in business economy as 'firm' corresponds to what is called in legal terms enterprise.

The opposite is not true, since by law the concepts of enterprise and firm are clearly different.

The first one in fact describes what could be understood as the subjective aspect of the economical phenomenon, strictly linked to the subject who performs in practice the activity, regardless of the fact that he may be a person or a corporate body.

The second term is used, instead, to describe the objective aspect of the phenomenon, that is to say the complex of material and immaterial properties reserved by the entrepreneur to the activity of the business. In an economical business-like

term the importance of the phenomenon is diminished and more focus is put on the objective aspect, using the more general term firm.

The need to continue to pay attention to this phenomenon in the same way in which the two sides of the same coin can be seen, is proven by the traditional classification which has been made in respect to industry bearing in mind both its subjective and objective aspects. Beyond the use of different terms in the various European legal systems, for the first concept the distinction between craftsman, small business and commercial business (which leaves out the specific sector of activity performed by each of them) has been traditionally accepted.

For the second concept, given the lack of uniformity among different legal requirements, the parameter is given by the dimensions of the business, bearing in mind fiscal indicators, the number of employees and the type of internal structure and working organization adopted by the business. It is felt that these limits are too rigid, the outcome of questionable and old-fashioned divisions.

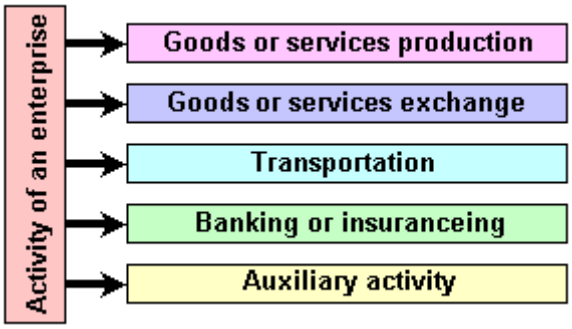
Not only is this latest key of interpretation far from being comprehensive, but it is also unusual. This is proven not only by the large number of regulations, which at least in the Italian system are meant to deal, for different reasons (fiscal, administrative, book-keeping and accounting, legal etc.) with the 'enterprise' and its dimensions (for the reduction to one scheme rather than another), but also by the more recent phenomenon brought about by the "new economy" with the enormous capitalization of very small businesses quoted on the Stock Exchange and in the various markets. All this revealed itself to be deceitful because fruit of an event too brief, in the majority of cases not suitable to transform virtual wealth into real wealth.

4. 4. 1 GENERALITIES

In order to provide a better understanding of the object of our study, it will be useful to focus on the business enterprise as represented in the following summary chart.

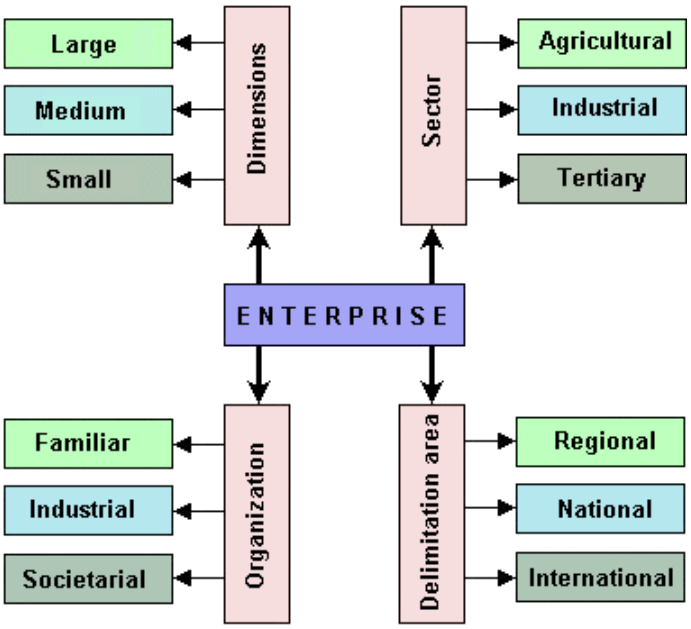
It also shows the traditional sectors in which business activities can be carried out.

It would appear convenient, as there are no specific signals of activity in this respect, to keep separate the specific agricultural sector and fields linked with it, from the area of application of teleworking.

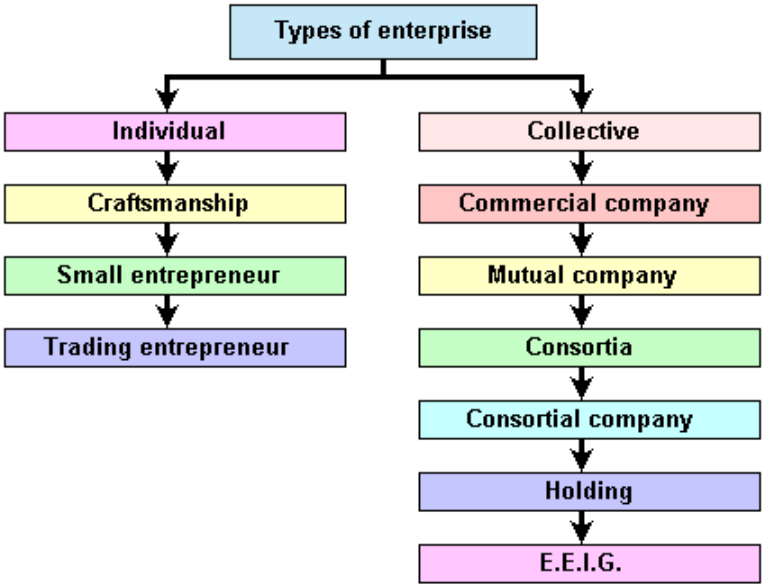


For an analysis of the above mentioned sectors, please refer to the related sections.

The summary chart will be useful for the translator, since it shows the types of business more or less common to the various national legal systems, where the differences can be due to both a different terminology (nomen iuris) and the particular field which they are related to.



Types of business and subjects who carry them out



In order to differentiate the subjects, three criteria have been traditionally accepted:

- prevailing work on behalf of the entrepreneur in respect to the collaborators and/ or staff;
- number of staff;
- quantity (measure of the business value, nowadays rather obsolete).

The differences among the various legal systems will be clearer when the comparison is carried out among legal systems of civil law and common law.

4. 4. 2 PRODUCTION

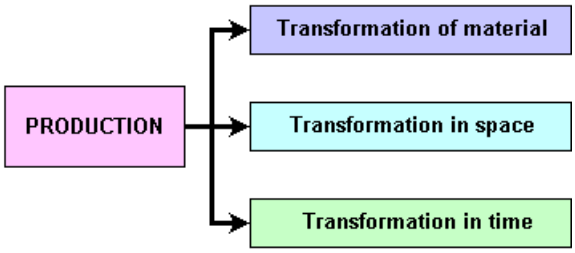
As already explained in the previous section there are different sectors where the activity of a business enterprise takes place. Herein is a brief analysis of each of them.

The traditional subdivision applied to business enterprise to distinguish between different sectors of activity identifies an initial large area, or macroarea of interest, in the production of goods and services.

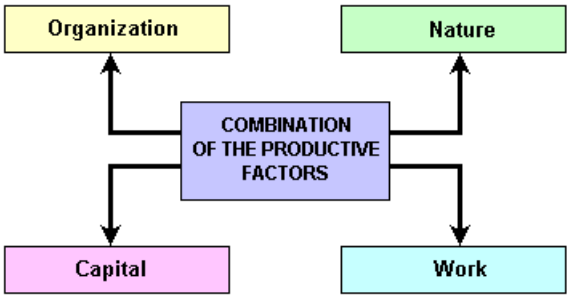
In economics the term production is defined as any process suited to create utility where it did not exist before, or to increase the existing level of utility. In more general terms, the word production refers to the whole complex of the activities carried out by business enterprises in order to transform raw materials into either semi-finished or finished products (production of goods) or the supply of services to third parties.

Regardless of the fact that the classification proposed by the Italian legislator might have been influenced considerably by the old commercial code dated 1882 (which was in turn influenced by the Napoleonic Code) in that it distinguishes clearly between the productive sector and the commercialisation of it, we must point out that the adjective "industrial" should not be taken as a strict limit outside which it is not possible to find any productive process. The sector, therefore, must be understood as something which any business taken either individually or collectively as enterprise can be referred to. This is shown in the synoptic chart in the previous section.

The following scheme will be useful:



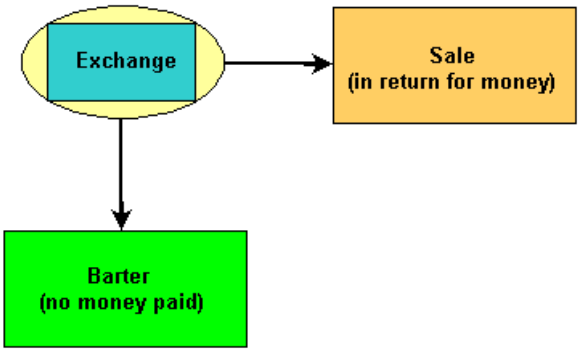
The following graph represents the combination of the productive factors:



4. 4. 3 EXCHANGE

The second macro-area concerning corporate business activities has to do with goods (or services) trade.

Here is a possible graphical representation of the trading activity:



According to the Italian legal system the term 'exchange' is substituted with the word intermediation. This generates a useless debate over the search for another third "genus" (in comparison to the other two outlined so far), to which it may be possible to lead back the performance of certain activities. In fact, the mentioned activity is the one performed by the entrepreneur in order to sell and commercialise finished products made by others. The entrepreneur to this extent is the real intermediary between industrial production (on a large scale) and the final consumer (who is only allowed to purchase goods from a retailer).

Whilst no particular problem arises in analysing merchandise trade activities, the exchange of services is more difficult to identify.

4. 4. 4 SERVICES

Banking, financial and insurance activities deserve special consideration because of the particular nature of the services they offer. The traditional classification does not give them any particular position, as they can be brought back either to production or to exchange. As far as this study goes, they represent a sector in which there may be great potential for application to the teleworking contract, once this contract has been freed of some of the possible downsides for the worker as examined earlier.

The aforementioned areas (banking, insurance and financial services) are in fact developing ongoingly, which demands continuous product updating in order for it not to become obsolete too quickly and subsequently cause the supplying firms to loose their market.

In this sense, therefore, the use of teleworking contracts could give great impetus to the dynamic of such firms, provided it might be possible to use it at two separate levels of operators - those in charge of data collection and elaboration (according to the diagram in the previous pages) as well as those who deal with the net of final users distributed all over the territory, often working in a separate place, but linked to the central organization of the firm.

Tertiary and advanced tertiary, expressions of common use nowadays, refer to an industrial area of high importance, strongly linked to the large macroareas of production and trade of goods and services.

The correlation between the sectors is 'genetic' and functional at the same time. It is 'genetic', since undeniably many service activities get their strength from the continuity and development of the productive sectors. It is at the same time functional because if the assumption we made is true, in the same way the very existence of a large range of services allows the productive activities to carry on

existing. Let us think, for example, of the role of the firms transporting goods by land, sea and air which distribute products anywhere.

The particular type of service provided, makes all the above firms useful to teleworking. In the same way as those described in the previous section they share, among other things, the use of I.T., the main requirement for the contract itself.

4. 4. 5 THE THIRD SECTOR

Nowadays, voluntary work represents an enormous economic resource whose contribution to society has increased in time thanks also to the attention of national legislators.

If we want to consider the questions concerning the so- called "Third sector" (not to be mistaken for the service-producing sector) mentioned in our previous section, it is paramount to give a commonly accepted definition for the expression.

It is the sector in which private non- profit organizations devote themselves to the promotion and safeguard of general interests, typically collective, although they are not appointed as such by any regulations. The third sector then appears to be that area defined on the one side by the private interest for the paid supply of services and goods and on the other side by the so- called "welfare state" in which the accomplishment of some tasks and activities is entirely attributed to the Governmental Administration.

It was the European social crisis in the 70's which gave birth to the sector along with its neologism or expression. This was done in order to start regulating the supply of services of collective utility carried out on behalf of private organizations.

The fact that there is a variety of terms and definitions to describe this sector is evidence that it is a widespread phenomenon.

Here follows a short list for it: Social private, Third Dimension, Third System, Philantrophic sector, Noprofit, Économie sociale, Informal sector, Independent sector, Voluntary sector.

As pointed out by several authors, the interest towards the third sector was noticed late in comparison to its real need, and any intervention realized was characterised, especially in Italy by a sense of something provisional and fragmental, given that, at least in the beginning, the organizations involved were fiscally monitored and regulated.

The second macro-area is the one that deals with the exchange of goods and services.

The word exchange, which evokes the concept of barter, was used as an alternative to “intermediation” with the only result that it generated a useless debate over the search for another third “genus” in addition to the two outlined so far. To the third one certain specific activities could be linked.

The exchange of services appears to be potentially better receptive to new requests and the typical characteristics of teleworking.

4. 5. 1 ENTERPRISE STRUCTURE

From its inception no enterprise can exist without being organised and sharing assignments and tasks among managers.

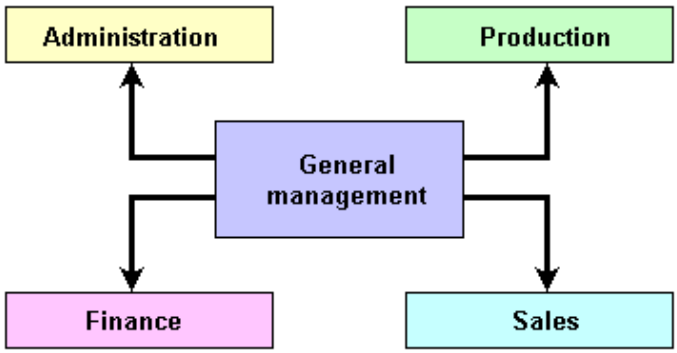
At the moment of its foundation an enterprise needs to have in place the correct organization. The need to identify sectors, areas, duties and anything else required for an efficient/coherent management of the resources and direction of the productive activity will increase alongside the (structural) growth and development of the enterprise.

In order to reach this objective it is traditionally thought that there are three main requirements which need to be fulfilled. They are:

- creating an organizational structure;
- a decision-making system;
- an information system.

Units -- services, departments, offices -- which carry out specific activities within the enterprise belong to the first. Everybody in charge of identifying the business objectives is part of the second system. We refer to the third system as the complex structure managing the acquisition, elaboration and use of data as these become available in the course of the business activity .

The above structures will have to be able to skilfully harmonise the following sub-sections which are traditionally found in every enterprise:



All the identified elements will create awareness about the organizational units which are part of the enterprise, the tasks and duties assigned to each of them, interrelations and the level of responsibility asked of any unit.

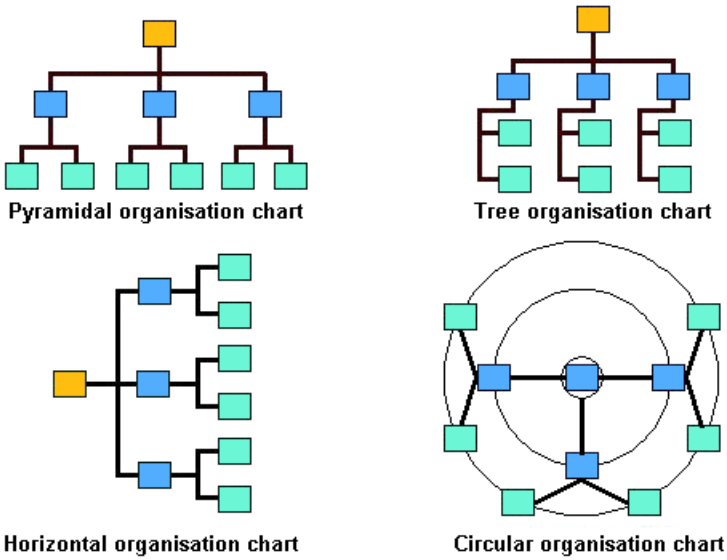
As far as the relationships within the structure are concerned, we find four types:

- hierarchic relations, if there is subordination;
- functional relations if there is the possibility to impose an order even without hierarchy;
- auxiliary relations where there might be economic interest in some specific services;
- advisory relations if these involve consultancy services on behalf of some to the benefit of others.

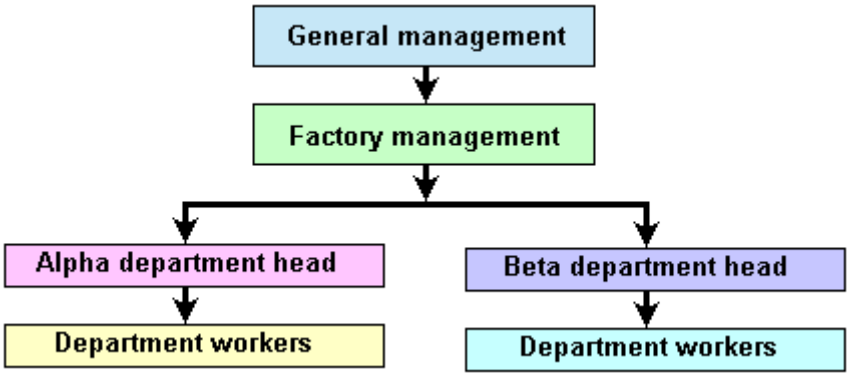
It is possible to distinguish three tipologies among the traditional organizational structures :

- hierarchic
- functional
- hierarchic functional or mixed.

They are graphically represented in different types of organisation charts (pyramidal, 'tree', horizontal and circular) shown in the following picture.



It is possible to represent the hierarchic structure or linear as follows:



The direction of the arrows clearly shows the direction information flows. The functional structure is represented in the following figure.

In the hierarchic functional structure the element which makes the difference is normally represented by an equal number of staff/experts working alongside the management. This excludes any independent interaction between the various sectors.

We shall analyse in the following section the different types of structures described so far. We feel it is necessary to consider now the flexibility or inflexibility of the mentioned organizations.

The question is not merely academic, but essential if we consider the objectives of this work.

Inflexibility, regarded as some sort of reluctance (of the entrepreneur) on behalf of the enterprise to develop their organizational model towards other figures, perhaps suggested by the market itself, creates some difficulty in approaching different types of contract or employees' services; more generally there may be problems with the efficient use of resources in order to meet demand.

Flexibility, on the contrary, represents an important means in striving towards improvement and the continuous adaptation to a changing market. It is probably a kind of guarantee, or protection helping the enterprise to stay up to date.

It would appear plausible to consider more suited to the introduction of teleworking areas, the companies whose organization is based on a functional model or on its logical development as well as oriented towards overcoming the old-fashioned traditional division in tasks and qualifications.

4. 6. 1 ROLE

In a Corporate Business the role of the so- called management is very important since in practice the direction of the business depends on the adopted strategies.

As we have pointed out in the previous section dedicated to corporate organisation and its various sectors, the main role is taken by the management.

We have seen in time a great revolution in the role of management with the progressive change from a centralised structure to a decentralised one. This new type of organization has become necessary due to the increasingly higher number of fields with which corporate activity compares itself and with which it builds up relationships.

The choice, therefore, towards one or another corporate structure implies, to begin with, a different corporate strategy with subsequent different assignment of duties and tasks. Thus, it is necessary to dwell upon them and analyse them one by one pointing out their advantages and disadvantages.

We pointed out in the flow chart of the last section that the first type of structure (hierarchy or linear) would appear to differ only slightly from the classic centralised model, given that even if they are "independent", the various directions of sector derive in practice their power directly from the general direction.

This performs a role in respect to collecting and filtering the information going from one to another, and sometimes, if necessary, it reshapes anything according to whatever is the desire of the entrepreneur.

Among its strong points is the fact that coordination is superfluous, given the importance of the information flow, but in the meantime it does not allow scope for great specialization, nor does it give importance on individual capacity. On the opposite, the second type of organization, defined as functional, involves the different directions giving real independence to each other, but allowing interaction between them with resulting optimisation without the need for close examination or approval on behalf of the general direction (performing in this case a coordination role).

With such structure the individual is appreciated more, his/her competence and specialization are outlined, but as mentioned before good coordination is necessary in order to focus on the general corporate objectives.

An intermediate model between the two is the one theorised by Fayol and called functional hierarchy. As shown in the flow chart of the previous section, it matches one or more central staff to the top structure. The staff is responsible for coordinating, so that each directive unit has a small team of experts.

These operate and communicate between themselves according to coordination and interaction with the general management, a mechanism which allows fast decision-making process.

This structure is affected by the limit of high costs, due to the large number of personnel (mostly highly qualified) and by the apparently double decisional level.

Any type of structure may be adopted, it cannot do without the support of a good information system, not to be mistaken with I.T. system.

The two are like the means to the end.

In the picture the role of the former and the latter is clearly outlined.

It should be clear now from the previous chart the role of I.T. support in a business, as technological means capable of making available to many people a large quantity of data.

4. 7. 1 IMPORTANCE

For a developing business enterprise being open to the new technological opportunities available from the market can prove of paramount importance.

Any type and structure of business chosen to be implemented among the ones mentioned in the previous sections, cannot disregard the need for a good I.T. system to distribute the acquired data. The relation between them is that of its means to the aim. What has been stated will be clear also if you look at the following picture.

The ability to make use of information and data gathered through the business activity to have them available for the business itself, is summarised with the expression “knowledge management” . In order to obtain the best possible result, it is necessary today to make the most from the use of the available technology. The first, well known, practical application of such system was found in the Japanese phenomenon of “toyotism”.

The model of the board of directors’ integrated factory accomplished by Toyota, poses in new terms the question of information as well as that of its means or channels of diffusion.

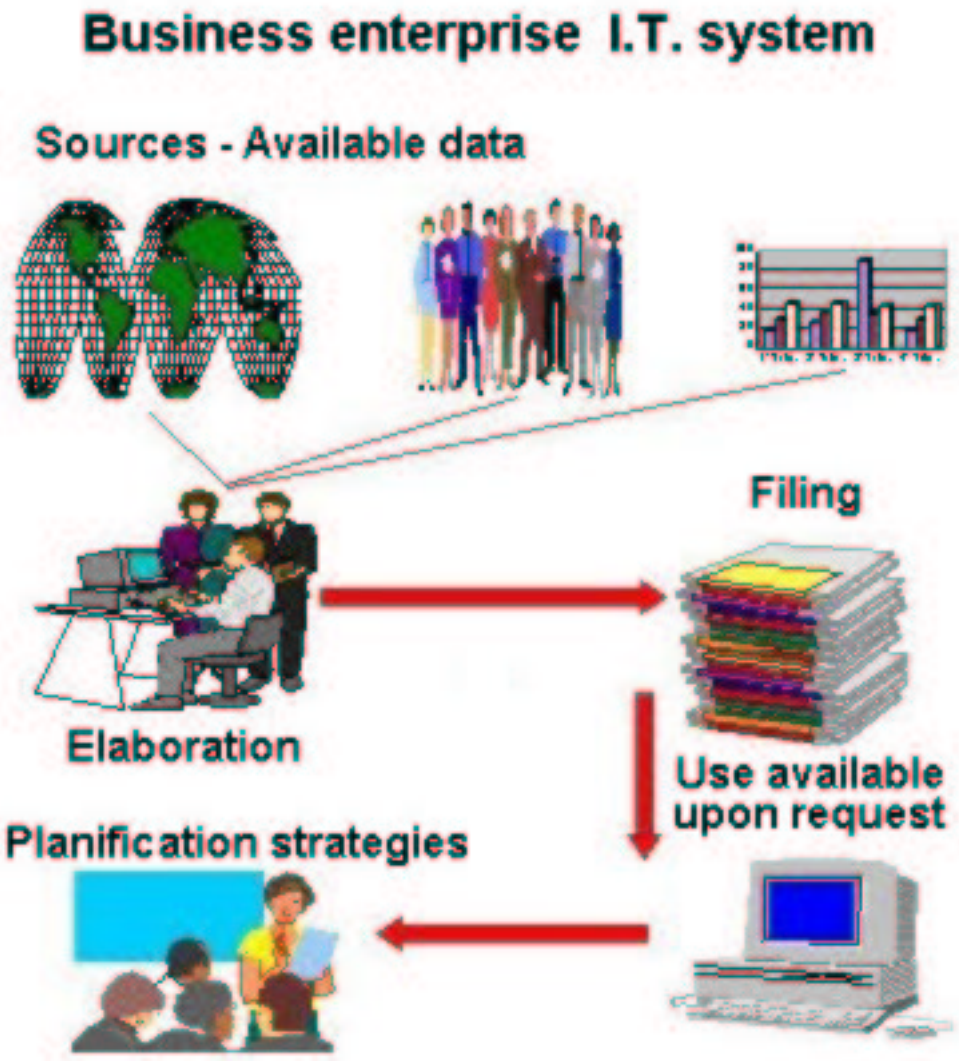
The practical result, defined “just in time” expresses exactly this idea of production where the information flows starts from the demand of the client on the market to the sales terminal displays and hence to the production terminal display in order to go to the chain, or even to the armature.

Organising the business enterprise as a network of data assimilation and collection points, the production management passes from the control of the running of the productive process to the information control allowing important economies of scale and the optimisation of the resources.

In a market which has been highly influenced by the increasing development and diffusion of Information Tecnology, in all production sectors as well as human activities, with positive effects on improved efficiency which reflects on productivity and on economies of scale, it appears necessary for a business enterprise to plan and put in place, where possible, similar working procedures.

Our attention is drawn to the so-called “office automation”, or the real revolution which invested the management of office activities, (especially those

traditionally carried out using pen and paper), to such degree that even the Italian legislator has had to recognise that the electronic document is prevailing over the one on paper.



The effort of the business enterprise will be directed towards the use of the individual employee's skills in order to allow him to be fully mobile and integrated in

his structure, thus reducing the negative refluence caused by the continuous and indispensable I.T. information in the administration of bodies and businesses.

We do not want to invade other areas of this research , but it appears important to point out that the process of application of new forms of contracts (such as telework) will have to take into account the degree of preparation of the employee. There is little approach and no research if the employee has not any I.T. knowledge at all and if it were necessary to train him to use I.T. .

It will be useful to have people who already have all the necessary knowledge about the structure and functioning of an Elaboration System, an Operative System and interface Windows 95/98/NT/2000, with the ability to create simple data processing with "Office" applications (Word, Excel e PowerPoint), to put in place and manage simple data banks (Access) and to learn to use Internet or Intranet services.

4. 8. 1 GENERALITIES

As far as working relationship is concerned, the first traditional distinction is between employment and self-employment.

Within the relationship between an entrepreneur and an employee, the entrepreneur exercises his rights stipulated by the employment contract, according to which the employee agrees to sell one's own workforce in exchange for a monetary retribution. The employee underwrites his obligation to provide intellectual or manual service/work as an employee and under the direction of the entrepreneur.

The contractual programme structurally should remain indefinite, and in general terms, if it is to allow the power of direction over the working service to be free of limits and restrictions.

Subordination is defined as the deprivation of authority and conveyance on behalf of the employee. In order to do this, he needs to fit into a productive and organisational structure determinated by the employer (upon whom decisions on time, means and place of the working activity depend).

There is a large number of social, health and welfare benefits as well as economic rights to whom employees are entitled. This is due to both the power of Unions and collective workers' negotiations (although margins are set for individual negotiation where negotiating power might have been acquired) and to the idea that the employee appears to be the weak contractual party against the employer, representing the strong contractual party.

As for the self-employment contract, instead, once underwritten, this contractual obligation does not imply a subordinated role, but just the provision of a specific commodity or service agreed as per contract.

The remuneration which is then received is nothing but the reward for supplying the commodities or services. In order to supply commodities or services a self-employed person owns and/or independently manages the necessary means for his activity; in particular in this type of contract one disposes freely of one's time, skills, energy and capability.

One ought to consider, however, that to higher freedom and greater gratification (and not only money) correspond higher risks brought along for the self-

employed together with less rights and greater responsibility: his income is neither guaranteed nor regular and depends on how well the 'business' does.

When business is not good, then there is no income; most of the rights and benefits granted to employees are not offered to self-employed people. For example a self-employed person is not entitled to any paid holidays, maternity leave, sick leave nor temporary non-occupation compensation scheme (in Italy), or PAYE contributions (pension contributions in order to be entitled to receive a retirement pension and cover for National Health Care).

It is entirely up to the self-employed to make his own arrangements and this is the opposite for an employee. The self-employed is directly responsible for his fiscal and accounting compliance and has to deal with a number of burocratic or administrative duties. In order to comply with that, he needs to rely on professionals such as accountants, consultants, etc..

A role which falls in between the two types of relationships mentioned is the relatively recent Professional Co-operator. In this case there is no need to comply with any of the requirements set for the self-employed, such as subscriptions to a Professional Roll and to the Registrar of Companies, VAT Registration with a VAT number, the requirement (by the Italian law) to keep sales purchase and nominal ledgers.

This type of solution is spreading in the sector of services (business consultancy, secretarial activity, translation work, training at various professional offices, insurance product promotions, etc.).

This type of relationship can also include those sales activities being increasingly offered by various business enterprises to young people and of which are many examples in newspaper advertisements.

In some cases, this type of contract can create working relationships very similar to those between employer and employee. Therefore, in such circumstances, it is possible to talk about subordinate-like activities.

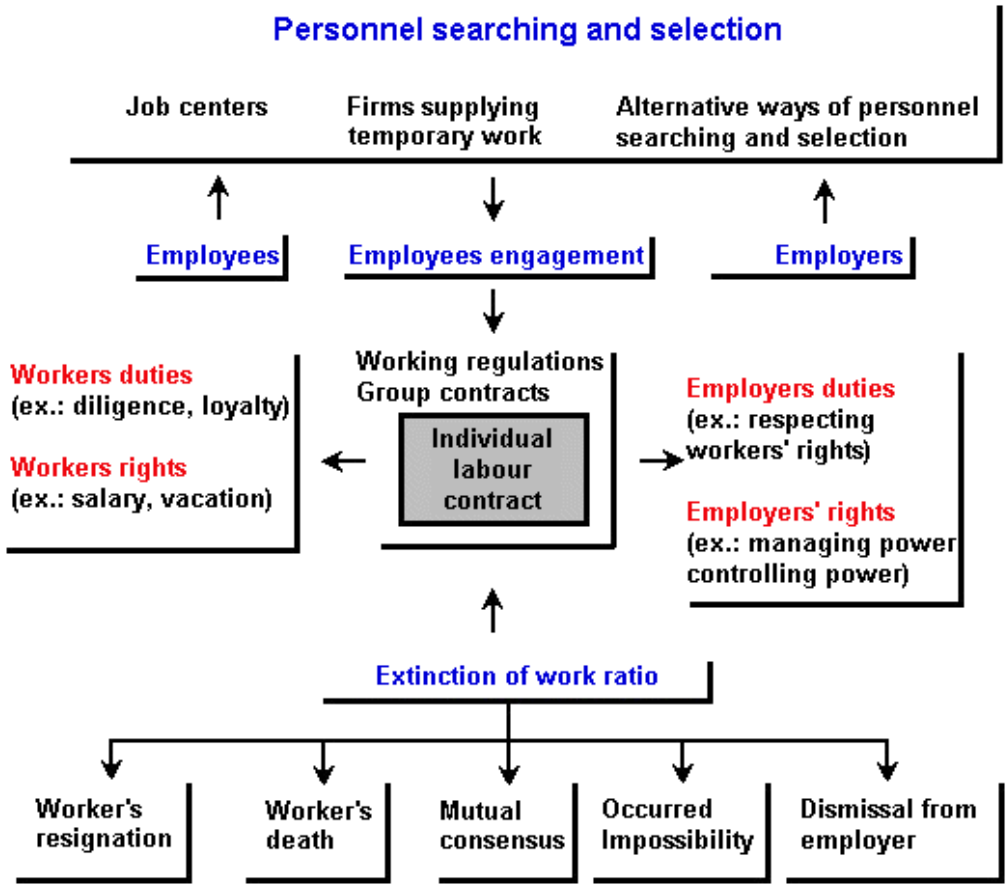
Any government organisation has always identified its social political aim in getting people into the working market, considering its own duty to promote full employment for those citizens able to work.

In order to reach this objective, at local level public infrastructures (employment registry office) have been created with the aim to give the above organisations power to gather and direct the working force towards the market, thus harmonising demand and offer.

However, the total inadequacy of the infrastructures has showed their ability to ignore any demand on behalf of the market and in the meantime they have followed the sad tendency, typical of some local areas not to bother registering existing working

relationships. All this meant that in practice such infrastructures were isolated and new employment agencies specialised in research and selection of qualified personnel to be appointed in posts under 'ad interim', or short-term contracts have come out.

In the following chart are shown all the necessary phases for the creation of a working relationship.



4. 8. 2 THE ESSENTIAL ELEMENTS OF EMPLOYMENT CONTRACT: THE SUBJECTS

According to the regulation on contracts, in order for the working relationship to be valid, a contract must be stipulated between two parties, the employer and the employee, at a moment when both parties are in their full mental capacities.

No particular problem arises when the contract is undertaken between private parties, whilst it is different if the employer is a public body.

In fact, both of them will have to comply with the principles established in the course of the Workers' Union collective negotiations (equal treatment for those workers with the same duties and qualification); however, while a private person might be allowed to contravene freely (for better) the rule as we have outlined it, the public employer is effectively bound by the limits set by the rule. Therefore, very little margin for negotiation is given to the employee who can only be appointed after successfully sitting competitive exams.

The most recent economic scenario has witnessed, at least in the field of ad interim work, the presence of a third party, the employment agency, a qualified intermediary capable of guaranteeing that demand meets offer.

4. 8. 3 THE ESSENTIAL ELEMENTS OF EMPLOYMENT CONTRACT: THE OBJECT

The object of the working relationship is put into practice when the service/ work – to which the worker is committed - is given, regardless of the fact that this service might be physical (typically of workers) or intellectual (typically of white collars).

The object of the service, at least in accordance with the Italian law must be lawful, viable, definite and definable, so that there may be real parameters for the evaluation of the service carried out against its monetary or non monetary equivalent value set by the contract.

The first limit is a legal one. Its aim is to exclude the allowance in a working relationship of any indecent or unlawful service carried out exploiting a human being regardless of any universally recognised right.

The second limit, viability, is understood as average capability to realise what was expected of the worker in order to avert as much as possible contestation about the quality of the work carried out on behalf of the employer.

The third parameter is the one that allows directly to measure the service carried out against its monetary or non monetary equivalent value, in the full respect of the single individual's skills.

The second element has great importance, especially when the choice over the retribution to be paid to the employee varies in relation to either time or quantity of work carried out. An employee can in fact be paid according to his time, or his piece rate, or alternatively in an intermediate 'mixed' form which falls somehow in between the other two.

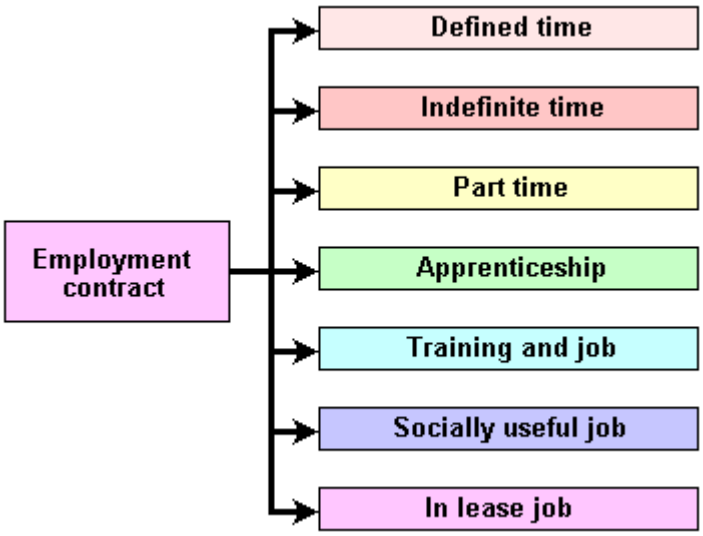
With the first type of pay the retribution is determined according to the time worked (hourly, weekly, monthly retribution) while with the second one the quantity of work effectively carried out over a given period of time is paramount, regardless of the time spent in real terms.

This second type of retribution has been considered in essence unjust and oppressive, and, therefore, the system has evolved into the mixed piece rate, a structure which entails a fixed basic retribution and one which varies depending on the real quantity of work accomplished.

This type of retribution has proven that positive results can be achieved if it is reintroduced alongside the time retribution, but only as an incentive to production, where the business enterprise (or the body) has made a decision in respect to its willingness to improve its productive standards. The results will be far from excellent if only the system of time retribution will be used.

4. 8. 4 TYPES OF CONTRACTS

In the following chart we provide a summary of the figures who can be used between the above mentioned parties in an employment contract.



The figure in the first box is the one that constitutes the rule and offers the greatest security to the employee, especially when it comes to such questions as stability and the long term of the relationship.

As a consequence the short-term working relationship is an exception which, at least in the Italian legislation is allowed only in particular fields like tourism or catering.

It is obvious that the evolution for this figure is in the subcontractor's contract where the temporary or ad interim service of a worker is fundamental element in the relationship. It is the figure which allows the overcoming of transitional phases for a business enterprise where a structural lack of employees could prove to have a negative effect.

Part-time work should not be confused with short-term work. In a part-time work contract the relationship is long-term, but the service is reduced in comparison to the traditional contract.

The other figures are assimilated in the category of particular working relationships, since they are either intended to help the unemployed seeking their first job enter the working market or as an attempt to remove dangerous large numbers of structural unemployed.

The promotion incentive for such figures is represented by fiscal benefits for those business enterprises which apply it.

4. 8. 5 RIGHTS AND DUTIES IN EMPLOYMENT CONTRACT

The general reference to rights and duties within a working relationship opens up thoughts on a larger scale, especially regarding the value of a human being in general. Work (or the right to work) constitutes, in fact, one of the means through which a person expresses and fulfils oneself.

The State, therefore, has the difficult responsibility to guarantee the fulfillment of such complex objective which on the other hand creates one of the main factors of wealth in the community, especially where there are not natural or varied resources to fulfil its requirements.

Thus, this is why the different National Constitutions identify and recognise as fundamental principles those which form the basis of workers' rights.

Analysing the Italian Constitution, we find the right to work as the foundation of social and political life, as well as a resource for one's own support, but at the same time a duty in order to contribute to the nation's wealth together with the right to receive retribution.

Of particular significance is the attention towards women's and underage work, alongside the recognition to rights, such as health care and welfare, the possibility to express one' s own independent opinion with the employer to the point of allowing people to abstain from work, exercising their right to go on strike, if necessary.

It may appear pleonastic to point out that often the above rights exist only on a formal level and not in reality, turning down the legitimate expectations of most workers.

There is a high level of interest around these issues also within the EUROPEAN UNION which has shown to be sensitive and receptive towards them.

The 1992 Maastricht treaty sanctioned the principle of free circulation, residency and establishment of European workers within the territory of the member States making it possible for the Union's working force to be completely mobile. The European employment agency, EURES, strong and active within the Union, strives to accomplish the same.

Great importance is given also to the ongoing training as a premise in order to be able to freely offer oneself on the working market, and be mobile as a further resource.

With such and so many rights (obviously seen as duties on behalf of the employer) there is a series of duties enforced upon the employee, too. Their violation can sometimes see the application of strict sanctions.

Among them, we mention the duty to obey (however, it must not be understood as the blind acceptance of any order when carrying out work which is not part of the worker's duty or, worst, illegal), the duty to be loyal (greater where the particular tasks imply business confidentiality), the duty to respect working hours, imposed directions, fundamental technical rules and to submit to disciplinary measures if these are issued.

The degeneration of some of these duties has sometimes allowed the development of a particularly negative phenomenon called 'mobbing', that is to say the employee's harassment on behalf of his employer, worse especially when this occurs taking advantage of the reverential fear of the former towards the latter.

Such behavioural conduct which has involved the exploitation of some groups of workers, especially women, has been kept quiet for a long time because accompanied by threats of unjust measures like dismissal or other kinds of oppressive sanctions in the working relationship.

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