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Use, management and design of a financial network.
An application : Prudential-Bache Securities' network.

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Use,management and design of a financial network.

An application : Prudential-Bache Securities' network.

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en vue de l'obtention du titre de
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CHAPTER 1.

Introduction.

1.1 Foreword.

First of all, the foreword of my memoir aims to thank all the people who did help me in the writing of this paper, during my traineeship in Prudential-Bache Securities London and the last few months at the Faculty.

All the people working in Prudential-Bache's communications centre and development department have helped me so much, especially Mr Mike Livermore, Mr Geoffrey Hamilton, Mr Wesley Wallace, Mr Eugène Boissière and all the others I can't mention here. I'm very grateful to them.

I would like to thank the banks and insurance company managers Mr Van Hepcee (Générale de Banque), Mr Claes (CGER), Mr Villers (BBL) and Mr Van Hercele (AG) who accepted to receive and help me to study some banking networks.

Regarding the writing of this paper, I thank Mr Ph. Van Bastelaer for his precious advices.

I also remember the moral help from my parents, brother, sister and many friends.

This paper is based on the experience of a financial network and begins with the description of Prudential-Bache Securities and its network. This experience, however quite interesting and rewarding, is not able to serve as the entire basis of this memoir. The author, then, presents the subject in a larger scope, always keeping in mind the traineeship job. Thus, the paper gets extended by a survey on different financial and banking networks in Belgium and this is helpful to explore the design of several networks scenarios based on the requirements of Prudential-Bache company.

This paper is written in English to allow the Prudential-Bache's managers who are American and English, to read it and check the contents for confidentiality reasons.

1.2. Definitions and abbreviations.

Definitions and abbreviations may be helpful to the reader in order to fully understand the considerations related to the particular financial world in which the subject takes place. Some other definitions or abbreviations will concern special principles and concepts in computer science.

AE

Account Executive, also called broker or investment specialist.

Person who works in a brokerage firm and provides every possible service in the pursuit of the client's investment goals, using all the resources of the company.

EMS

European Message Switching

So was called the network existing in Bache Securities until September 1986. It was a typical message switching, store and forward system.

ERA

Electronic Retrieval Assistant

One of the best application software used by the employees of Bache Securities. ERA displays the marketing, client and operations information the AE needs during the workday.

ISO

International Standard Organization

For definition, see [MACC83].

OSI

Open systems interconnection

For definition, see [MACC83].

BSC

Binary Synchronous Communication

For definition, see [MACC83].

HDLC

High-level Data Link Communication

For definition, see [MACC83].

SNA

System Network Architecture

For definition, see [MACC83].

CICS

Customer Information Control System

IBM's data communications operating system

VTAM

Virtual Telecommunications Access Method

IBM's high-level software in telecommunications using CICS.

TCAM

Telecommunications Control Access Method

IBM's high-level software in telecommunications using CICS.
TCAM is supported by VTAM.

ISD

Information System Development

Prudential-Bache 's department which programs the applications.

PPC

Permanent Physical Channel

Established channel which is never modified in the configuration.

PVC

Permanent Virtual Circuit

Established channel which is rerouted in the event of a link failure.

IMS

Information Management System.

IBM's high-level operating system (analog to CICS but queued).

DCS

- Data Communication System.

Belgian RTT's packet switching network.

VSAT

Very Small Aperture Terminal.

Broadcast facility via satellite using a small dish at the customer place.

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1.4. Particular aspects of a financial network.

A financial network is the whole of media and protocols providing the communications of financial information like banking transactions, orders at the money markets, consultation of data bases containing financial informations ...

The financial networks we are considering exclude the large, non-incorporated networks between independent companies like, for instance, EARN (European Research and Academic Network) and even SWIFT (Society for Worlwide Interbank Financial Network) which transmits financial data between the banks.

We are studying a network which is the communication backbone of a company whose purpose and activities are financial. The network cost and management are crucial to the companies.

We shall compare the financial network with what the OSI model proposes and see what the companies keep from it or throw away.

The basic points in the ideas underlying the design of a network will be split into 3 points : first, the network itself, then, the staff hired to keep the network up and running and last, the users aspect.

1.4.1. The network.

The first idea coming into mind is the physical realization of these networks.

A financial network usually is an incorporated one, based on leased lines, both national and international. Leased lines are more secure than public circuits and this security aspect is important for managers of financial networks.

In direct comparison, the OSI model is very open, the main aim of these standards is to create compatibility on switched networks.

The model emphasizes the utilization of the well-known seven layers (physical, logical, network, transport, session, presentation, application layers).

The financial companies envisage this model for their networks. The interest stems from a desire to maintain internal compatibility and to avoid dependance on a single manufacturer/vendor. The OSI model, if adopted universally would enable multiple vendor choice which is preferable to being tied to a single vendor with its problems of developed incompatibility.

However, even now some companies think that the last three layers of the OSI model are inaccurate and they don't follow this overlying in their network structure. Most of time, their networks offer the services that the OSI model structures in layers but they are mixed in the different levels.

A disadvantage of the OSI layering model is the additional overheads whilst the message crosses the system. These overheads will eventually degrade the circuit as the number of "layer control" bits will become excessive in relation to the message size. Companies retaining their own model can significantly reduce their overheads as their model is not designed to be, or intended to be universal.

We also notice that these financial networks usually provide a back-up service because the reliability of the network is crucial to the firm. A network failure representes a very heavy profit loss to the financial companies, mainly because, during the failure time, no transactions are made. So, the back-up may consist of a different independent network or some pieces of the network working in an off-line system or any other alternative...

A secure network costs a lot and this introduces the cost aspect. This is another fundamental argument in the choice of leased lines : it's obvious that, for heavy traffic (which is usually the case in the financial companies), leased lines are cheaper than any switched network. The companies, especially if they want an incorporated international network, are hiring lines for their own use.

1.4.2. Network operators staff.

The network operators staff is always very important and busy in the banks and financial companies. The reliability of the network is crucial to the firm and this staff is trained to react quickly to every problem ; most of time, this staff is split into 2 sections: the user help desk in contact with the users and a group of technicians.

They have network management tools at their disposal to warn them of every fault happening anywhere on the network and allow its correction or recovery.

The International Standard Organization is working on management software specifications, but they are still at draft level (Draft proposals ISO 9595/1,9595/2). In three or four years time, it might be effective. Thus, the companies who place much stress on network management functions can find no matching standards within the present international situation.

All this shows that one of the particular aspect of a financial network is the stress put on the availability and reliability and people are devoted to these functions.

1.4.3. Users aspect.

The users of a financial network are financiers or financial companies employees and they do not (necessarily) know anything about computers and communications lines. Every financial network designer should keep this firmly in mind.

The application softwares are written by the company programmers most of time and concentrate on the fluent dialogue with the user. Their softwares provide every facility to prevent and correct users mistakes.

So are summarized some of the principal differences between a financial network and the others, in particular its incorporated and reliability aspect, its needs of network operators and its users lack of knowledge about computer science.

CHAPTER 2.

Description of Prudential-Bache Securities/ Bache Securities.

2.1. Introduction.

The next chapters aim to detail the different aspects of a particular financial network in its technological, human and economic consequencies.

Before speaking about networks, it seems fundamental to describe one of the companies who use a financial network. Prudential-Bache Securities' network is a good example of a critical network whose particular aspects have been detailed in the previous section.

We'll first study this company in its different aspects: its history,its goals,its international and organizational situation.

Prudential-Bache's history starts as follows:

A major event in Wall Street (New York) took place in June of 1981, when the Prudential Insurance Company of America acquired an old and large brokerage firm, Bache Hasley Stuart Shields Incorporated.

Bache traces its origin back to 1879 and has more than 100 years of investment experience. The Prudential Insurance Company of America, with consolidated assets in excess of 76 billion dollars brought massive new resources and capabilities to Bache and so, in late 1982, the name Prudential-Bache Securities was introduced in the United States to reflect the merge of these two firms.

Out of the States, Prudential-Bache remains separate from Bache, then, the European subsidiaries are locally named Bache Securities.

The author would like to say that the names of Bache and Prudential-Bache are used without distinction in this paper. They both relate to the same company.

2.2. Purpose.

Prudential-Bache's activities are mainly financial and investment services: stocks, bonds, commodities, options, money markets funds, investment banking.

The Prudential-Bache's purpose is to provide these services to their clients and in order to achieve it, the company trains investment specialists, also called Account Executives (AE's) and is backed by research capabilities in the security industry.

Prudential-Bache is member of all North American Stock,commodity,option and many international exchanges.

Let's study the Account Executive's job. He is trained in all aspects of the financial industry and licensed by the required regulatory agencies. One of his primary function is to provide every service in the pursuit of the client's investment goals with all his personal knowledge and experience and besides the resources of Prudential-Bache company. From New York data base, he gets information about the situation and prices at the markets: New York, London,Tokyo,... He decides when it is the best moment to sell or buy at a fixed price. He sends orders back to these markets through New York in order to achieve the sale or purchase of commodities, currencies,...

The average number of orders sent by an AE is about 25-30 a day. He really needs to be connected by any networking environment with the financial places all over the world, especially at the peak hours which take mainly place at the opening of the New York Stock Exchange at 3h00 pm Belgian time. At this time, most of the orders are sent to New York and the brokers are very interested in the brandnew updated prices at the markets. He is the one in contact with the client.

Prudential-Bache's concern is to let every client know promptly about market developments,to keep him fully informed regularly regarding account status and to make him confident that his assets in his account are secure.

Speaking about Prudential-Bache's clients, we can say that most of them are institutions or large investors but the client with a limited amount of funds is welcome as well.

Prudential-Bache is willing to extend and is opening new offices everywhere e.g. in Europe (Milan,Antwerp,...).

2.3. International and organizational aspects of the company.

The international situation of Prudential-Bache is the following: the head branch is in New York and Prudential-Bache has over 250 office locations throughout the world spread into about 210 in the continental United States and 37 offices in 17 countries. Regarding the European and Far Eastern repartition, see the figure 2-1.

The whole staff counts up to 9500 sales, clerical and management personnel including the 500 AE's who are working in the offices outside the United States.

The European branches are mainly located in the European capitals and important financial places like Monte-Carlo,Geneva and London.

The Far East has a few branches in Tokyo,Singapore,Hong-Kong, and Australia is represented by Sydney and Melbourne.

That is the geographic situation. This international aspect provides the obvious advantages of servicing as many clients as possible around the world plus the facility of trading in the various National/International markets. These facilities include profiting from arbitrage (currency exchange) and National Legislation differencies.

The situation has also inconveniences in complicating the inter-connection of such dispersed offices.

Out of the domestic U.S.A., the main trading centre is London, England. There are several offices spread around London, one of which is dedicated to the communications between the USA and England, Europe, Far East and Australia. This communications centre is exclusively dedicated to communications, it does not count any AE's or sales staff amongst its personnel.

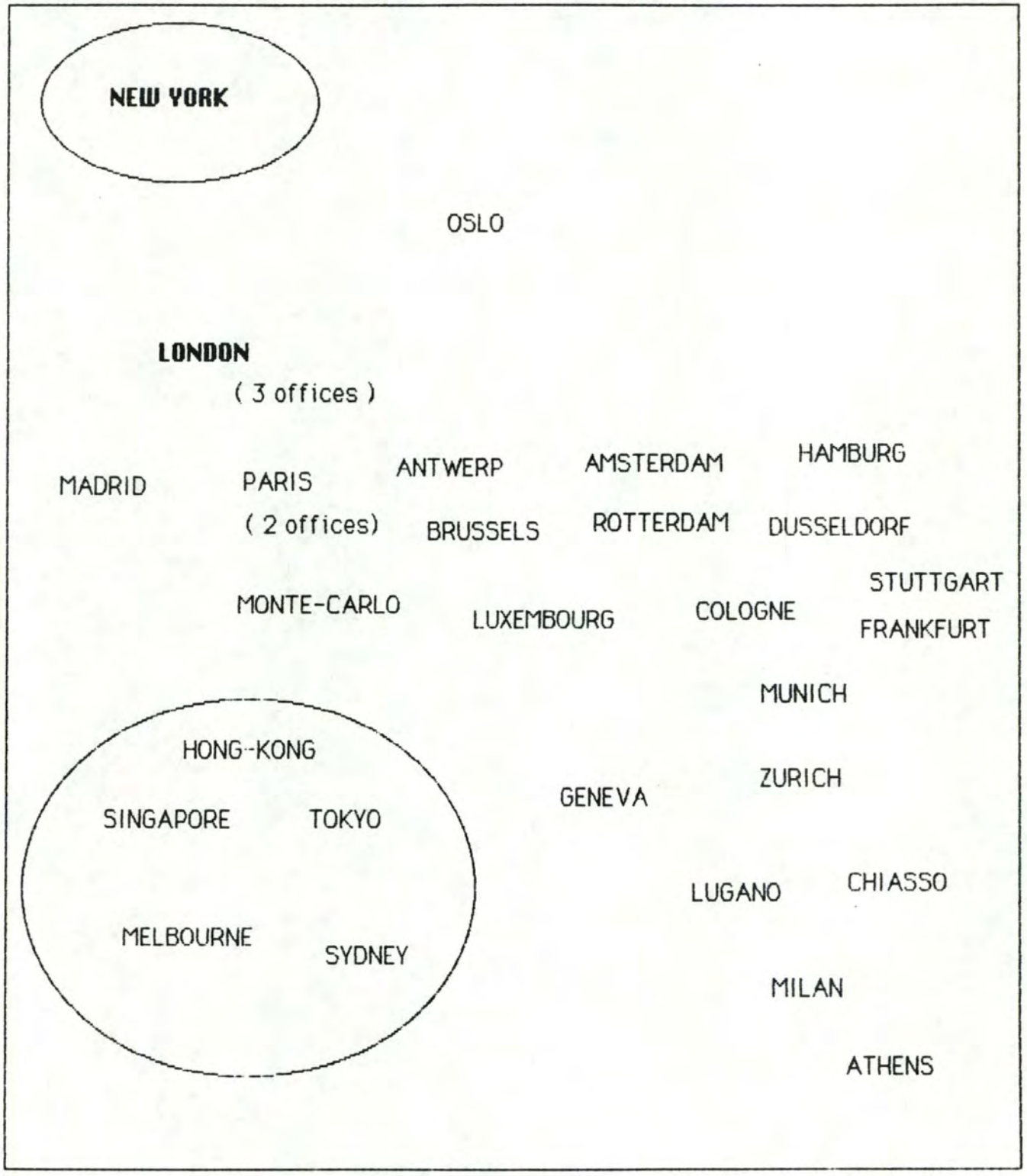

Fig 2-1. Offices layout.

The organization pyramid (see figure 2-2) is due to Prudential-Bache's history whose start was in New York. Most of the dealings take place on this market even if especially London Stock Exchange,the Far Eastern ones like Tokyo and many other American markets are very busy too.

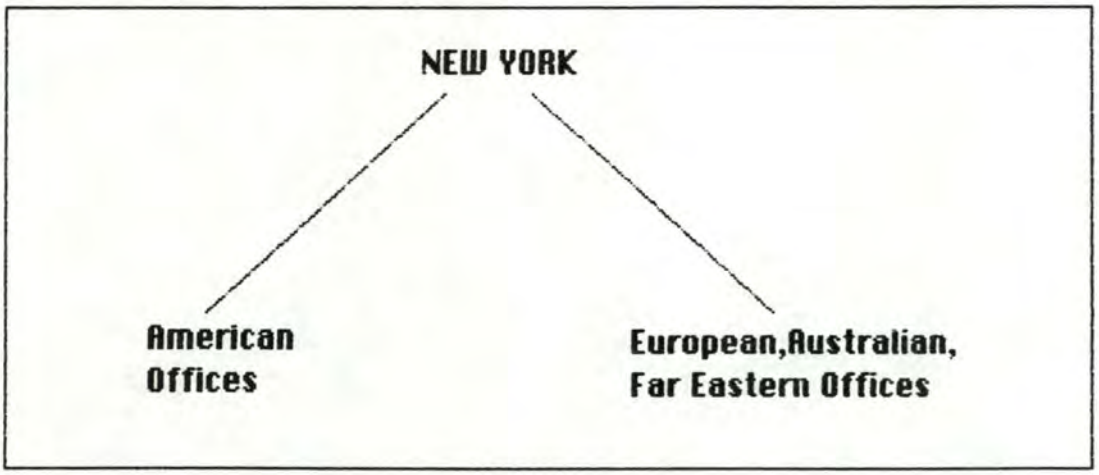

Fig 2-2. Organization pyramid.

New York is the head branch including what this position involves: the huge buildings are the heart of all the main political and strategic decisions concerning Prudential-Bache.

Let's have a look at the offices organization.
There are mainly two types of offices: the usual ones (or branches) staffed with AE's and the communications centre.

Regarding the offices everywhere over the world, they have the same organization scheme. There is a main chief who supervises the two sections in the office: the AE's productive department and the operations department.
The AE's productive department is obviously staffed with AE's whose job has been specified earlier. This is also called the marketing department.
The operations section includes the wireroom (or trade processing room). These employees send the AE's orders, receive and check the bills,executions,...
The rest of this department is called the administration and portfolio management.Its function is to check the customers accounts and make sure the transactions results have been recorded and reflected into the right accounts.
The whole department is supervised by an operations manager.

We should also consider the organization schemes of the communications centres: New York and London. They are similar and divided into 2 sections: the communications department and the Information System Development (ISD) department.The first one is working on the installation and the running up of the data network. Its structure and decision tree are like a pyramid with the main boss at the top and the operators at the bottom.

The ISD department staffs programmers. Prudential-Bache Securities is developing its own application softwares. The decision tree is the same as in the communications department with programmers instead of operators at the bottom.

CHAPTER 3.

Existing network.

3.1. Overall view.

The next pages consist of a detailed description of Prudential-Bache Securities network and mainly its European part, as it is in April 1987.

This kind of network is evolving all the time. A network is something alive and things are changing a lot in a short period. The following layout and explanations might be wrong or only partially right very quickly.

Let us summarize the aim of the network:
Prudential-Bache has a communications system that provides direct links between the offices and the markets through the New York headbranch.
The New York office is the centre of all this traffic: it gets orders and information requests from the branches. The New York system is an on-line system. It executes the orders which take place at its own Stock Exchange or sends back the orders to the concerned markets. It transmits the requested information back to the offices, out of data base. This data base contains the accounts situation, some currencies,commodities,... prices and advices to the brokers.Overnight, New York sends the bills back to the offices printers. These bills are the reflect, on the customers accounts, of the transactions that were executed during the day (see figure 3-1).

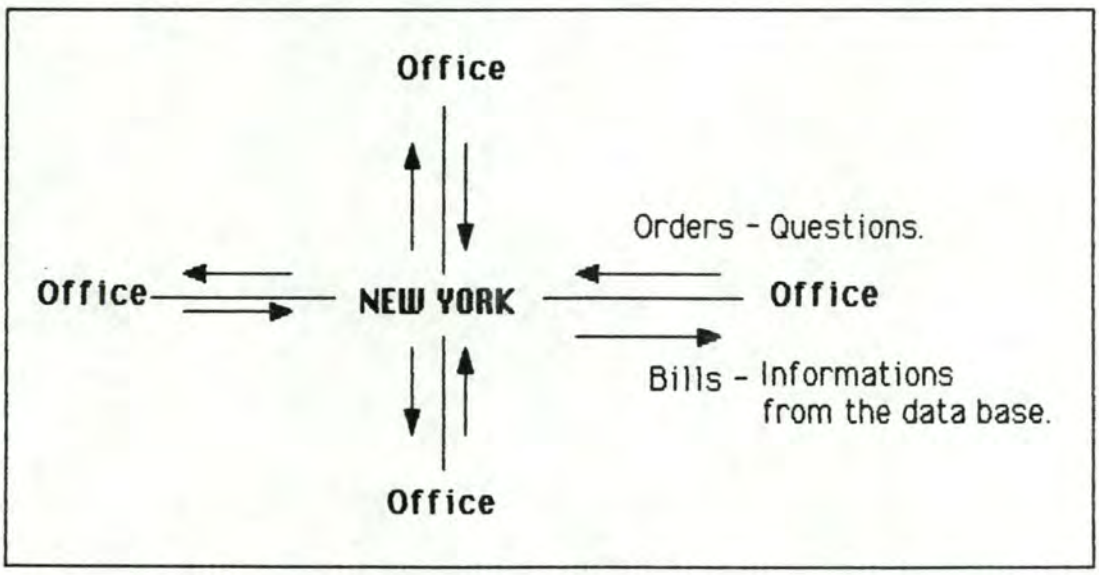

Fig 3-1. Functional view of the network.

It is a very centralized network. The London communications centre exists only because there was no other easy way to communicate with Europe and Far East at the trans-Atlantic circuits time.

These circuits were very expensive and it made sense to create a concentrator site in London which would multiplex the European circuits into a single trans-Atlantic link. If New York head branch had been able to avoid the installation of another communications centre, it would probably have done it.

There is really a centralization concern of information and power in New York. It might be explained by the confidential aspect of the informations passing through on the network, by the fact that 90 percent of the orders are going to be executed at the Wall Street Stock Exchange.

This centralized aspect of the informations is going to decrease slightly in the future because London is getting more minicomputers and is going to process the data concerning its own financial market. This "distributed processing" is gaining in popularity because it greatly reduces the data-flow between remote sites, more flexibility in use of circuits plus the potential to reduce cost.

But the decisions node remains in New York and it means a power concentration at all levels: the choices concerning all branches are made over there.

The overall view focuses hereunder on the general network layout and describes shortly its different aspects: hardware and protocol following the O.S.I. structure, the back up systems, the past and future of the network.

3.1.1. Layout

A general view of the network is presented on figure 3-2.
The equipements legend is detailed in the next section (3.1.2. hardware).

We notice that London is the central node in Europe. This central node is physically represented by a communications centre which rules and manages the European, Australian and Far Eastern part of Prudential-Bache 's network.

London is a top of a triangle New York - London - Hong-Kong made by satellite lines and also the London - Frankfurt - Hamburg triangle based on usual analog leased lines. These triangles are the support of the security and availability level that we'll study in the next paragraphs.

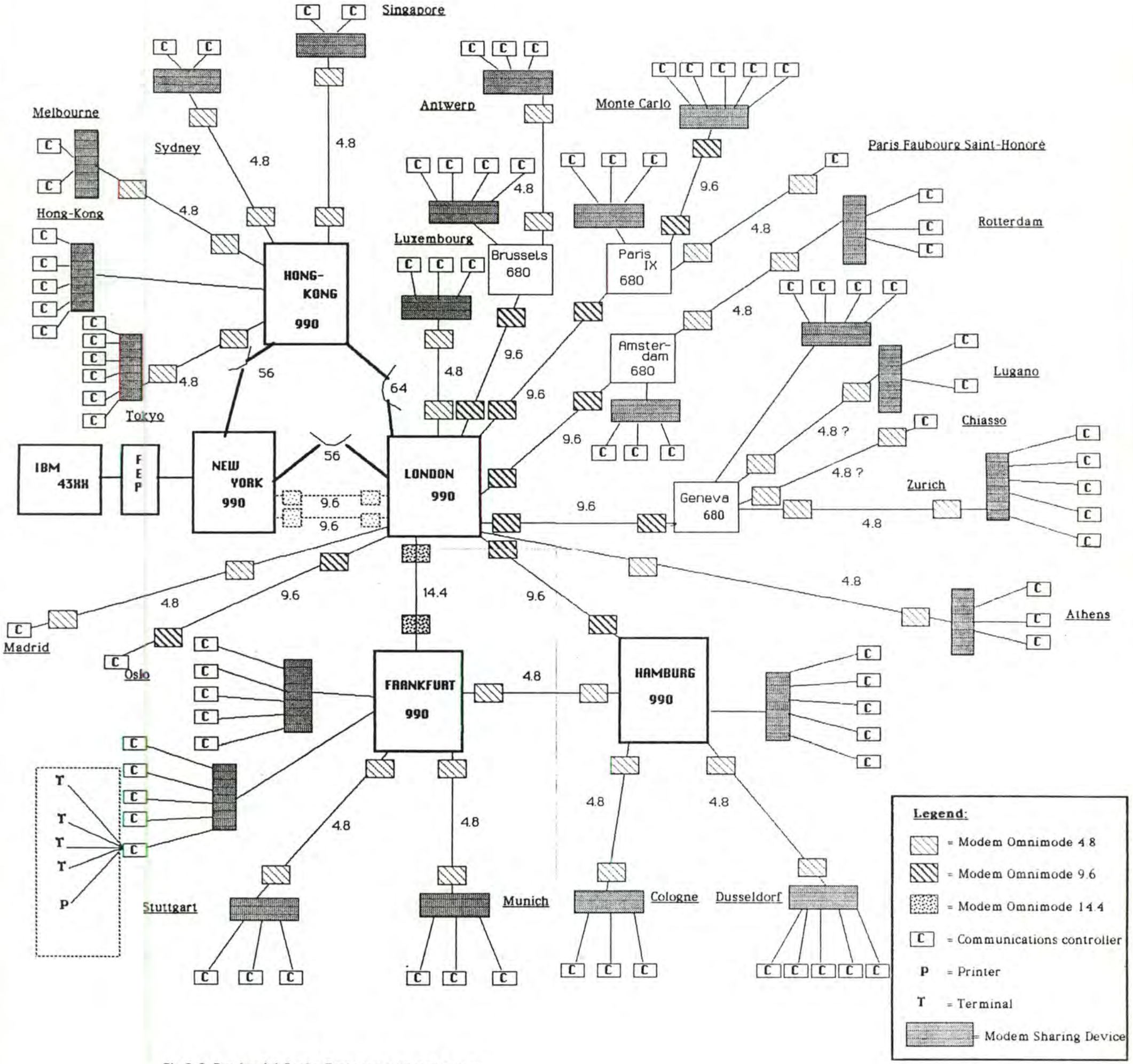

Fig 3-2. Prudential-Bache European network layout.

The offices like Frankfurt, Hong-Kong, Hamburg have got a special situation compared to Madrid, Monte-Carlo,... They are equipped in order to provide this triangulation facility (thanks to multiplexers) and this trend is extending to offices like Paris or Geneva in a near future. The offices which are also hub to others (like Brussels regarding Antwerp) are equipped with multiplexers too.

On the first layout, we can't see the different offices spread in London. The next picture (figure 3-3.) focuses on London offices. The main office is Cutlers Gardens at Devonshire Square.

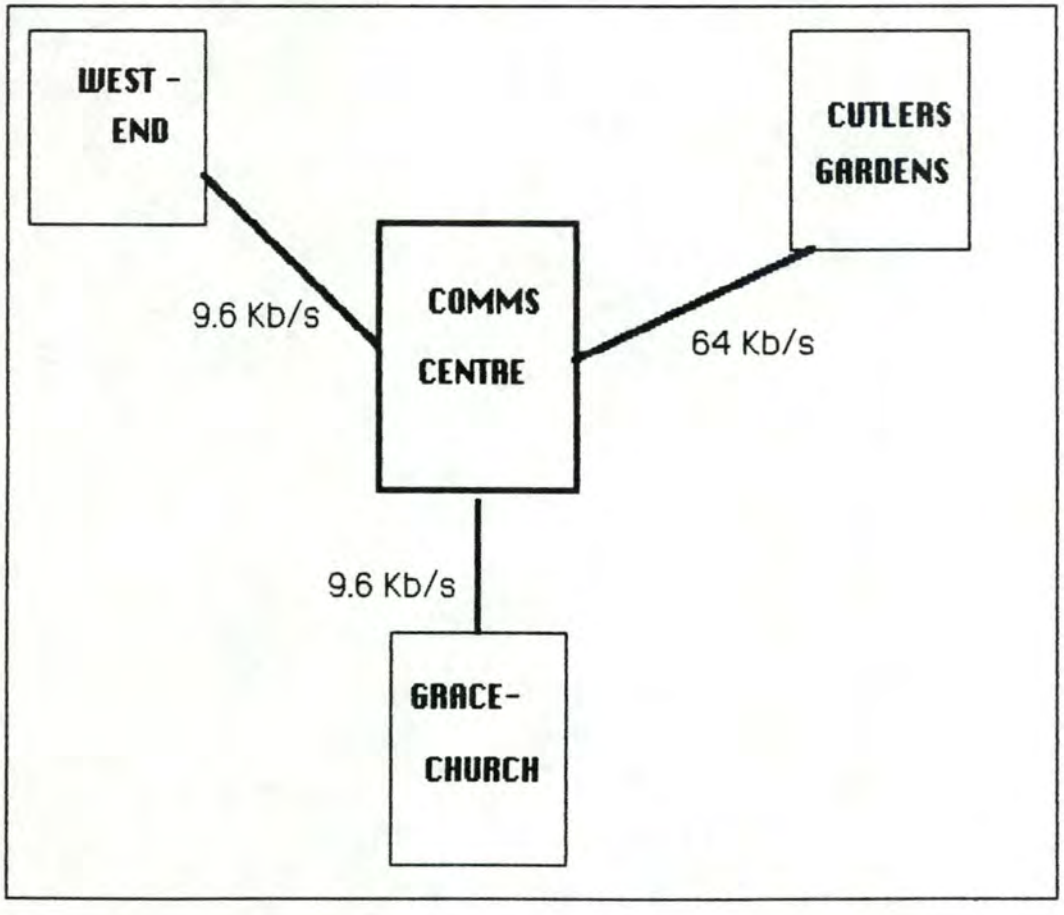

Fig 3-3. London offices.

The American part of this network is less interesting, the traffic is split from New York into its different leased lines to the 200 offices in the States.

We'll study this network following the O.S.I. structure: the first layer, the physical link and the second layer, the data link protocols.

3.1.2. Hardware and Physical link.

The physical layer may be divided into 2 parts: the lines and the end equipments.

Let's start with the lines.

They are mainly two types of them: the satellite lines and the leased analog lines.

The satellite lines, using the Intelsat satellite, are hired on the New York - London - Hong-Kong triangles. The speed is 56 Kbps when New York is involved in the line because the American standard speed is limited to 56 Kbps while Hong-Kong and London are linked by a 64 Kbps line (European standard).

These satellite lines work on time-division multiplexing and the size of the HDLC window on the New York - London line is 31 messages. This last line is going to change into a T1 circuit, running at 1.544 Mbps. This T1 is transmitting digitized voice and data on 24 channels at 64 Kbps each.

The leased lines are the basis of the London - offices links and their speed is ranging from 2400 bps to 64 Kbps for the moment. The choice of the line speed depends on the importance and the staff size of the joined office. The speed configuration might increase together with the importance of the office.

For instance, a London branch, Cutlers Gardens at Devonshire Square is getting very large and an optical fiber running from the London Communications centre to Cutlers at 2.048 Mbps is on project.

Regarding the end equipments, they can be divided into several categories :
the mainframe, front-end processor, multiplexers, modems, protocol converters, cluster controllers and terminals.
All their features and functions will be detailed in the next section (3.2) but we can say a few words about each of them.
The mainframe in New York is an IBM 43XX type, working with the data communications operating system CICS (Customer Information Control System).
This mainframe is connected to the IBM 3725 front-end processor which faces London and handles the European traffic. The output goes into a 990 multiplexer.
These 990 type multiplexers are provided by Infotron firm.

Their basic functions are
- the network concentration
- the network node processing
- the centralized network control and management

It's a statistical time-division multiplexer and its facilities are various.

London and a few other European branches use this 990 or are equipped with Infotron 680 multiplexers which offer similar facilities as the 990's except the connection to more than one 990 multiplexer.

London is also equipped with protocol converters which transform the EBCDIC synchronous data coming from New York into an ASCII asynchronous traffic going straight to heavily required printers or Personal Computers.

The Omnimode 48 or 96 modems (depending on the line speed) from Racal-Milgo are installed at many places on this network. Their function is the usual modulation/demodulation.

The branches also use Cluster Controllers which change the EBCDIC binary synchronous data transmission from the multiplexers into an ASCII asynchronous traffic which suits the devices.
The terminals (screens and keyboards) in the offices are provided by Reuter's company.
The figure 3-4. gives a summarized view of the hardware configuration.

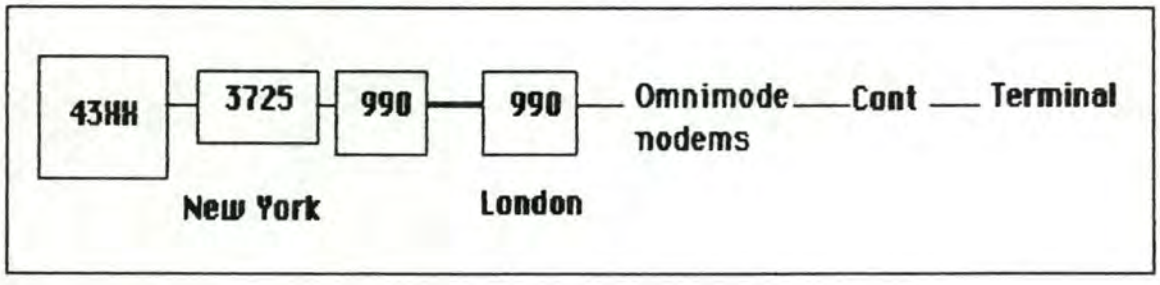

Fig 3-4. General configuration.

3.1.3. Logical Link layer.

This second layer on Prudential-Bache's network is called the binary synchronous emulation. This protocol is a mixture of BSC (Binary Synchronous Communication) and HDLC (High-level Data Link Control) between the multiplexers.
The character mode is EBCDIC on the whole network except at the end terminals (ASCII) after the controller or protocol converter intervention.

These are the two first layers. Prudential-Bache doesn't use any upper layer so far.

We'll see the different aspects we have tackled in more details in the eight following sections.

3.2. Important nodes

So far, we have a general view and knowledge of Prudential-Bache's network.

Some nodes are more interesting than others and especially New York, London. We'll learn more about their functions and equipments provided in order to achieve these functions,...

3.2.1. New York

As we know about it, New York is the mainframe, data base and major equipments centre.
The mainframe is an IBM 43XX type. It works with VTAM (Virtual Telecommunications Access Method) and TCAM (Telecommunications Control Access Method) , using CICS support.

CICS is an IBM data communications operating system which provides all the non-application software needed in a teleprocessing environment, these facilities are provided by CICS for online systems. As any data communication operating system interfacing the application programs with the operating system, CICS meets the needs of the system user, guarantees a fast terminal response time and is obliged to be highly reliable and available.

CICS is a transaction-oriented system and also a multi-tasking one.Its manages the huge data base accesses and cares about their security and integrity, by using tools like special tables...
It has a table-oriented structure, most of the resources (terminal, data set,...) are defined by tables and CICS is divided into many modules in order to achieve an easy maintenance.

When any user is willing to log on from his screen, the VTAM software in New York allows him to get into what is called a VTAM session. VTAM is the high-level software which is required for any operation and controls TCAM.

There are many "regions" in this software and each region has got a connection table called Network Control Program (NCP). This table handles a precise number of connections from the host to devices and, depending on the terminal address and on the VTAM region, which is related to this terminal through the NCP, manages the user session (see figure 3-5).

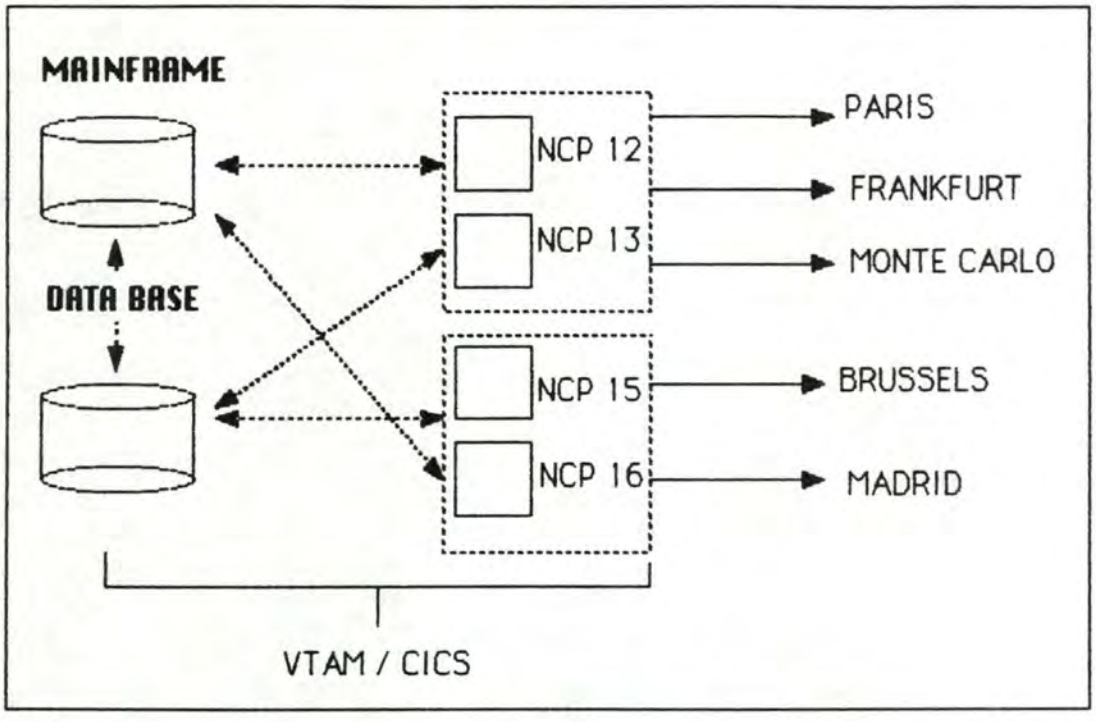

Fig 3-5. NCP/ VTAM connection.

VTAM or TCAM call the CICS functions like task management, storage management, terminal and file management...
It happens that VTAM or TCAM regions get problems and in this case, specific branches are down while the rest of them are still working because their NCP is different and the connected regions are working fine.

Facing Europe, the IBM 3725 Front-End processor is in charge with the traffic control between the central system and the hundreds of terminals. The 3725 communications controller has a modular structure and the logical sub-systems are listed below:

- the control sub-system checks the connection to the central system and uses the NCP stored in the system memory. Many 3725 front-end processors may be connected to the same system.

- the transmission sub-system allows the connection through modems to the lines and terminals.

- the service sub-system is used by an operator for the maintenance and the control.

At the other end, the front-end processor is connected to a 990 multiplexer whose facilities will be detailed below.

New York is the origin or the end of nearly everything going through the network.

3.2.2. London.

The main function of the London node is a hub for the European traffic going through the 990 statistical multiplexer which is actually a concentrator. The figure 3-6. gives an accurate view of this node configuration. The equipments are detailed below.

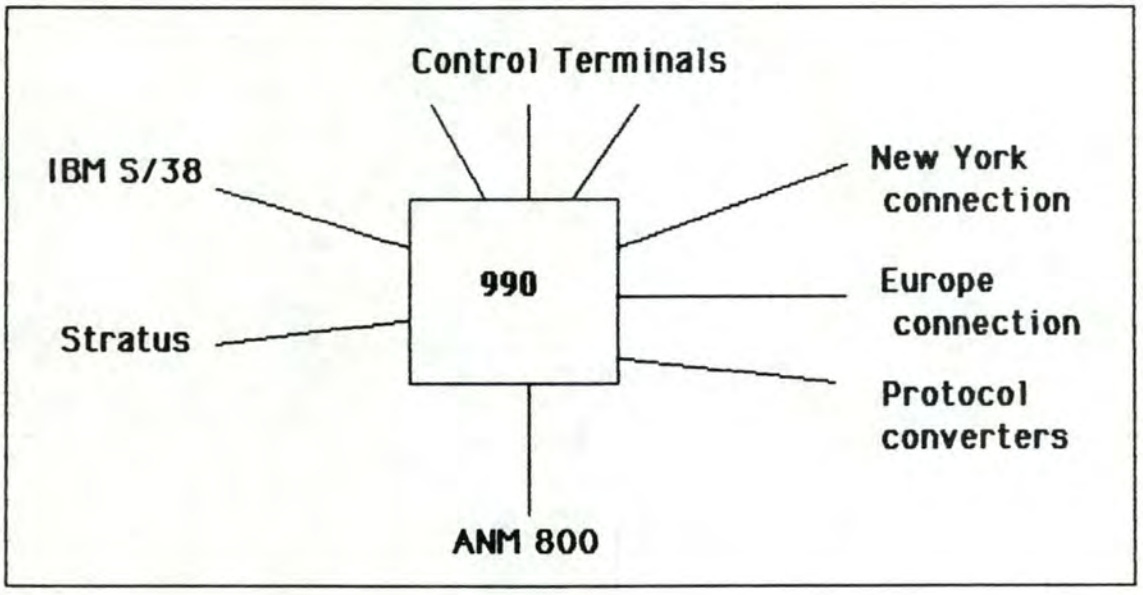

Fig 3-6. London communications centre configuration.

A statistical time-division multiplexer can be considered as an intelligent device that uses microprocessors and memory to multiplex data of active channels only. Therefore, there is no wasted bandwidth because idle channels do not take up any of the bandwidth and greater transmission efficiency is realized.

Let's remind the typical functions performed by this controlling 990 :

- the network concentration :
  The 990 combines high-speed, statistically multiplexed inputs of the other statistical multiplexers (680) or network concentrators (990) in the network.

- the network node processing:
  In distributed applications, the 990 acts as a network nodal processor. Data incoming from the network is processed and routed through the 990. The 990 handles many character-oriented and bit-oriented protocols including: IBM BSC 3270,IBM BSC 3780, HDLC,... The centralized network control and management allows control from any of the user-supplied consoles.
  The network configuration information is stored in non-volatile memory and can be easily changed or expanded.

- centralized network control and management

In systems with more than one 990 (Prudential-Bache has got 5 990's so far) remote access commands provide the capability for a system console to interface with and exercise full control on any one of the remote 990's.
There is a password protection to access a local or remote 990 in order to provide system security.

Below are listed some features available on the 990 network processor:

1) The load balancing facility:

It preserves communication by dynamically rerouting data around the faulty node to a different link module, if a link module is overbooked or malfunctionning. It automatically reconfigures the data traffic over the high-speed links between the 990's.
The alternate reconfiguration offers these types of data paths:

* Permanent Physical Channel (PPC) : these channels are established by the operator and never modified by the configurator. They can be considered nonswitched, nonreconfigurable circuits (see figure 3-7).

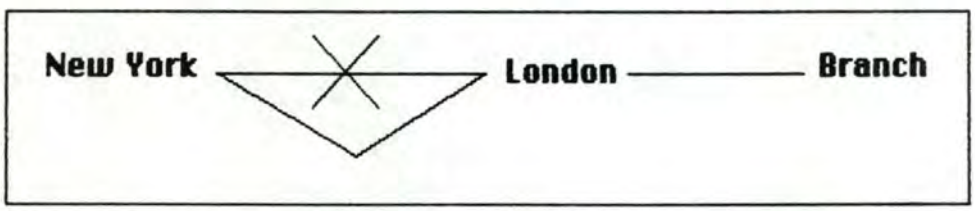

Fig 3-7. Permanent physical channel.

* Permanent Virtual Channel (PVC) : These are synchronous or asynchronous channels with nonswitched paths established by the alternate routing capability at the various nodes. During initialization, PVC's were routed from the caller to the specified destination over the fewest number of intervening nodes and over link modules with the greatest available bandwidth. Connections between these channels are automatically rerouted in the event of a link failure (see figure 3-8).

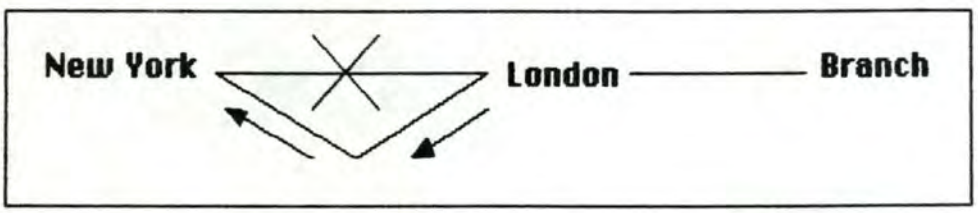

Fig 3-8. Permanent virtual channel.

2) The ANM800 :
It is an IBM XT Personal Computer with an Infotron-provided software package with adds several features to the 990 network processor that allows the network manager to see the layout of the network; understand, isolate and respond to abnormal occurences more quickly; and compile statistical histories for comparative analysis.

3) Errors management:
the 990 system provides complete protection against data loss or data errors with an automatic retransmission queue technique. A retransmission is requested whenever the cyclic redundancy check character (inserted by the transmitting unit at the end of the message) does not match the character calculated at the receiving unit.

4) The BSC emulation:
the emulation is the most recent improvement in the transmission of IBM 3270 BSC protocol. This emulation is detailed in the next section 3.3.

5) The X25 pad:
the X25 link module in the multiplexer provides a protocol gateway between the internal structure of a 990 network processor and a X25 host (which is another 990).

6) Data compression:
990 data compression is implemented on the BSC emulation channel. These channels have the capability to receive lengthy strings from the external equipment that consist of the same character and then convert them into a shorter string prior to transmission through the network. At the destination channel, the original data string is restored.

7) Redundancy and reliability:
redundant central logic is available as an option on the 990 network processor. In a 990 equipped with redundant central logic, one set of central logic modules is online and the other set is on standby at all times. The 990 nework processor has the capability to switch automatically to standby central logic whenever the online central logic fails [INF084].

This multiplexer illustrates the communication centre hub function. The ANM800 enables the operators to manage the network.

The ISD department in London works with both IBM System/38 and Stratus computers.

The S/38 processes the eurobonds, commodities,accounts,...and personnel data.

The Stratus, which is a fault-tolerant system, manufactured by Stratus, processes gilts front, eurobonds front and back office (Eurobonds from September 1978).

Both the S/38 and Stratus capture data which is transferred to the New York host for reconciliation; the results are sent back overnight.

3.2.3. European nodes.

Some european nodes are equipped with 990 or 680 multiplexers. The 680 has a function similar to the 990 except the ANM800 connection and the facility of connection to more than one 990 on the network.

Most of the equipments is provided by Reuter: screens, keyboards,... except the modems from Racal-Milgo and these multiplexers.

3.3. Binary synchronous emulation.

We will now present the protocol lying on the hardware backbone. This corresponds to the O.S.I. second layer.

3.3.1. Definition and mechanism.

The Binary Synchronous Emulation (BSE) might be defined as follows: the BSE emulates a BSC protocol, using a HDLC protocol on the heavy loaded parts of the network.

Let's see the advantages and inconveniences of the BSC and the HDLC and we shall see that the emulation combines the best aspects of each.
The protocol, before the change of the network, was BSC only.
BSC requires an acknowledgment (ACK) or no-acknowledgment (NACK) after each transmission in order to make sure the data or the poll has been received. It's obviously a waste of line and time, especially for the polling when a device has nothing to say to the host. All this traffic is travelling from New York to Milan, for instance, and back to New York.

This procedure is available on the Milan - London part of the network but the installation of a satellite line prevents the use of it:
the propagation delay of a satellite line is about 300 milliseconds and then, the time needed for a travel from New York to London, to the Italian office and the response back to New York might be greater than the usual 3 seconds time-out delay considered by the host. So,the device is going to be seen like idle and won't be polled anymore after several unsuccessful (of course) trials.

So, the BSC is bad in this case because it must travel end-to-end and transmission delays cause time-outs.

The HDLC procedure has the advantage of working with a window that allows to send many consecutive data without requiring an acknowledgment between each of them.

The situation in Bache network was that the host and the devices were BSC-oriented while it wasn't possible anymore with the satellite lines.
The managers then decided to switch to the binary synchronous emulation, first for these time-outs limiting factor but also because 80 % of all BSC communication is not data productive and that the delay characteristics of the intervening network are often unpredictable.

This software is provided by Infotron which is the firm that provides the 990 multiplexers too. These multiplexers are supporting this software, the protocol is written on chips on the multiplexer cards.

The multiplexer interface is intelligent enough to perform the interactive functions of the corresponding BSC device and each multiplexer is an emulator: the multiplexer in New York is a control unit emulator (CE), it is seen like a controller by the host; the multiplexer in London or in the offices play the part of the host in front of the control unit in the office (HE) (see figure 3-9.)

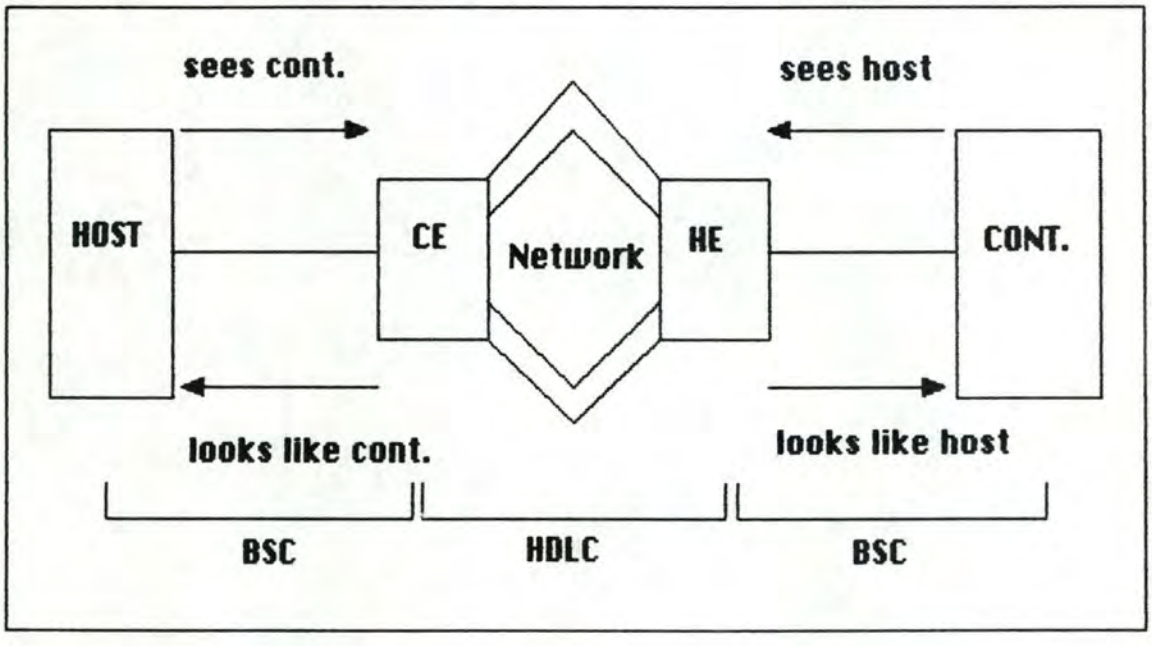

Fig 3-9. BSC emulation configuration.

The protocol between the emulators and their facing equipment is BSC and the one on the satellite lines is HDLC
We combine the use of the HDLC on the satellite line and we rule this line in the most efficient way, because we'll see that the polling keeps running between the emulators and the end equipments only and the useful data are passing with the window mechanism on the satellites lines.

Let's see how this emulation works:
the BSE transmission has two fundamental concepts:

1. the local acknowledgment

2. the remote polling/selecting

1. Local acknowledgment.

The emulator is able to receive, decode and respond to BSC messages from its corresponding end (in front of it, on the same side of the network).

The BSC interaction is not going end-to-end, it's running

- between the host and the control unit emulator in New York that acknowledges all the messages because there is no transmission problem between them: they are very close from each other. This emulator buffers the data and sends them to the other host emulator.

- between the host emulator and the control unit, the emulator receives the data through the satellite line and reroutes them to the right office according to the address bits in the frame, after checking whether the data are correct with the cyclic redundancy check (if not , the emulator asks for a retransmission from the CE).

The receiving equipment (device) acknowledges or refuses the data and asks for a retransmission, following the BSC protocol.

2. Remote polling/ selecting.

The figure 3-10 showes how the local host emulator polls the devices remotely from the host itself. This emulator maintains a continuous polling and sends the data back to the control unit emulator which answers to the host itself.

The figure 3-11. presents the select procedure. The host sends the data to the control unit emulator, which transmits them to the host emulator . The HE includes them in its polling sequence : the controller is warned by a select message and acknowledges back (or not) in order to get the data.

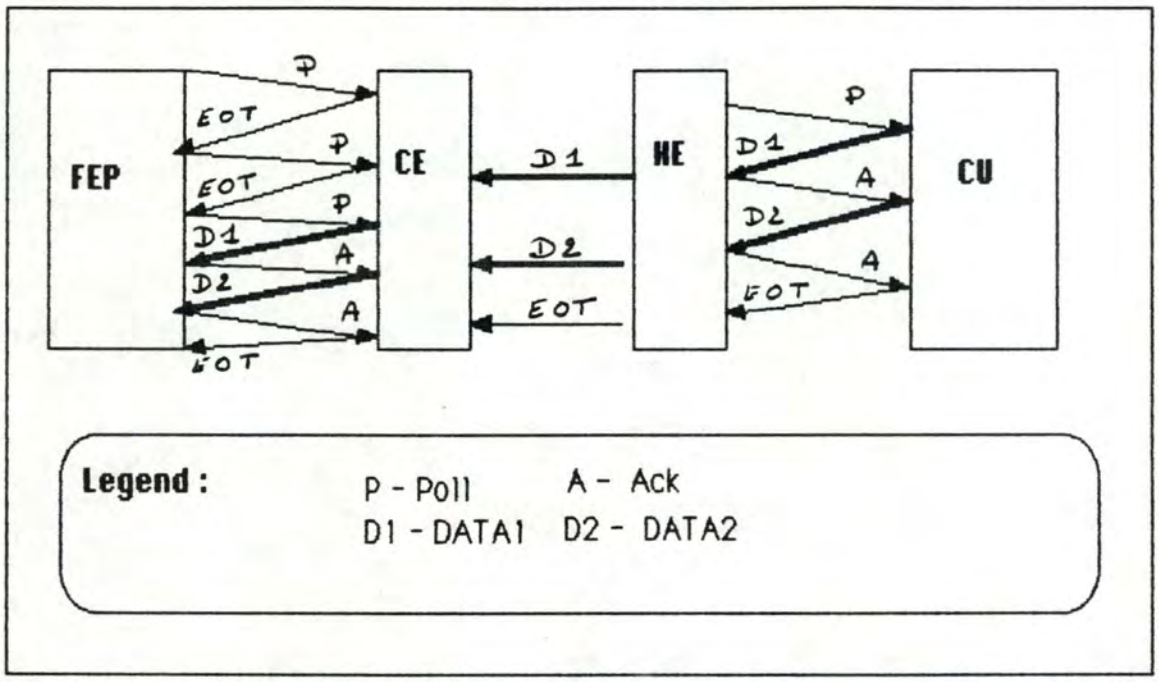

Fig 3-10. BSE Polling sequence.

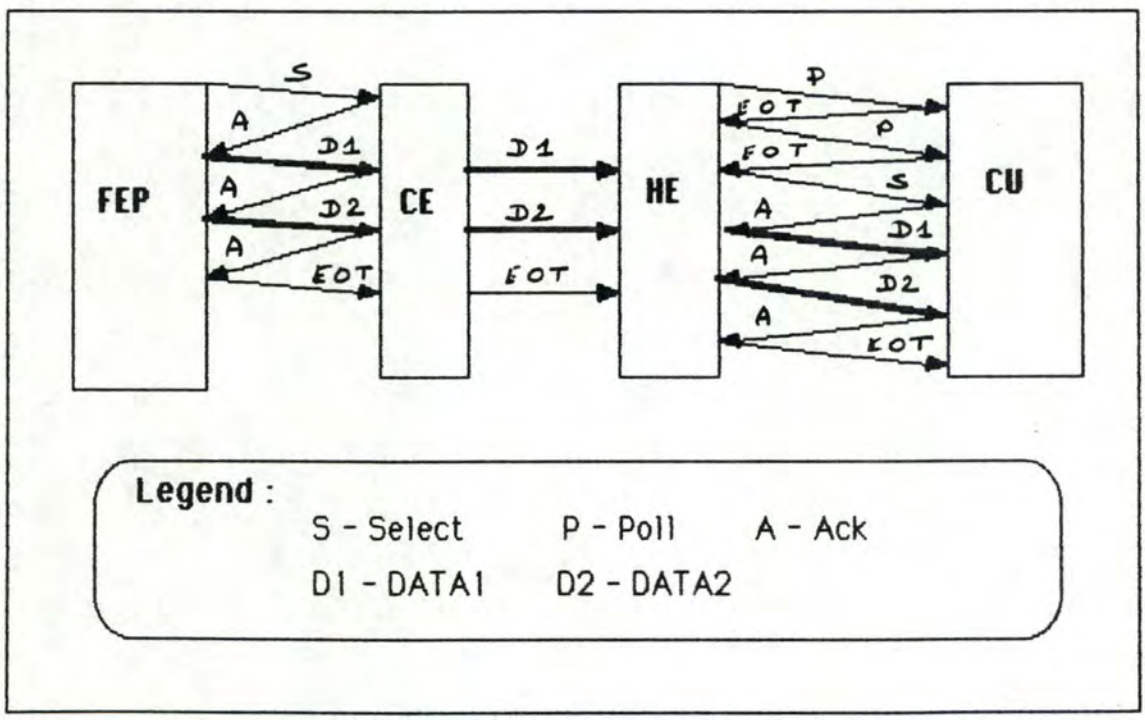

Fig 3-11. BSE select sequence.

In a few cases, when the controller or device is inserted in the polling for the first time, the poll is rerouted through the whole network and a response is going back to the host to tell him the status of the equipment.

Because device polling/selecting is performed local to the control units and not exchanged between the emulators, the response delay and bandwidth are greatly reduced.

However, a few control messages are going through the satellite line. Let's see for instance, the situation of a printer in trouble (out of paper) in any office. The host emulator is receiving a message from the host through the CE which acknowledges everything before delivery. The HE gets a bad status back from the printer and then, is archiving all the messages to this destination. But its buffer might get overloaded and in this case, it sends a special wait message to the CE and the host stops accessing this device.

When normal operation is restored at the destination, an appropriate status message is sent to the HE. The HE sends the archived messages to the restored device and the CE allows the host to access the device again.

In each circumstance, the emulator (CE and HE) must communicate with the interfacing BSC equipment in a manner emulating the remote BSC device. The emulators maintain a half-duplex transmission format with the BSC equipment, although communication between emulators is full-duplex (HDLC).

The data from the emulators to the BSC equipment has priority over data to the emulators and a RVI command (Reverse and Interrupt) allows the CE to override the select command from the host when data is ready for the host and change it into a poll.

The figure 3-12. shows a Poll-Select collision sequence.
It illustrates the storage facility inside the emulators: the polling sequence from the HE to the controller allows the device to send a few data to the host and they are sent in full-duplex, in the same time as the data coming from a select procedure from the host.

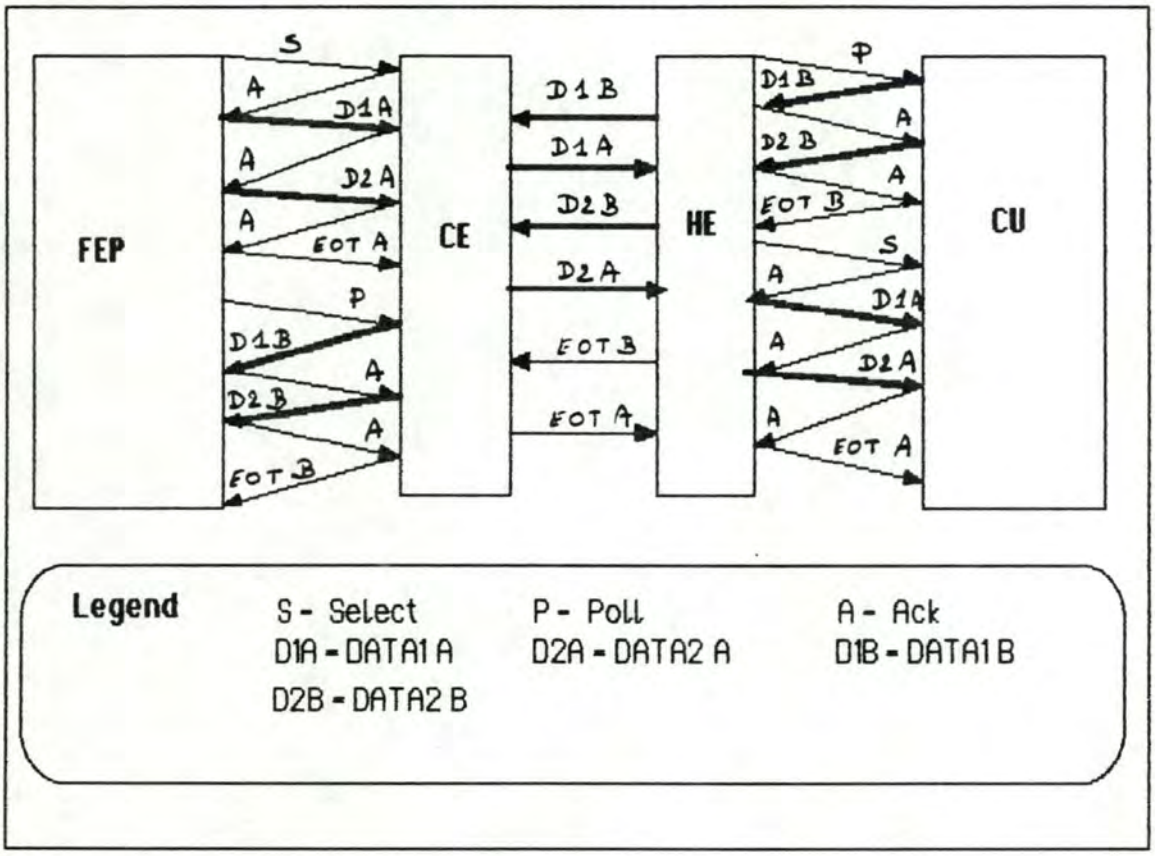

Fig 3-12. BSE Poll-Select collision sequence.

3.3.2. In practice.

The actual diagnosis about the BSC emulation efficiency is that it is running fine 6 months after the installation.

Prudential-Bache was only the second large scale installation of the BSE software (and the first in Europe). The vendors lack of experience and rather short development time of the product caused Prudential-Bache many problems. Most of these software related difficulties were overcome by installing debugged versions of the firmware; the other problems related to the lack of experience with the product parameters.

A typical error occured during the configuration phase of the multiplexer and related to the response from a device when polled but having no data.
Two choices were possible - no response or EOT. Prudential-Bache selected the no response option.

But, after seven consecutive polls without response,the device is considered like inactive and is out of the polling sequence. The host emulator doesn't know if the lack of response is due to a complete inaction of the device or to its failure. So, it happened several times that devices and even controllers (with the devices connected to it) were seen like inactive only because they hadn't any data to transmit to the host for a rather long time.

This has been cured and works perfectly well now.

We see that this emulation keeps its promises:
it really spares the satellite line for the data traffic and avoids for the polling to get heavy on the crucial lines. It allows to improve the speeds and the general behaviour of the network without modifying its end equipments (host, terminals, controllers,...).

From another point of view, this emulation still rules a BSC protocol between the multiplexer and the controllers. The distance between them sometimes is rather long and the leased lines get very busy with the polling. When the distance increases, the error rate is likely to raise too and retransmissions might be required.

Prudential-Bache tries to avoid this by the installation of multiplexers inside the offices, the line distance which uses BSC is decreasing and HDLC protocol distance is increasing.
For instance, Brussels office has got a new multiplexer which handles the traffic to Antwerp and Brussels office, of course. The London multiplexer is completely transparent, the data are going across it but everything looks like a HDLC multiplexer to multiplexer conversation between New York and Brussels. By this way, Bache is using the advantages of the HDLC with a BSC equipment.

3.4. Back-up system.

This back-up system refers to the security concern of the company. This security has been set up at different levels.

We have seen that the multiplexers offer an automatic load balancing facility in case of problem on the New York - London line (detected by a lack of carrier detect on this line), the 990 multiplexers in both cities are able to switch over onto the London - Hong-Kong and Hong-Kong - London lines.

This triangulation and the London - Hamburg - Frankfurt one improve the network reliability. By this way, Prudential-Bache tries to mitigate the rather high risk of fatal failure due to leased lines. The lines are sometimes down but the repair is rather quick by calling the adequate national telecommunications organization.

These PVC's were also useful at the beginning of this network because Bache was still keeping the old submarine cable running at 9.6 Kb/s from New York to London. The Hong-Kong triangulation was still non-existent. The traffic was normally routed through the satellite line but in case of problem (weather very bad conditions,...), the traffic was automatically alrouted onto the submarine cables (they have been taken out now).

If the leased line to any final office (like Madrid, Monte-Carlo) goes down, there is no alternate route for the traffic. Thus, the reaction is to get in touch with the national telecommunication organization and, in the same time, to ask to the office to use a telex service.

This telex service is organized as follows:
every office has got a telex terminal. Prudential-Bache hires the services of CCI company who provides services using its telex network and especially its connection to New York. Then, in case of emergency, the office calls up the nearest CCI branch and sends via telex to this branch. CCI reroutes this via an international packet switching service to CCI New York which alroutes it to Prudential-Bache New York through a 1200 bps line.

Using this procedure, the orders arrive at the New York market in time to be executed but the application services provided by Bache and accessible from the screens are momentarily down (consultation of prices,...).

This telex procedure is also useful if a triangle goes completely down or in case of major problem: the complete failure of London multiplexer. That means that all the European branches are unable to work.
The communications centre managers know very well about this problem and even if the risk is low, they think about many alternatives: a second multiplexer next to the first one or a disaster recovery centre separated from the communication centre. No decision has been taken so far.

3.5. Dual access from the devices.

This dual access is an access to Bache's application software and also to Reuter 's network and consequently to its informations data base.

Reuter is a large services company. This firm has got correspondents at the markest all over the world, they enter the prices and main informations about the markets and these infomations are processed and spread to the international subscribers.

Many major banks, foreign exchange dealers, stock, commodity brokers and other Reuter Economic Services clients are implementing their own in-house computer systems and Reuters services are a complement to this system.

Reuter's network has the same extent as Prudential-Bache's one.

The connection with the screens inside the offices is the following: the line coming from Bache London is split into many controllers and afterwards they enter into a hub (as Reuter calls its own equipment, it's a kind of cross junction). The Reuter's leased lines pass through modems and controllers and join this hub too. This hub is linked to the screens. When the user wants to consult the Reuter news switching from Bache's information, he presses a key and the hub changes the connection and makes it between the Reuters line and the screen link (see figure 3-13).

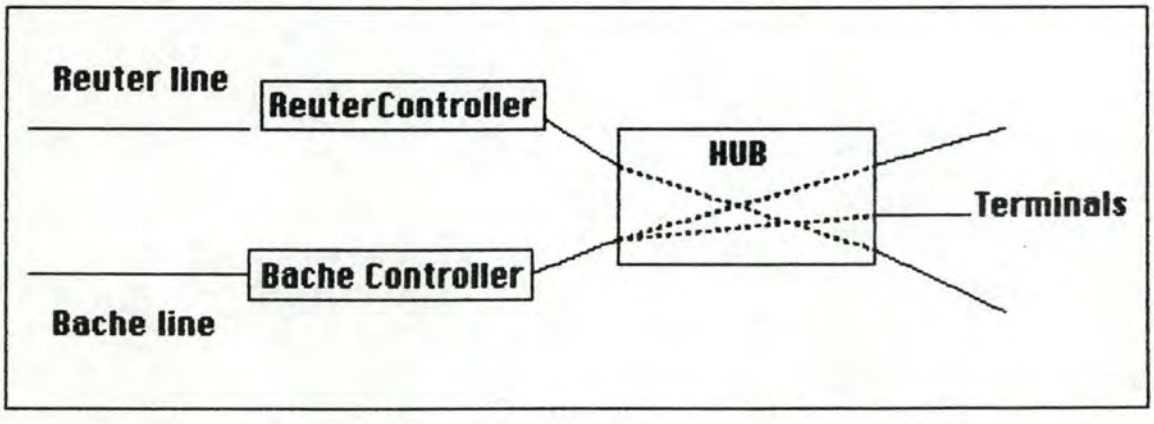

Fig 3-13. Dual access from the devices.

A programmable keyboard has been introduced by Reuters, enabling the suscribers to gain access, on a single terminal, to their own in-house system of communications as well as to the Reuter services.

The terminal, indeed, has control of the hub switch, thereby selecting the required service.

The main Reuter's software is called Reuter Monitor Dealing Service. It facilitates the direct trading and has got two sections: Reuter Monitor News services which give subscribers access to a comprehensive and up-to-date file of the latest world news supplied by Reuter's correspondents and Reuter Monitor Services which provide a fast and reliable means of receiving continuously updated rates and exchange prices.

Added to Bache's software, this connection to Reuter Services is quite valuable. The brokers switch from one to the other by pressing a single key. It allows to make the best trades by getting a lot of information on the different topics: commodities, bonds, options, stocks...The brokers can choose which kind of information they want: this broker asks for information on commodities only and Bache pays for this service only.

The Bache's and Reuter's services are complementary and both needed from administrative people and brokers.

3.6. Software supported on the network.

We know how this network works and we can wonder now what it is used for.

This network is the support needed to the users, the managers and operators to access the software.

3.6.1. Users oriented-software.

This application software has been written by Prudential-Bache New York and is located over there. The access to this software is made through a VTAM session.

There are mainly two parts:

- "switch" which allows the user to send wires or orders through the network. Some specific screens inside the office got this facility (mainly the wireroom).

- "ERA" which means Electronic Retrieval Assistant (a consultation program). It enables the terminal to display the marketing, client and operations information the user depends on during the workday. The system may be seen as a large filing cabinet containing the clients' records and product-related information. Most of the files are updated daily and, by a single request, the terminal display any file the user whishes to see. [ERA86]

A new software has been put forward at the disposal of who wanted in the offices. It is called Televiev. This software is a telecommunications software product which provides multiple session-switching ("windowing") capabilities for terminal users within a VTAM/TCAM network environment. So, there is no requirement to log off from an online application to establish a session with another online session. [TELE85]

3.6.2. Network managers oriented-software.

Prudential-Bache has got two types of managers-oriented software: the first one, NCCF (Network Communications Control Facility) and the ANM (Automatic Network Management) supported on the console connected to the multiplexer.

These softwares are available in the communications centres only, of course.

NCCF application is resident in the mainframe and allows operational control of the network. Any terminal, provided it has been enabled for NCCF, can exercise this function from anywhere in the network. Control functions may be entered to start and stop lines, controllers or terminals; provide information as the status of any device; reset error conditions and so on.

NCCF control may be extended to the entire network or regions of a network. This factor is controlled by the network generation program.

The managers are more interested in the ANM supported on a dedicated IBM XT or AT Personal Computer. This ANM, a wonderful management tool, will be detailed in the fourth chapter, but we can say that it gives a good picture of the network: a network map, statistical histories, an action on the status of the devices too.

The difference between these two tools is that NCCF is located in the host while ANM is independent of the host and is connected to the multiplexer.

3.7. Network choice reasons.

We have seen what this network looks like.
Before this network, there was another one which has been working for more than 3 years till September 1986. We'll see why the company has changed to the new one and why to this network type .

First of all, what was the previous network ?

Prudential-Bache was calling it EMS for European Message Switch.
The EMS was switching order, execution and administrative traffic between the New York system and Prudential-Bache offices in Europe and the Far East.
It was also the backbone of ERA
The EMS hardware in London was supplied by Data General and consisted of 2 Eclipse Minicomputers. The hardware had been dually configured to give 100 per cent hardware support and thereby reduce the vulnerability of computer failures.
The London and New York computers were connected via 2 9.6 Kb/s SNA links and the lines to the European and Far East offices were roughly the same as in the new network without triangulations. The speeds, generally speaking were lower [EMS86].

The EMS was the symbol of the power transfer from the London Control Centre to the branches. With the EMS, branches were able to retrieve their own traffic, obtain status information to their circuits and queues. The London communications centre was still able to perform retrievals for history files,... but was playing a less active role in the operation.

The new network, unfortunately for the users, is a comeback to a certain power inside the communications centre and mainly in New York.

After 3 years in service, the EMS was getting too slow and a few applications couldn't be proposed because of a too slow response time. That's why the idea of a satellite line between New York and London (the data "motorway") has been pointed out. The problem was this 3 seconds time-out in the host working on a B.S.C. protocol.

There were many options at this stage, Bache could have replaced everything and switch to SNA for instance but this solution hasn't won the game. In the last chapter, we'll study these different scenarios and alternatives and compare each with the other. For the moment, we follow Bache's idea.

This idea was to use an emulation in the way that the host would get its response back before 3 seconds ... even if the message hasn't arrived to its destination. This emulation which spared the satellite line from the polls looked like a fair solution which allowed to keep the end equipments. This is an important aspect in a financial company: the cost of an upgrading is to be compared to the total change cost of the network. If the first one is smaller and meets the general requirements, it's worth to try.

The other reasons in favour of this type of network were concerning the multiplexers interesting facilities: the automatic load balancing in case of emergency, the X25 pad wich enables the multiplexer to work with a X25 host, which might be a future to this network.

Besides the technical aspects, the political point of interest might be that this upgrade transfers nearly the whole power back to New York and this in comparison with other solutions and even with the previous EMS
The branches are not able to retrieve their own traffic anymore and they have no way to know how many messages are on their printers queues for instance, except by calling London communications centre.

London has got a control and management facility concerning the network but the data are just passing through its multiplexer and there is no way to keep trace of them after a certain time.

3.8. Future of the network.

The actual network has got a lifetime ranging from 2 to 5 years, according to the people working in Bache London.
The question of a network future, including its improvements, is always interesting and takes place in 2 different sights: the technical improvements of the network and the trend that leads to those improvements, especially the environment in which the network grows up.

Let's consider the technical future of Prudential-Bache Securities' network.

The author would like to stress the fact that he is studying the european part of the network and the following developments concern this part exclusively.

A major project, almost in realization, is the replacement of the 56Kbps satellite line New York - London by a T1 circuit.

T1 channel is an American Standard and its speed is 1.544 Mbps.
At the beginning, it will cross the Atlantic on a satellite support but the American and British telecommunications national companies are likely to install optical fibers in the future (called TAT8).
To take advantage of T1's capacity, multiplexers at each end of the circuit combine individual voice and/or data input channels for transmission. Non digital inputs, such as analog-voice signals must be digitized via codecs (coders/ decoders) prior to multiplexing and transmission operations.
The PCM (Pulse-Code modulation) technique requires 64Kbps for codec operation. The T1 has got 24 channels of 64 Kbps each (the missing 8 Kbps are used to establish and supervise the call connection). The T1 offers the facilities of automatic alternate routing, bypass,... It promises such features as compressed voice transmission,... [DC086]

The usual data traffic between New York and London will follow this new way but besides, the phone calls from the european offices will reach New York through this T1. A cost/profit analysis is necessary, many aspects take place in this: the data communications lines connected to the multiplexers no longer require modems, since transmission takes place over a digital facility but mainly the connection cost and the mean duration from Europe, Australia and Far East to New York are significant.

Another telecommunications user, the Marine Midland Bank has installed many T1 across the States (New York, Syracuse-USA, Rochester-USA,...) and the results were important costs savings, a rapid addition of circuits to meet user needs, the use of higher transmission speeds, the flexible network routing and the priority recovery with automatic alternate route [JUN86].

This T1 is in the installation phase in April 1987.
Another optical fiber running at 2.048 Mbps will be installed between London communications centre and Cutlers Gardens (London main brokerage office). This office staffs about 600 A.E.'s and the number of terminals is enormous. That's why an increased speed (for the moment, it is 64Kbps) looks like necessary.

The other planned developments are brand-new triangulations, for instance, London - Paris - Geneva - London ... unfortunately keeping their top in London which increases this centre importance and thereby its risk concentration aspect.
Let's notice that the triangulation trend involves the installation of multiplexers in many offices.

Now, we know about the next improvements.

Another point of interest in the future of any network is the financial and economical environment. In october 1986, London has been the scene of the famous "Big Bang", a major modification of the Stock Exchange functionment.

The Big Bang refers to the ending of a fixed commission prices, but it also encompassed the concept of 24-hour banking, so putting London in line with other financial centres such as New York and the Japanese markets. Foreign institutions are dramatically increasing their presence thanks to the relaxation of foreign exchange controls which are making it easier for overseas dealers to trade through London markets [COMM86].

During the run up to the Big Bang, both British and foreign banks have been expanding their activities by acquiring stockbrokers and dealers, transforming themselves into financial conglomerates.

That's what Bache did too. Prudential-Bache took over another dealers company located in London, dealers who are quite used to work at the London markets. That meant, to the communications centre, new lines to install.

This take over was scheduled to take place after the change of the network and before the Big Bang, of course. So, we can see that this network is born in order to be achieved for the Big Bang.

This deregulation means more trades at the London markets from everywhere in Europe and thereby increased transmission speeds on the network. That also means more minicomputers (IBM 3090 besides the IBM S/38) in the London ISD centre to process these trades locally and no longer in New York.

This is the play that the Big Bang performed in the birth of this network. It coincides with New York decision to change the network for many reasons and it was one of them.

However, what would the Big Bang's role be in its future ?
Because of the Big Bang, the trades amount increases dramatically. If the trend keeps going like now, there could be many new small offices in London and this network offers a growth capacity, the multiplexers cabinets can be added to each other (the only problem would be inside the host in New York). The speeds to the different offices would increase as far as they can,while the trades in London will get more frequent, but working on a T1, the speed to New York has probably reach at its maximum.

We have seen how this network will look like during its lifetime.
Prudential-Bache New York is thinking about the next network in a few years time. We'll speak about the next alternatives later on.

3.9. Personal activities in the network management.

Let's consider the author's activities concerning the network installation and management.

The traineeship was lasting from August 1986 to January 1987. In September, the change of the network took place with the installation of London multiplexer.

There were so many problems that another person was welcome to help the offices to understand how this new network was running and then, the user help desk counted one more person.

That was an interesting part of the traineeship because it involves a large knowledge of how the things are working and also a rewarding contact with the users. This job involved to learn the different management tools we had at our disposal. It was a wonderful opportunity to attend the way decisions are taken, how the managers schedule the analysis, testing and realization, why they chose these technics and how, despite all their efforts, they still get surprises in the same time the network grows up.

The human environment in the network management was quite interesting to a trainee. The people who are working the whole day and night (by shifts) are the fundamental part of the network, without them, no network might keep running for a while.

In December, the network was running far better and a trainee was no longer really useful in the operators staff. At this time, the communications and ISD departments were thinking about moving out of the actual office which was getting too small. They were speaking about the utility of a local network in the ISD new centre.

They asked the author to write down a report about the best local network meeting the following requirements: the connection of 20 to 30 Personal Computers to a Stratus , System/38 and 3090 from IBM as well. The alternative was to choose between an IBM token ring and a CSMA/CD (Ethernet) local network.

With an eye on the layout of the new building, the report was tending to advice an IBM token ring when, suddenly, due to many problems inside the new building, the managers changed their mind and are looking for another building.

The local dispositions, the electrical environment and many other variables were no longer available and this was the end of the report and the traineeship in the same time.

This traineeship has been quite useful and profitable. This was the opportunity to learn communications from inside: the doubts, choices, installation, hard times at the beginning, the users panic and lack of knowledge, the importance of a good schedule of analysis and tests.

CHAPTER 4.

Fundamental elements in a financial network: the human and economical aspects.

4.1. Introduction.

This chapter about the human and economical aspects of a financial network might be surprising in this paper.

These two points of view are often neglected for the benefit of the technical concern in a network design.

We must remember that a financial network is dedicated to its users and should be user-friendly. The human aspect for the network managers and operators should not be forgotten either. Network management meets difficulties that the author has experienced. They are more striking during a network installation and commissioning but are liable to re-occur subsequently.

These difficulties are, for one part, general to any kind of network and, for another part, particular to the network design and configuration. We shall present them in the next paragraph.

A paradox is the following: a network is at a rather technical high level but is used by people who don't know a lot about computers, lines, data traffic,... All they know, most of time, is the terminal in front of them.

That sometimes makes the relationship between the users and the managers or operators difficult and to prevent this, the managers offer the users different facilities like an user help desk.

Meanwhile, the operators, who are crucial to the running up of the network, are human beings and are susceptible of mistakes that can cost a lot to the company. We shall study the different tools they have at their disposal to allow a quick reaction to any problem but prevent a wrong one.

The second aspect we shall discuss in this chapter is the economical one.

For the company, the network is a way to increase the profit taken from the job of people spread around a country or the world.

The company who has an incorporated network is the only one who pays the bill and it might be heavy. Therefore, a network has to be as efficient and reliable as possible compared with its cost, and pay more than its costs.

4.2. Human concern.

Let us start with some considerations about the human problems that must be kept in mind during the design of a network.

We divide these problems into two parts: on one hand, the management difficulties and some of the solutions to them, on the other hand, the users problems and facilities.

4.2.1. Management side.

4.2.1.1. Difficulties.

We classify the difficulties the managers meet, into two parts: the first one explains the problems that every manager faces , that are independent of the network configuration; the second one discusses the problems due to the specific configuration of Bache Securities' network. Both of them have been experienced by the author and it seems that Bache Securities' difficulties were a good example of the problems that occur during the installation of a new network.

The first class of problems appears in any company which rules a financial network.

For each type of problem, we specify the origin of it.

One of the most common source of difficulties in everyday life is the user. Let us give a picture of the usual user: whether he is working in a bank or in a brokerage house, he (or she) is ignorant about computers.

A few examples show how far it goes:
the author, in the communications centre, got telephone calls from users complaining that their printer in the office wasn't working while there was no paper in it, or telling that their screen didn't work while the brightness was off, or the terminal not plugged. This kind of problems looks like stupid but it sometimes takes a long time to sort that out, the user always gives very few or vague details and maintains that it is the network (and thus the communications centre) fault.

Besides, the user is reluctant at any change in his way of working.

Another origin of problems is the operators faults :
it happened that operators forgot to put paper in some printer which was dedicated to the receipt of specific orders at the markets. These orders haven't been printed and consequently executed.
The orders had to be sent again the day after but that meant a large amount of money lost in one day.

The operators faults are not frequent but measures have to be taken beforehand in the network design to prevent major problems. Most of time, indeed, the operators have a big power and the possibility to bring down the whole network.

If there are many communications centres working on the same network, with the same facilities, there might be problems between them.

No one wants to assume the responsability in case of major difficulty and it becomes difficult to know where the problem has started and what to do because each centre throws the problem back to the other.

Another source of problem is the security aspect.
For instance, if the back-up relies on a mutual agreement with another company, the second network might fail down in the same time as the usual one.
The various aspects of the back-up must be studied and that's a full-time job.

The second class of problems is dependent on the network configuration. We have discussed the Bache Securities' network in the previous chapter. We can put together all the problems due to its configuration.

We have seen that the network is based on leased lines. That causes problems because almost, every week a line somewhere on the network goes down (for many reasons: it might be cut,...). A major problem occured when the satellite line to New York failed, as well as the two sub-marine cables. The Hong-Kong triangle was still not in use. Besides, the back-up relying on the CCI telex network failed for a short time because of a power failure in the London branch.
Eventually,the situation was that the whole European, Australian and Far Eastern part of the network, passing through London, was down. That means that all the brokers are trying to transmit their orders to the markets or to get information about the prices and are just not able to do it.

The situation becomes awful when the Stock Exchanges are hectic and when it's urgent for these orders to be executed to benefit from the markets variations.

We know that if the multiplexer in London goes down, the situation is the same. It didn't happen so far but it's possible and the results would be dramatic.

The two communications centres (New York and London) have a 990 multiplexer and the same management tools working on it. That means that if an operator in each centre works on the same line, in the same time, the result might be different from what each one expected.

The management softwares might be the source of problems too:
the ANM, for instance, offers the facility of sending test characters through a specified path on the network. But one of these specific characters, sent by one of the operators, forced the modems on its way and the office at the end of the path went down. The relation between the two events (the character sent and the office down) was not obvious and it took a time for us to realize that the modems couldn't support this special character.

An irritating problem happened regularly at the beginning due to the incorrect software on the multiplexer cards. It took a long time to identify and correct this problem and during this period, branches or a few controllers would fail for no apparent reason. This made life difficult for the operators, continually restarting failed controllers.

4.2.1.2. Solutions.

To meet all these difficulties, the managers provide many solutions.

First of all, they try to anticipate the problems with the users by a user-friendly interface software and also by the provision of an user help desk.

The user help desk answers their phone calls, tries to solve the problems thanks to the control devices or softwares and contacts the adequate people if they don't succeed in (see user help desk functions in annexe 2).

The user help desk staff and the operators might be the same people but most of time, all this network management staff is divided into two sections: the user help desk and a network control centre which is an operational centre in charge with the continuous checking of the network and the technical problems.

The user help desk is in contact with the user and use a kind of checking list in response to the user calls to avoid the trivial problems like the printer without paper,the terminal which isn't plugged.
If they can't solve the problem, they know exactly where or who to call: the national telecommunications institutions in order to repair the leased lines, the other communications centre, the technicians staff,...

An idea from Bache Securities to solve all the start difficulties was to keep a manual log (besides the automatic log on the management consoles) containing the specification of the problem, its location (office), the time needed to cure the problem and especially the treatment or reaction to solve it. This has been helpful to locate the repetitive problems and try to find a final solution.

After the user help means, the managers and the operators get help tools too. They need to have control terminals, equipped with specific software in order to react to local problems in the offices or agencies. That's the play of the NCCF software that we have studied in the 3.6. section. This is a management product for the network exploitation.

There are also products that help to situate the problem, for instance, the ANM.

The ANM is an IBM XT or AT with an Infotron-provided software package. The Personal Computer connects to the 990 multiplexer via a link module with a specialized firmware package that allows communication between them.

The ANM adds several features to the 990 that have been designed to help the network manager see the layout of the network; understand, isolate and respond to abnormal occurences more quickly; and compile statistical, histories for comparative analysis.

The ANM features include the:

a. Network Monitor

The network monitor provides a geographical representation (map) of the actual network. This map will include an outline of the area in which the system is located. This operator-generated outline will depict any city, state, country, etc. Superimposed on the outline will be the 990 nodes . The nodes will be color-coded to indicate their status (green, if everything is allright, red, in case of troubles). From the network monitor the operator can investigate the cause of a nodal problem on a device level. (A separate submenu allows the operator to draw the map outline and insert or delete nodes.)

b. Alarm Log

The alarm log is a chronological record of every alarm condition reported from every device of every node in the system. An alarm condition is considered as a outline outage, a buffer filled to 80 percent of capacity, a device initialization, a total number of inbound and outbound errors or round trip delay that exceeds the threshold set by the operator, a node congested with data, or a deteriorated link.

c. Reports.

The reports menu allows the operator to view all 10-minute status reports as they occur either from every device of every node for a period up to 48 hours. These reports can be compiled into many different formats, providing the network manager with a very comprehensive picture of the system performance. Also, statistics information from any previous 24-hour interval can be included for a comparative delay.
(The operator can record statistics on diskette by means of a separate submenu).

d. Diagnostics.

The diagnostics menu allows the operator to exercise any channel path or segment thereof in the system or set a control signal profile at either end point of the selected channel path.

e. Console.

The console menu allows the ANM to act as a standard console for any node in the network (see figure 4-1).

f. Message Center.

The message center allows the operator to receive a message from an earlier operator and to leave a message for a later operator [ANM86].

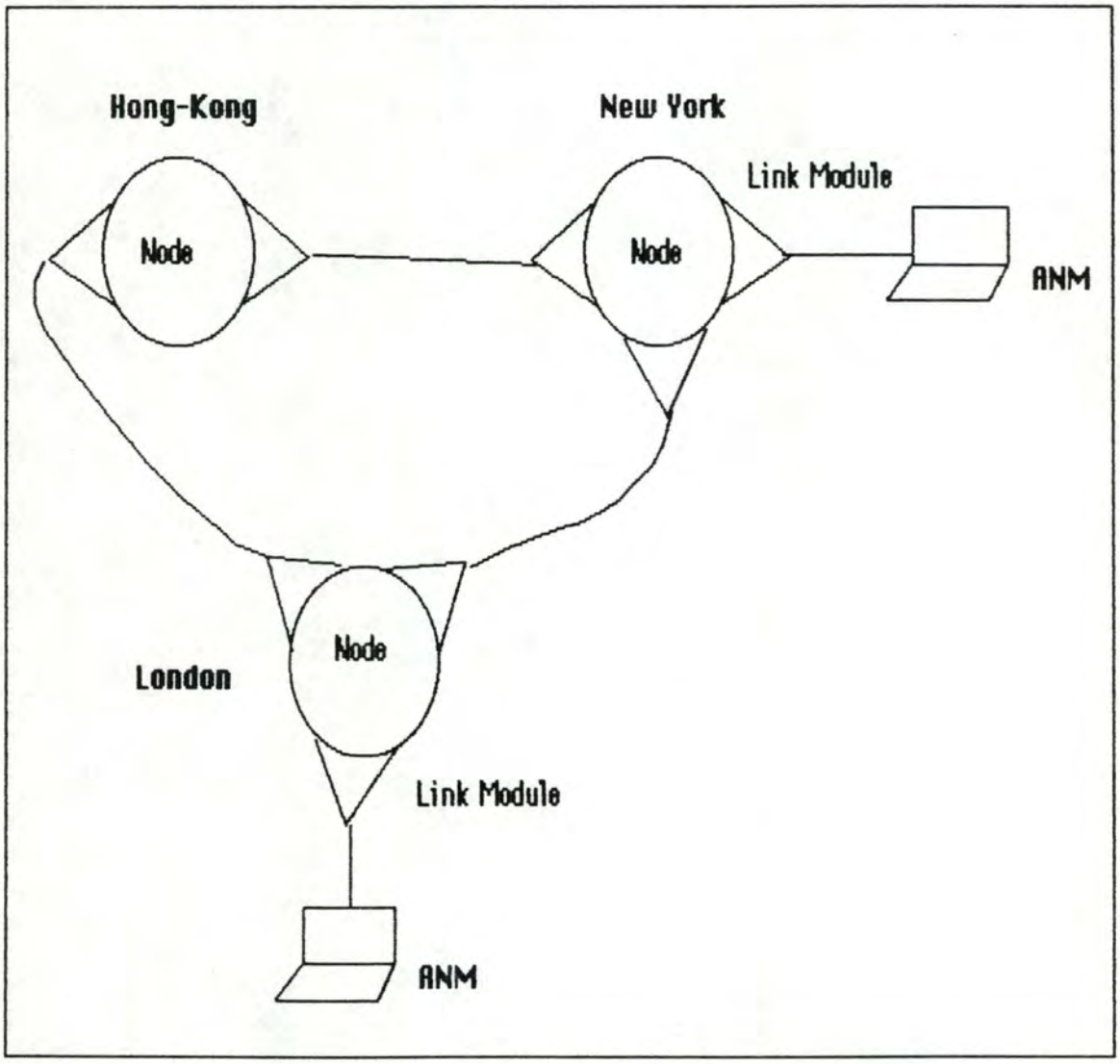

Fig 4-1. Subarea of Bache Securities'network - ANM action on any node.

4.2.2. Users side.

4.2.2.1. Difficulties.

Looking from the management point of view, we have discussed some of the users difficulties in front of their screen or printer.
Let us remind that computer science or networks are not his job at all.

A short response time and a great availability are the requirements from the user, but he is not really interested in what provides these features.

Consequently, he doesn't like any change in his work tool and he is afraid of losing some facilities he appreciated before.

In case of problem, his first reaction is to call the user help desk in the communications centre.

4.2.2.2. Users facilities.

The software located in the mainframe, that the users have at their disposal, are made in a concern of user-friendlyness. That always means a compromise between the efficiency and the guidance of the user.

For instance, the new concept of self-bank from the Belgian bank, BBL, requires a special guidance because the user, then, is anyone. The customer comes in front of the screen in the agency and makes his transactions on his own. The software is designed as a decision tree to guide him and each choice makes a further step inside the tree.

In Bache, we have seen the different softwares provided to the user: switch, ERA and the niew Teleview (multi-windowing facility).

Reuter provides its Reuter Monitor Dealing Service for the trading.
The switch from one to the other is very easy by pressing a special key.
Everything has been provided for the users and their customers accounts security: passwords, identification of the sender of any order,...

Another facility to the users is the standardization of the equipments:
the same devices in the whole office and in all the offices.

4.3. Economical aspect relevant to a financial network.

In the design of a financial network, the economical concern is fundamental. A network is a compromise between its cost and the benefit that can be taken from it.

It is rather difficult to calculate the benefit and we shall speak about another analysis: cost/ efficiency.

The efficiency of a network is in terms of reliability or availability, fast response time, control facilities to maintain this efficiency in case of problem and the faculty of an easy adaptation and expansion.

The difficulty is to design a network based on geographical requirements, which meets these efficiency criteria but is not too expensive.

The term "design of a network" contains different aspects:
the hardware (devices and lines), the software supported on it, the protocols, the back-up, the staff working on the network,...
The cost of all these aspects must be taken into account.

The designers, then have to compare the different networks type that exist on the market and find which one meets the efficiency requirements at a rate as good as possible and is less expensive.

There are basic decisions like using dedicated lines or a switched network. They must be justified and it's mainly the cost aspect that makes the choice.
Based on an average amount of data transmitted by hour by user, a calculation is made to know up to which rate it is interesting to choose the switched network instead of the leased lines.
Generally speaking, when the traffic is heavy, the leased lines are cheaper because the bill of a switched network is based on the number of packets crossing it.

The calculation gets complicated when the network join places spread into many countries and especially all over the world. It would be difficult to design a network using the different switched networks established in the different countries, from the States to Australia.

However, the leased lines bring other costs: the repairs and the back-up or rerouting solutions because the rerouting of the data is not provided as in a switched network in case of link or node failure.

It is possible to know the mainframes and devices costs, the software, operator staff and back-up costs but a network cost also includes the time spent in testing, the youngness errors of the network, which might be evaluated in terms of trades or transactions loss during the failure period.

CHAPTER 5.

Considerations on different financial networks.

5.1. Introduction.

This considerations chapter on different financial networks aims to extend the scope from Prudential-Bache's situation to other financial companies or banks network configurations. It is based on a survey that has been made by the author among many companies of this type.

The chapter is divided into three parts:

- the first one summarizes the aspects of the survey and presents the questionnaire structure;
- the second one details the companies networks on the basis of the answers to this questionnaire;
- the last one compares the answers with each other taking Prudential-Bache's configuration into account.

5.2. Summarized aspects of a survey on some banking networks.

The financial companies that have been chosen for the survey, have the same features as Prudential-Bache:

- their objective is to work with customer accounts and make profit in favour of the client and the company itself in the same time

- they have installed a communications system to link the branches or agencies spread in many cities. This communications system is a private, incorporated network and the data passing through on it concern finance.

- the people who use this network are financiers, bankers or bank employees and don't know a lot about computers.

- the companies have formed a special staff to take care of the network.

- when they choose their network configuration and the application software, they face the same requirements that we have discussed in the previous chapter: to facilitate the managers and users work with a fast response time and a great availability.

There are many ways to study other financial networks but the author chose to make up a questionnaire. The author has visited four major Belgian managers from the financial companies in order to fill in this questionnaire during the conversation.

These companies are Belgian, that is why the questionnaire which is in annexe, is written in French.

The questionnaire is divided into a few parts:
first, a short presentation that explains the author's situation and the reasons that justified the enquiry (that was made orally, most of time), and then, the next parts that respect this memoir structure:

- eight questions concerning the network itself (cfr chapter 3)

- six questions concerning the human aspect of the network
  * the first three ones regarding the operators
  * the last ones asking for more details about the users
  (cfr chapter 4).

The cost aspect doesn't take place in this questionnaire. This kind of information is confidential.

Let's detail the questionnaire structure.

A. Regarding the network configuration,

AI. It is always important to mention the services provided by the network and the type of data it is supporting.

AII. The network topology and its either centralized or decentralized trend are worth to be detailed.

AIII. The managers explain their network choice motivations.

AIV. We have seen that the financial companies worry about the back-up solutions and this question aims to know how far this concern goes.

AV. In the introduction, we have compared the financial network configurations with the OSI model from ISO. The importance of the OSI structure in the managers mind is worth to be considered.

AVI. Last of this group of questions is the future of their network or the improvements they project or forecast.

B. Regarding the staff who works on the network,

BI. The size and the qualification of the operators staff is an aspect of the human concern.

BII. The control tools they have at their disposal are interesting.

BIII. So are their kind of reaction and the rapidity of it.

C. Regarding the user.

CI. The kind of user may differ from a company to the other: the financier who is hurried or the user who has a training in computer science,...

CII. Some questions about the type of software(s) that the user has at his disposal and the author(s) of this (these) software(s), complete this questionnaire.

The companies managers who have accepted to meet the author to fill in this questionnaire are coming from:

- **CGER** : Caisse Générale d'Epargne et de Retraite.

- **BBL** : Banque Bruxelles Lambert, a large Belgian Bank.

- **G** : Générale de Banque, the main Belgian Bank.

- **AG** : Assurances Générales, a large insurance company.

All of them work with one or many information networks. We shall detail the network(s) of each company on the basis of the responses to the questions.

5.3. Details on some other banking networks.

This section describes the networks from the four mentionned companies. In the description of each network, there are codes like (AI) or (BII),... They relate to the codes of the questions that have been mentioned right before and mean that this part of the description answers to the question designated by (AI) or (BII),...

5.3.1. CGER (Visited manager: Mr Claes).

CGER offers two kinds of services:

- banking services inside the agencies (800, located in Belgium)
- teles service which allows the customer to know his account situation by printing of an account abstract. This teles terminals are outside the agencies.

The data passing through on the network are financial (enquiries, transactions,...) (AI).

An aspect that's worth to stress is that it is a real-time network (the terminals in the agencies are updating the data bases in real time).

The CGER's network (see figure 5-1) is limited to Belgium and its configuration is two years old. It is a SNA network. It looks like a star and it totally centralized.
The 3 hosts are in Brussels with a director module, the IBM's IMS (Information Management system) software and the data base.

There are 6 regional centres which are equipped with 3725 FEP connected to the host by 19.2 Kbps leased lines. Besides, each centre is connected to one of its two neighbour centres to increase the reliability of the network.

Beyond the regional centres, the agencies are connected in multipoint through 9600 bps lines. There are 25 leased lines by regional FEP and each line serves 4 to 5 agencies and teles terminals.

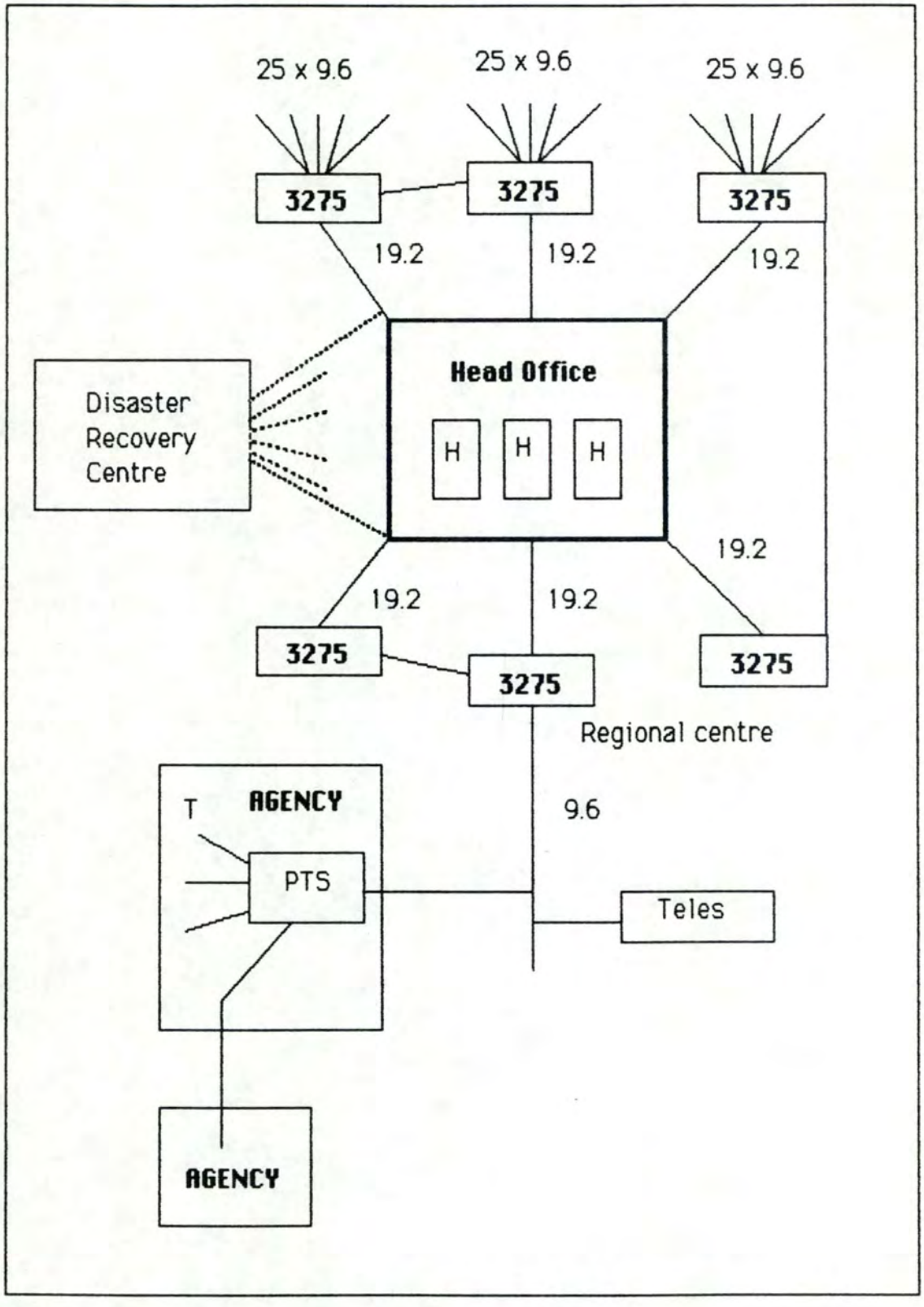

Fig 5-1. CGER 's network.

In each of the agencies, there is a PTS mini from Philips that is used for:

- the off-line job if the line to the FEP or host fails or for any other reason that leads to a failure of the network regarding the agency. The mini simulates the host work and as soon as the situation recovers, the mini transmits all the informations that it has checked and archived, to the host.

- the guidance at the Philips' terminal in such a way that the data travelling on the network are definitively correct.

- the cash management of the agency.

By this way, 400 to 500 agencies are connected but there are 300 to 400 left that are connected to the mini through modems. (AII)

This network choice motivations are, first, the necessity of a complete network architecture (in comparison with the previous network working on BSC and concentrators) and secondly, the fact that this architecture has to be the only one inside the bank. The managers wondered: why not SNA? (AIII)

The security and back-up aspects have been deeply studied:

- in case of line failure, the PTS mini works off-line.
- if the mini fails down, Philips reacts in 2 hours time.
- if the 3275 FEP is in trouble, they have 3275-like devices to replace it.
- if one of the 19.2 Kbps line between the host and a 3275 goes down, the Brussels centre reroutes the traffic through the 3275 connected to the first one (triangulation back-up).
- finally, if the Brussels head centre is out of order, the 6 regional centres are switched to the disaster recovery centre which is equipped in 24 hours time. (AIV)

The managers take interest in the OSI model. They have designed an interface OSI/SNA for the creation of their teles software.
They were two layers in this software: the management of the SNA communication and the teles application.
For the two different teams working on each part, the reference model was the seven layers of OSI. (AV)

Regarding the improvements concerning the network, they don't want to change anything for the moment because this configuration is rather new and they are happy with it. Their desired improvements concern the applications. (AVI)

The staff working in the network is split into 2 teams:

- the user help desk which counts up to 5 people and is equipped with the 700 system from Telindus. This system checks all the lines to the modems, using a part of the bandwidth around 75 bauds to control the signals.

  This team is in contact with the users and is the first intervening party. They try to sort out the origin of the problem and call the adequate people.

- the network control centre which staffs the operational and technical team. They check the whole network all the time, reroute the traffic in case of failure,...
  (BI - BII - BIII)

The users are the bank employees or the customers at the teles terminals and don't know anything about the network. (CI)

The application softwares are developed by the CGER itself (CII).

5.3.2. **BBL** (Visited manager: Mr D. Villers).

BBL services are various and there are many networks to provide them:

- the bank agencies network (1000 agencies, located in Belgium)
- the administrative centres network (16 centres)
- the travel agencies network (28 agencies)
- the foreign branches network
- the private firms connection, SWIFT connection, Reuter connection, Belgian Stock Exchange connection.

There are 3 kinds of data on the network:

- the non guaranteed enquiries traffic from the users to the central system and the opposite. There is no recovery procedure in case of failure.
- the guaranteed transactions traffic. The transactions arrival and the sequence control are guaranteed.
- the batch transfer. (AI)

We shall detail the agencies network and say a word about the other ones.

The agencies network is national and links up to 1000 agencies to the central system. This central system consists of many mainframes from Burroughs connected onto a bus (see figure 5-2). There are two major centres: one is at Etterbeek, the other at Marnix (Brussels). These centres are linked via two 2 Mbps lines.

This is a multipoint network. There are 350 processors on 48 lines at 4.8 Kbps each (see figure 5-3).

4.8 Kbps is a rather slow data rate and to avoid a too slow response time, the BBL splits the traffic into

- the urgent traffic
- normal traffic, for which the real time is not required, the "opportune time" is enough.

Thus, the polling on the first line (8 branch processors) asks first for the urgent traffic and afterwards for the non-urgent traffic. 95% of the urgent enquiries get an answer in the 4 seconds. The one who answers to the second polling loses it turns in the next polling sequence.

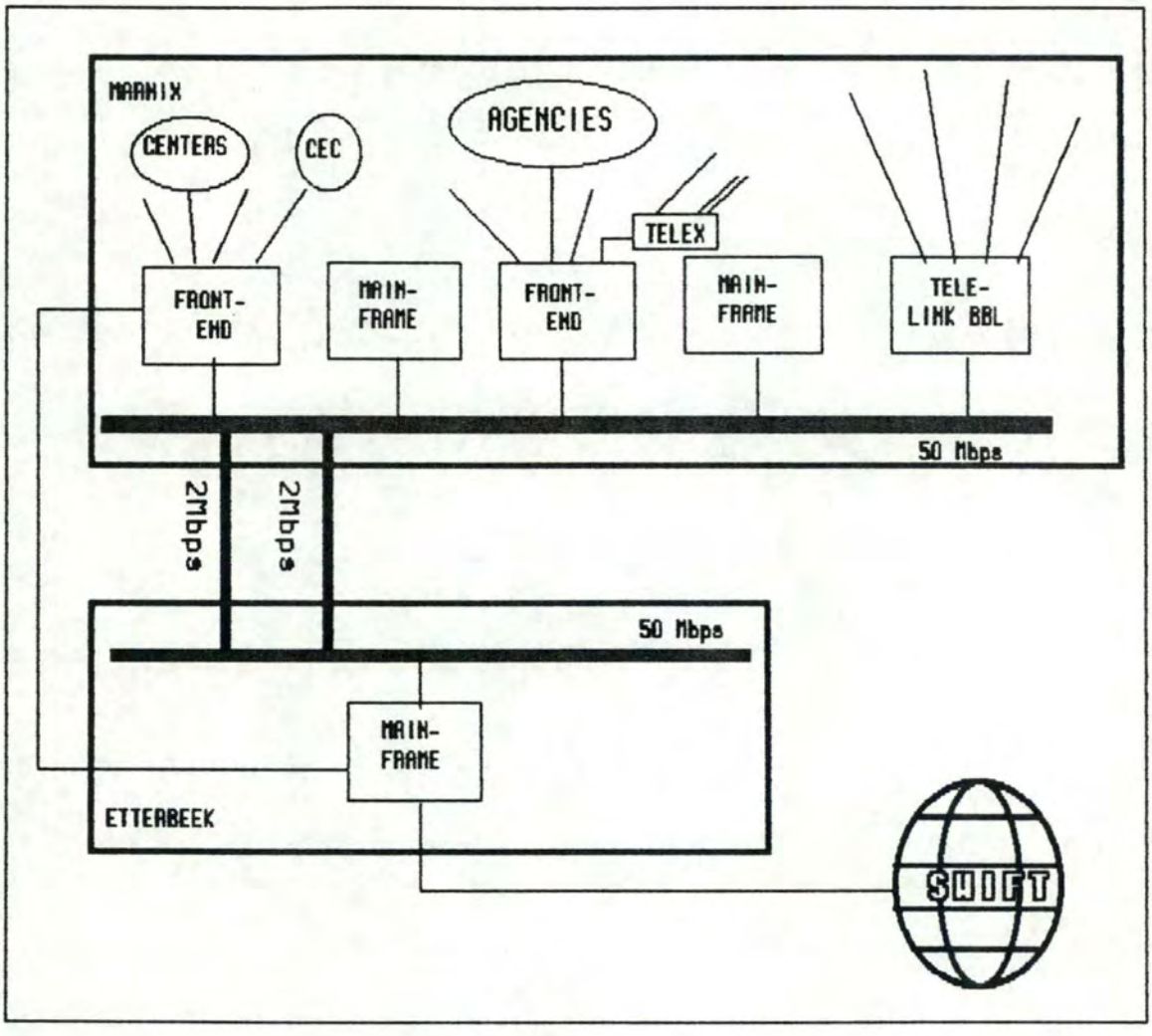

Fig 5-2. BBL's centres configuration.

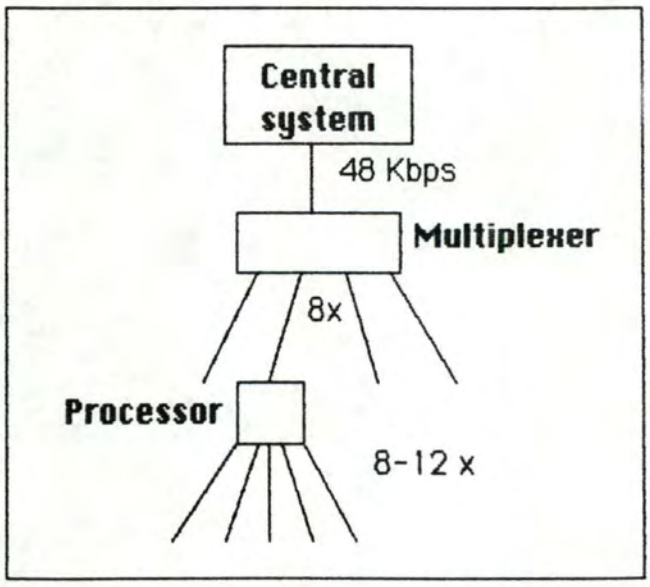

Fig 5-3. The BBL's agencies network.

The 16 administrative centres are linked via point-to-point lines and connected on a local area network.

The BBL's travel agencies are also connected in multipoint to the FEP on the central system. This central system is connected with the airline companies networks (SAPHIR for SABENA,...)

The BBL is connected to the CEC (Chambre Economique de Compensation - clearing house) and the informations are transmitted the whole day at the speed of 9.6 Kbps.

It is also connected to the SWIFT network (Society for Worlwide Interbank Financial Telecommunications). We shall study this network later on.

All these networks are centralized but allow the decisions decentralization by the information access from any agencies and the disposals of data base pieces in the agencies mini's.(AII)

When the BBL's managers choose a network design, they first think in terms of functionality, of the most convenient technology and the quality/price ratio. The economical reason is very often conclusive.

For the new network (see AVI) the BBL is planning, the important features are the constructor independence and a concern of the integration of all the networks. (AIII)

At the security point of view, the BBL opinion is particular: they rely on a very good service and if something fails (which is rare), there is almost no back-up. They wait for the repair. They think that, as the users are used to a very reliable service, they won't be able to switch to back-up procedures. The new network will use the Belgian packet switching network DCS as back-up solution. (AIV)

The BBL's managers think in terms of ISO for their new network that counts up to 4 of the 7 layers in order to be constructor independent. They think that the fifth, sixth and seventh layer are still inaccurate and not very well defined. (AV)

Let us detail now the new network which will centralize and integrate all the previous networks.

It will be a private X25, a switched network based on 64 Kbps leased lines with two entry nodes into the central system. Each agency will be connected either to 2 PADs (Packet Assembler Disassembler) at the entrance of the network or to only one PAD and to DCS in case of problem.
(AVI)

There is no operators staff but the BBL has established the CNAS centre (Centre National d'Aide et de Surveillance - Help and Control National Centre). In case of problem, the agencies call the CNAS which hires 20 people services (systems engineers, mainly). (BI)

The CNAS uses control and management tools and trouble-shooting measures with a computer that's dedicated to the control of the network. Like CGER, they use a part of the bandwidth (around 75 bauds) to check the modems signals and switch the remote processors in the agencies ON/OFF. (BII)

If the problem is out of the CNAS intervention field, it calls the adequate people: RTT or the constructors (2h30 is the maximum repair time for any device on the network). (BII)

User intervention is absolutely minimal. The processors are activated from the CNAS and, where new software releases are necessary, they will have been down loaded overnight by batch transmission.

But a new kind of users, inside the bank, is the customer himself. BBL has launched the new concept of "self-bank": the client enters his transactions on his own. The guidance is very important and the last source of errors might be the transactions amount, that's why the program asks it twice. The program is made like a decision tree: each choice leads the customer further in the different arcs. The software is written by the BBL programmers. (CI - CII)

5.3.3. Générale de Banque.

The Générale de Banque services are various and there are many networks to provide them:

- the agencies network (G-network, 1100 agencies)
- the 6 regional centres network
- the arbitrage network
- the CEC connection from the 6 regional centres
- the international connections :
  - a telex network with the abroad agencies
  - a connection to SWIFT

We focus on the G-network (or G-net) which integrates the connection from the regional centres to the agencies.

The data are financial, transactions on clients accounts, arbitrage orders,... (Al)

G-net is a X25 private packet switching network that's limited to Belgium (see figure 5-4). It is installed since mid-1985. Its architecture is based on four essential components:

- the availability in each of the 1100 branch offices of a mini-computer (PDP from DEC) equipped with a disk containing mainly programs and a customer data base, terminals for the input of banking transactions and printers. The main objective of this system is to provide easy and rapid data input and to allow their validation based on locally available information.

- 6 regional data processing centres equipped with IBM or compatible mainframes (connected to each other by a SNA network at a line speed of 64 Kbps) and front end processors.

- a private X25 packet switching network allows for communication between branch offices and data processing centres. It is provided by Northern Telecom. The agency processor is connected to the network through a 2400 bps modem .
  The network is used in its first phase mainly to transfer all banking transactions validated in an agency to one of the regional processing centres where a serie of batch programs update and consolidate the customer data base; before opening of business in the morning the local data base on the branch processor is updated through the network.

- a control Centre responsible for the real time operational surveillance and maintenance of the complete system (Network Control Centre - NCC - and Data Collection Centre -DCC -).

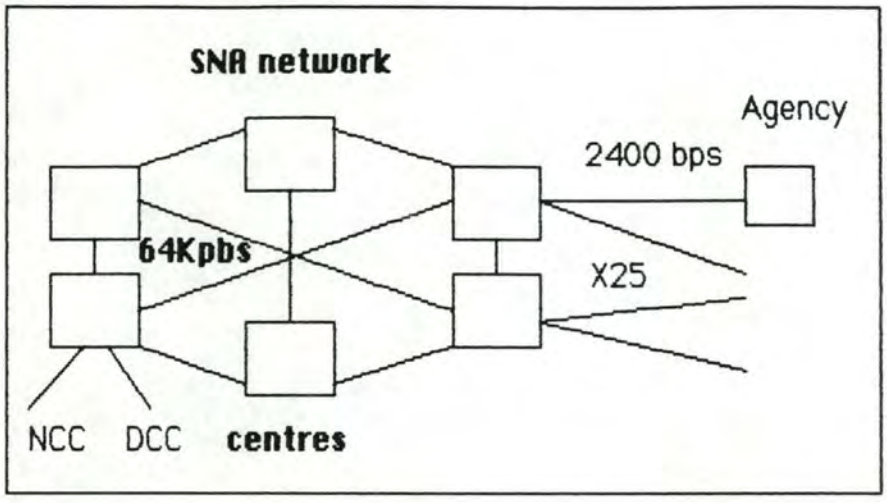

Fig 5-4. Générale's network principle.

Each centre is an SL-10 node: that means that it is provided with the Northern Telecom SL-10 Packet Switching system that contains the hardware software and management capabilities required to implemement data network facilities. The complete network incoporates one or several SL-10 nodes, each consisting of multiple processors which can accommodate hundreds of communication lines interconnecting a variety of host computers and terminals.

One SL-10 node is designated as the NCC.

The protocol between the regional centres is SNA but between the regional centres and the agencies, it is GNA (G-Net Architecture). There are SNA gateways in the regional centres to allow communication between an application in the branch processor and an IMS (from IBM) application in the host, thus offering a real-time enquiry service on the customer data base of the centre (see figure 5-5).

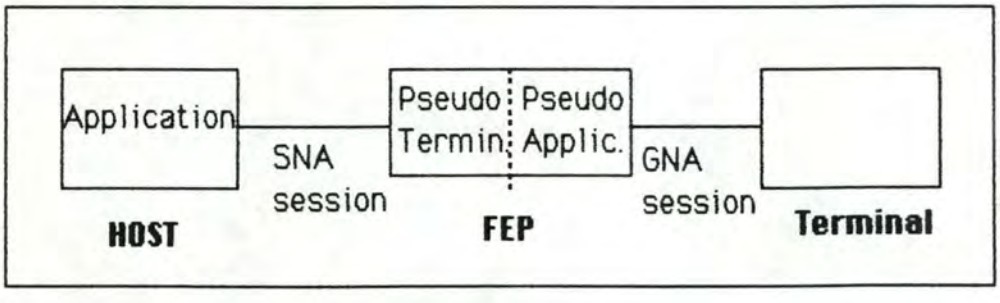

Fig 5-5. SNA/GNA gateway.

This network looks like rather decentralized because the 6 regional centres are at the same power level and manage everything regarding their own agencies, even if there is only one network control centre. The data bases are decentralized. (All)

The main reasons for this choice were:

- to provide the Générale with a telecommunication network able to support all present and future needs.

- to install an "universal" and "open" network whose access protocols follow internationally agreed standards. This type of network is independent from any manufacturer and provides easier interconnection of multi-vendor systems.

- the communication architectures offered by IBM or DEC at the time of the choice did not meet all Générale's requirements:

    - SNA did not provide for branch to branch communications and the access of an agency to any of the six regional centres was not possible without the intervention of the local centre to which the agency is connected.
    - DEC did not provide any communication controllers (like IBM's 3705) and the routing functions have only been implemented in later Decnet releases; the non availability of an X25 package led Générale to the decision to implement its own communication architecture.

    - The choice of an open network provides the possibility to combine some of the individual networks installed by the Générale into a single data network and therefore to reduce the line costs. (AIII)

G-net is a X25 packet switching network, thus all the rerouting facilities are provided in case of failure on the network. The end equipments are still susceptible of failure and have to wait for the repair. (AIV)

The GNA (G-net architecture) corresponds to the OSI model: the first three layers follow X25 set of protocols.

The Network Communication Manager (NCM) use in GNA provides all functions of a Transport station and corresponds to the level 4 of the OSI model: this layer is the first to implement an end-to-end protocol across the network between communicating systems and provides higher layers with an interprocess communication service.

Several higher levels (OSI layers 5, 6 and 7) have been developed by the Générale.

The fifth level, called NRT in Générale terms, provides from all of the functions that are generally described to a session entity, only those which are meaningful to an interactive mode of operation, leaving aside those which are more aiming to batch-like operations. More special is the function of real-time enquiry between an application on the branch processor and the IMS application in the host.

One of the first service that has been developed was a kind of "file transfer protocol", allowing the transmission of batches of transactions between the branch offices and the regional centre.

Other services have been implemented, the most important ones are:

- a kind of virtual terminal protocol allowing distant operator access to a branch office system from a NCC terminal.
- a real time protocol taking care of alarm and command transfers to and from the NCC... (AV)

After that, it's obvious that ISO specifications are fundamental at the Générale's managers point of view. The OSI model is the basis of their new network and they want to integrate as many other networks as possible on the G-net:

- the telex network will be replaced by G-net
- the connections from the Générale's centres to the CEC might be replaced by one link from the Brussels G-net node to the CEC.
- the arbitrage network is going to improve its telecommunications aspect and also the applications.

They want to allow the continuous transmission on the SWIFT's network.

All the new applications are thought in terms of G-net compatibility. The Générale wants to anticipate the future by taking into account all the needs (namely, the integration of the international traffic) and by following the State of Arts in telecommunications. (AVI)

The network management facility is provided by the NCC and the DCC. The NCC provides real-time, operational surveillance and control of the network while the DCC includes such administrative tasks as report generation, service data entry and software storage, at the Générale, the DCC function is implemented on a PDP 11 system.

The NCC is the nerve of the network. It is multiply connected to the network and is in continous direct contact with each network node, monitoring their behaviour and activities.

The NCC is equipped with disks for storing data (call accounting information, fault alarms and traffic statistics) collected from each node, and a number of display and hard copy terminal consoles for real-time network monitoring and diagnostic probing by supervisory personnel.

Each network node continously generates performance data to the NCC about its own behaviour, its internodal trunks and its user access lines. The information transmitted is grouped into two general categories:

- On-line fault detection
- Performance statistics

Network supervisory personnel are notified about any fault by means of an alarm report, displayed on the alarms console, together with an audible alert signal.

The alarm source may be sofware as well as hardware. Another NCC terminal displays all active alarms in the system.

Network status information is similarly updated and displayed at the NCC. It provides a synopsis of three elements:

- Throughput
- Resource statistics
- Errors statistics (errors, failures and resource shortages)

The Network Operations personnel alerted to faults or degradation conditions can quickly take corrective action by issuing local or remote command on their terminals. Commands can execute test procedures, disable/enable hardware, query statistics counters and service data, and selectively access memory.

The DCC need not be on-line with the NCC. It is connected to the NCC by means of a synchronous X25 interface. Periodically, currently every 20 minutes, the NCC establishes a connection with the DCC and dumps all the network data it has collected and stored on its disk since the last dump. The DCC archives the data, sorts it, and organizes it into a coherent file structure for independent asynchronous interaction by DCC users (network planners, accounting groups,...) (BI-BII-BIII)

The users are the same as in all the banks:employees. The softwares are written by the Générale. (CI-CII) [GEN87]

The Générale is the most important promotor in the Mister Cash network which is managed by the CIG company.

5.3.4. AG (Visited manager: Mr Van Hercele)

This company is an insurance firm and the services it provides are quite different from the banks services we have seen before.
These services are

- the insurance production by brokers
- control and development of insurance application softwares
- administrative applications
- work for the Metropolitan Bank and Finance

The data on the networks are the insurance transactions: the brokers fill up the screen of preprogrammed transactions (policies, disaster treatment,...).

There are about 100 000 transactions a day, each transaction needs the filling of an average of 3 screens. That means that about 300 000 screens or dialogues are going end-to-end. (AI)

The AG's networks extent are limited to Belgium.
There are two networks according to the host type (located in Haren).
There are mainly two mainframes:

- a Honeywell Bull DPS 88/82 (2 GCOS-8 processors) used for the insurance production
  plus a quadri-processor DPS 8/70 for the control and development.
  These two first mainframes use the same data base (70 Gigabytes).
- a IBM 4381 used for the administrative job and by the Metropolitan.

Each one works in transactional, time-sharing and batch overnight.

Let's detail each network:

Connected to the first Honeywell Bull processors are 1000 terminals and to the quadri-processor, about 100 terminals.
The interesting part is the connection from the first mainframe to these 1000 terminals.
The host is connected to a Datanet front end processor .
This FEP is designed by Cii Honeywell Bull too. To the FEP, through the modems, are connected the remote Datanets inside the branches. The line between the host and the remote processor is a HDLC/X25 48 Kbps leased line. It is a private X25. The Datanet inside the branch serves many cluster controllers and to each cluster are connected 16 terminals (in 3270 BSC mode) (see figure 5-6).

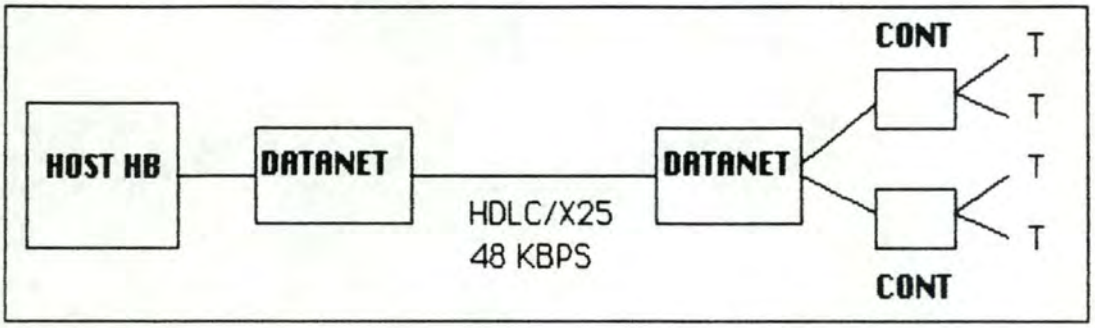

Figure 5-6. Honeywell Bull network 's principle.

These remote Datanets are also the origin of 9.6 Kbps lines to smaller offices. This type of Honeywell Bull's network is called DSA (Distributed System Architecture).

The other network, linked to the IBM 4381, is a SNA network which works with VTAM and IMS.

There is a 3705 front end processor and 9.6 Kbps lines to the IBM 3274 cluster controller . There is also a connection to a Burroughs B26 cluster controller in the Metropolitan (see figure 5-7).

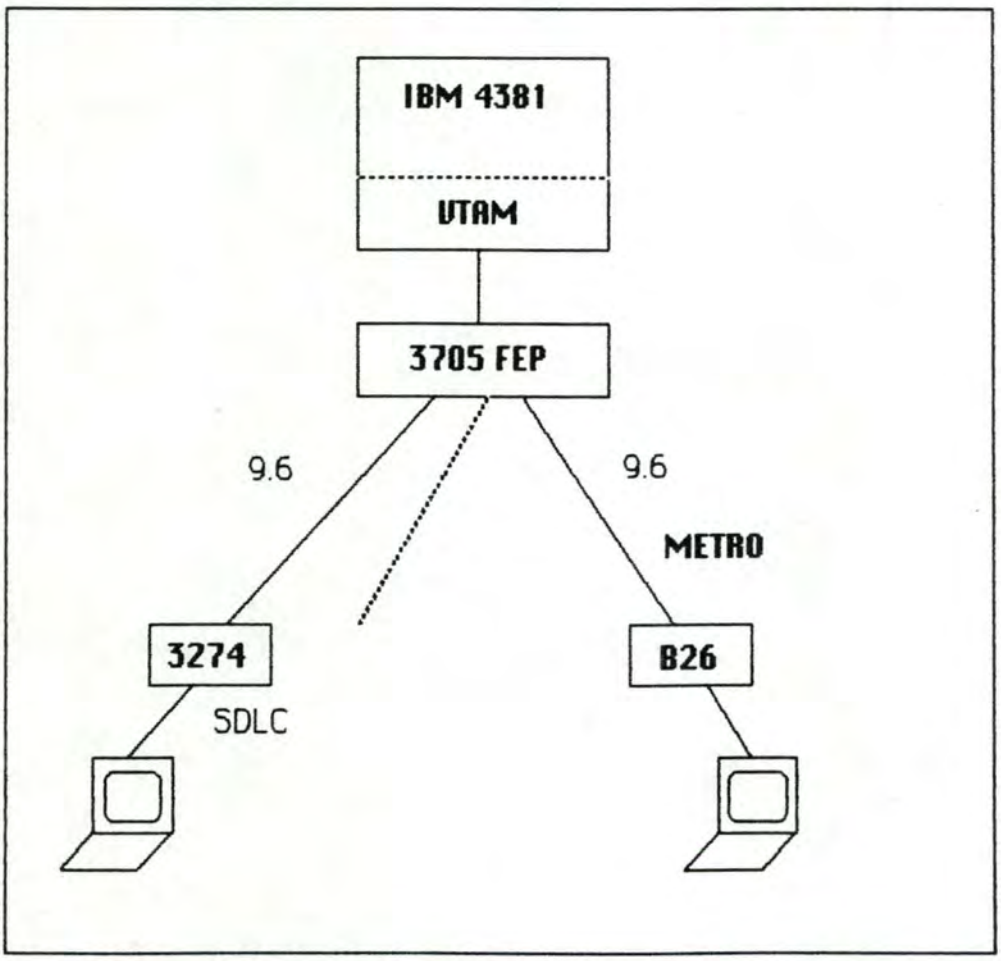

Fig 5-7. AG 's SNA network.

We can see that these networks are very centralized, all the processing takes place at the same office (Haren). (All)

These networks aren't real time networks because the updates in the main data base take place overnight only.
During the day, for each enquiry, there is a first input/output in the movements file that keeps the current updates to checkif the data has been modified and otherwise a next try in the main data base happens.
That means one more input/output operation for each enquiry but keeps the data base safe. So, the data base is accessed in consultation only except during the merge with the movements file overnight. (AII)

The choice motivations are historical, this configuration exists since 1975. The managers think that SNA/VTAM are good softwares and that it is difficult to choose between IBM and Honeywell Bull. That is why both of them coexist. (AIII)

The back-up solutions have been provided at different levels
- the branches dispose of spare Datanets
- if a 48 Kbps line goes down, the first idea was to use DCS as back-up but it has appeared as too weak (at both hardware and software levels) and unable to support the whole traffic.
  The next idea, which is the final solution, is to link some centres between each other and to use the load balancing facility of the Datanet (see figure 5-8). (AIV)

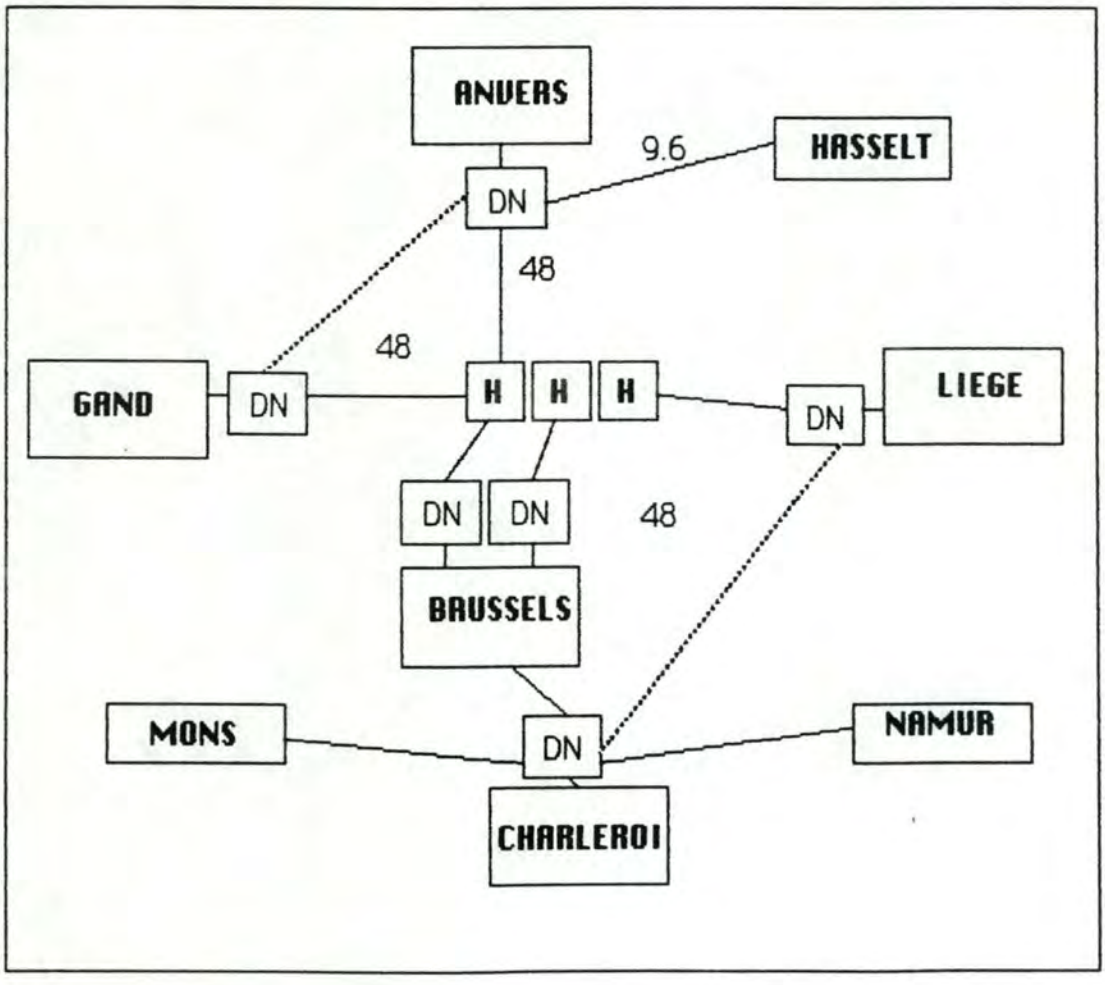

Fig 5-8. AG 's back-up solution

The Bull DSA is OSI-like up to the fifth layer. The DSA and SNA are not compatible, they need a special converter between them.
AG reckons that the ISO model is very important, also because IBM gets open to it. (AV)

The improvements that are on their way for the moment are

- the link between the DSA and SNA through a special Datanet called Janus (see figure 5-9).

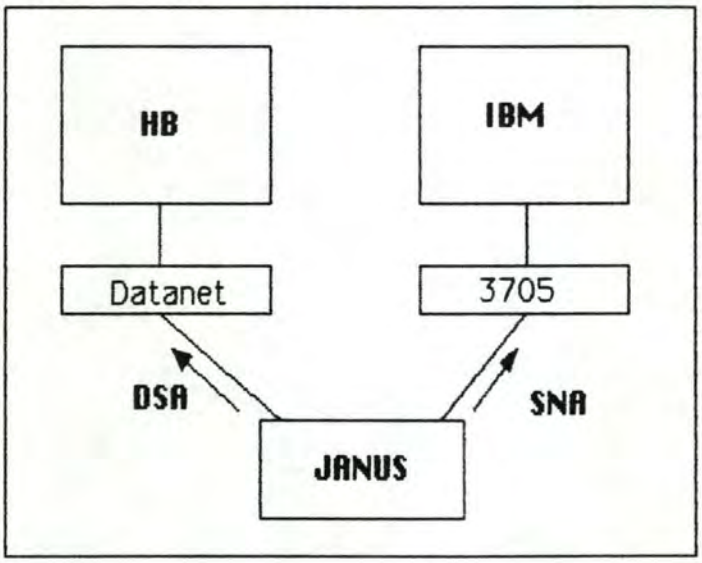

Fig 5-9. DSA - SNA link.

- the connection from the Honeywell Bull host to the IBM 4381 of Assurnet (another insurance company) through a X25 link . (AVI)

The operators staff is divided into many systems engineers at one hand and the user help desk at the other hand. This help desk functions are summarized in a document in annexe. It is a very good list of the objectives, actions, tools and formation of any user help desk. (BI)

The main way of problems detection are the phone calls and the consoles. (BII)
The reaction is to call the specialists: RTT or manufacturing companies (Bull,...) to cure the hardware problems and the AG's programmers for the software troubles. (BIII)

The insurance brokers that use this first network know how to fill an insurance act but that's all. Once a year, there is an half-day readaptation courses for them at the computer science point of view. The application softwares are written by the AG's programmers. (CI-CII)

5.4. Comparison.

For each question, we shall compare the answers from every company (including Prudential-Bache). The tables 1 and 2 may help to remind shortly the different answers.

The AI question concerning the services provided by the networks and the type of data don't differ very much from each other: they transmit the same kind of data (enquiries,transactions,...) even if the services are provided to a variable number and type of people.

The network topology question (AII) shows many kind of networks: SNA, DSA, private X25 networks,integration of many different networks and of course, the Prudential-Bache's network topology, which counts one mainframe and concentrators at many places. Except the Générale de Banque, all of them are very centralized: the control and the informations are in one place only (the hosts location, most of time). This might be explained by the confidential aspect of these informations. The Générale has chosen to spread the data bases among six centres and to take care of a rapid communication between each other. That is another option that requires six hosts installation and is probably more expensive.

The topology is always lying on leased lines. The RTT's DCS has still not convinced the bankers which think it is to weak and unable to support the whole traffic. One of these managers said that if DCS was dealing with their entire traffic (and it is still not proven it could), it wouldn't be able to transmit anything else .

In comparison with the Prudential-Bache's network, we remark some major differences: all these last financial networks are limited to Belgium while Prudential-Bache's network extends to the world but also, the Prudential-Bache's protocols level is the lowest. The other networks are more developed and look like safer.

The motivations (AIII) in the current configuration choice are different but a trend comes clearly out of the discussion with the managers: they want to integrate their different services on an unique network (as G-net, the future BBL's network, the CGER's SNA and Prudential-Bache's network). We see that for this new network, the OSI model is important in a concern of "open" network as well as in a concern of constructor independence.

Among the motivations, the economical reason is never forgotten, of course.

The security of the network (AIV) and the back-up possibilities are very well studied. Many solutions are provided to any kind of failure. BBL is the exception at this point of view: they don't provide back-up solutions because they think that they have designed a very reliable network. This is one of the back-up options : the "forteresse" state of mind.
When the failure is due to a hardware problem, the companies have maintenance contracts with the manufacturers in order to get a fast repair service (most of time, they define a repair delay).

We have said that OSI of ISO (AV) has a definite place in the network managers mind: some of them think that only the four first layers are usable (BBL, Prudential-Bache) and the remaining three layers need greater development to make them acceptable (G-net).
The ISO model looks like being the basis in any future financial network design.

The future of their network (AVI) is always in terms of integration or linkage: they plannify a new network that's going to integrate all the services (BBL's concern, G-net future, Prudential-Bache's concern) or they want to link the existing networks with each other (AG). When their network is young and as strong as SNA, they focus on the applications (CGER).

Besides the technic of the network, the bank managers never forget that without people to take care of it, their network isn't viable. They generally install a user help desk and a technician staff, all with the best help tools. Their kind of reaction is rather common to all the companies and are listed in the document based on AG's documentation in annexe 2.

The users are always the same: bank employees, insurance brokers, financial brokers, or the customer themselves (self-bank in BBL). The companies try to provide everything to avoid them any problem with the network utilization (remote switch on/off). Some of the companies provide readaptation courses to the communications improvements.

We have noticed that the Générale and BBL are connected to the SWIFT's network. Although this network doesn't match our definition of a financial network, we present its objectives and configuration in annexe 3.

	CGER	BBL
AI. Services - Data	Agencies - Teles Financial data	Agencies, centres, travel agencies,... Financial data
AII. Topology	Host in Brussels - Minis in agencies SNA network between them Very centralized	Multipoint network between agencies Multipoint network between travel agencies New network: private X25 Very centralized
AIII. Motivations	Need of an unique architecture Why not SNA ?	Appropriate technology Functionality/ Economical Reason.
AIV. Back-up	Provided in each case: facility of the Philips'mainframes to work off-line.	No back-up. DCS for new network.
AV. // ISO	Interested, ISO/SNA interface for Teles.	Interested to the 4th layer, for the new network.
AVI. network future	Happy in the current situation. Focuses on applications.	Integration on the new X25 Packet Switching network of all the different networks.
BI. Staff composition	User help desk/ Network control centre.	CNAS = special centre to take care of the network.
BII. Help tools	700 system from Telindus - other consoles.	700 system from Telindus - other consoles.
BIII. Reaction	Sort out the problem - Call the adequate people.	Sort out the problem - Call the adequate people.
CI. Users type	Employees - Customers (Teles) No computer science knowledge.	Employees - Don't do anything (remote switch on/off).
CII. Application soft origin	CGER	BBL

Table 1. CGER's and BBL's answers.

	Générale	AG
AI. Services - Data	Agencies, regional centres. Financial data	Agencies, connection with Metropolitar Insurance acts
AII. Topology	G-net: agencies to regional centres connections. X25 private packet switching SNA between centres. Rather decentralized.	2 networks : DSA (Honeywell Bull) network. SNA network Very centralized.
AIII. Motivations	Open network, following standards Integration of all networks.	Historical, coexistence of IBM, Honeywell Bull.
AIV. Back-up	Provided by the G-net software and the many lines connecting the centres.	Load balancing between centres Datanets are reliable.
AV. // ISO	G-net = 7 layers // ISO More than interested	DSA goes up to the 5th layer Interested.
AVI. network future	Integration of every network on G-net. Applications developed for it.	Link DSA/SNA through JANUS
BI. Staff composition	Network Control Centre and Data Collection Centre.	User help desk and technicians
BII. Help tools	NCC and DCC consoles and software.	Consoles - phones.
BIII. Reaction	Call the adequate people, reaction if simple problem.	Call the specialists if unable to cure the problem.
CI. Users type	No computer science's knowledge	No computer science's knowledge Utilization readaptation courses.
CII. Application soft origin	SGB + CIG concerning Mister Cash	AG

Table 2: Générale's and AG's answers.

CHAPTER 6.

Some considerations on the design of a financial network.

6.1.Introduction.

This chapter on the design of a financial network aims to study different alternatives to Prudential-Bache existing network and therefore, collects all the features and requirements these alternatives have to satisfy.

To achieve this goal, we base ourselves on the features of the current network (chapter 3), on the comparison with other financial network configuration including the differences we have mentioned (chapter 5). We don't forget the cost and human point of view (chapter 4) and detail the users and managers requirements. These alternatives have to help Prudential-Bache in its purpose (chapter 2).

Here is the list of the main general network design objectives [CYP78] :

the dependability : the architecture must provide for the following :

A. A very high probability of continous availability for a specified subset of the total network functional capability (at least).

B. Autonomous recovery from errors at the lowest functional level feasible, with no effect on higher functional levels.

C. A systematic passage of error/status information to higher levels for those cases where recovery is not achievable at the lower level and must be handled at a higher functional level.

Examples of specific facilities aimed at these objectives are the automatic retransmission at the data link control level, an alternate path capability at the path control level (provided by Prudential-Bache's network).

price/performance:
continued emphasis is placed on total cost and on performance in its broadest sense of the value to the user. System structures that help to reduce costs for systems development, operation, and maintenance are particularly important to the improvement of overall price/performance.

accessibility and usability:
the growth in the number of users depends, particularly, on the usability of the system, because of a limited skill level among users. Complexity of the system that is irrelevant to the use of the system must therefore be shielded from the user. Well-defined user interfaces should have subsets for users with different skills.

changeability:
the systems stucture must facilitate the tailoring of the system design, in both hardware and programming, to meet the evolving needs of the individual installations. Applications must be permitted to be independent, of the communications system and, to a large extent, independent of the peculiar characteristics of the remote end-users. Communication function and protocols should be largely independent of box architecture (hardware and software) and independent of the user-interfaces employed in individual products.

diversity of transmission facilities:
the structure must permit the exploitation of different transmission services in different parts of the same network and must change that service as the circumstance warrants it.
The primary choices to be anticipated include:

1. Choice of communications carrier (for example, a terrestrial voice carrier, a satellite carrier, a packet carrier,...).
2. Choice of service of a particular carrier (for example, non switched or switched service), and a particular bandwidth depending on tariffs, geographic dispersion of destinations, and anticipated traffic.

The problem is to find if the actual network reaches these objectives and if the proposed alternatives do.

The three main alternatives we shall study are a SNA network (Prudential-Bache is very IBM-oriented regarding its equipments); VSAT (Very Small Aperture Terminal),a communication system that is tested from the moment at Prudential-Bache New York: this system consists of an antenna and a dish on the roof of each branch and all the transmissions would go through satellite and finally, the actual network configuration as it is with important improvements.
We shall present these alternatives in the next sections.

Let us see if the actual network meets the previous objectives:
the dependability aspect looks like warranted, the price/performance ratio is not easy to calculate but Prudential-Bache seems satisfied at this point of view, the accessibility and usability don't look like too bad, most of the users got used to this network rather quickly. The changeability is, at the author point of view, a reef. This network is very dependent on the multiplexers configuration and the emulation that is supported by them. It is obvious that if changes have to be made, all this configuration might drop. The diversity of transmission facilities is provided by leased lines and satellite lines.

Let us detail some other inconveniences of this network:
This network is fragile because it relies too much on London communications centre functionment (nothing is provided in case of disaster of the centre or power failure, except the telex but it is a bit slow). Also there are too many intervening nodes and multiplexers between the end devices (Munich and New York, for instance). All these nodes and leased lines are sources of failure.

There is no end-to-end control: the control takes place on each small part of the network between two successive nodes but New York can't obtain a retransmission from the sending side without human retyping.
This network's lifetime ranges from 2 to 4-5 years according to the different managers in London communications centre.

There are good points in favour of this network: the author has noticed that the leased lines speeds have been very well chosen, there are no bottlenecks at this point of view even at peak hours. This is one thing that is going to be kept in the network design.
Indeed, the author thinks that it would be difficult to choose anything else than leased lines for an international network whose response time is crucial with an heavy traffic.

6.2. Users requirements.

6.2.1. Usual users requirements.

There are common requirements to all the financial networks: the great availability and a fast response time (< 5 sec). The users require well-defined interfaces that are easy to use, that prompt messages clear enough to the user.

At the hardware point of view, they need a fair amount of terminals and printers and these devices must be standardized and not too complicated.

They also need a good and clear documentation, manuals about the software and hardware.

If there are any back-up procedures, they must be easy to use and as efficient as possible (the ideal is that the back-up is almost as good as the original system).

6.2.2. Special Prudential-Bache's users requirements.

The brokers need an increased avalaibility and a faster response time. The availability is crucial: when the network fails, there is a large amount of money lost every minute, especially at the opening of the New York Stock Exchange. The brokers world is an hectic and hurried sphere and thus, the response time must be fast enough.

The Prudential-Bache's brokers use many softwares: the Reuter Monitor Dealing service and ERA (and switch in the operations room). They need a very fast mean to switch from one to the other, to monitor many markets in a short delay. There are special keys on the keyboards that allow to jump from a screen to another. A multiwindowing facility is welcome at this point of view.

The reliability in the sending of messages is very important: it is crucial to the operator (in the operations room) to know if an order has arrived to New York and if it is accepted or not.
Currently, there is an "ack" prompt on the screen after a checking in New York of the sequence number and of the contents with the repetitive fields to make sure the amounts and other details are correct. This system might be improved, according to the users.

The brokers need a fair amount of large screens: some of them are hung from the ceiling to enable the users to keep an eye on the prices of the main currencies and commodities. The printers are very important to receive the bills overnight.

6.3. Network managers requirements.

This paragraph is a summary of what has been detailed in the fourth chapter about the management difficulties and the solutions to them.

The managers require the necessary tools and consoles to control, monitor the whole network. They want the best tools able to show a general picture of the network and zooms on the different nodes (cfr the ANM800). Statistics, alarms and historics must be provided too.

When there are many control centres on the same network, there must be reglementations to avoid that they interfere in each other's work.

6.4. Economical situation.

The economical aspect gives a certain basis to this network and to two of the alternatives : SNA and the current improved network. The first idea is to keep the leased lines between all the branches at a determined speed. The author has calculated that they have been chosen at a very good rate. The traffic is too heavy and irregular (with high peaks) to think of any switched network if it is used for all the traffic all the time. Internationally speaking, it would be difficult to organize.

The line between London and the States must be a satellite one to reach the convenient speed. The T1 circuit, running at 1.544 Mbps, eventually, has saved a lot of money (as it did for the Midland Bank, cfr chapter 3.8) and it works very well. Many London offices are connected to the States through it for their vocal communications too. Prudential-Bache is going to benefit from its growth capacity to connect other branches through it.
However, at the beginning, the author doubted about this circuit because the 56 Kbps satellite line was used at an average of 15% of its capacity and presented peaks that used about 35% of its capacity. It seemed then that 56 Kbps were enough for the usual traffic. The voice communications cost between Europe and the States had to be evaluated. Eventually, the T1 saves money because of the heavy and long telephone communications between the States and mainly London.

Another basis of the network that can't be avoided is the London communications centre. New York head branch dream would be to connect all the European, Far Eastern and Australian branches directly to the New York centre as it is for the network in the States but the cost of the direct leased lines to the States would be just prohibitive.
The cost of a communication centre with a whole staff was enormous too but unavoidable.

So, we have a leased lines network running from the branches to the London communications centre and besides there, to New York.

Let us notice that the VSAT system might change this basis completely: the leased lines and communications centre might disappear, all the traffic would travel via satellite.

From there, we are looking for the cheapest protocols and software equipments whose functionment meets the objectives we have mentioned in the introduction (cfr 6.1.).

The cost of the existing network is a confidential information. It is difficult to evaluate exactly the cost of the alternatives that we shall present: the SNA architecture, the improved network and the VSAT system. A complete analysis would take a long time and require specialists.

6.5. Alternatives presentation.

We have mentioned three main alternatives to this network: let us start with the simpliest one that is the same configuration with improvements.

A first idea to reduce the London total failure risks is the installation of two multiplexers instead of one. Each one would support half of the traffic and the risk is divided by two: half of the branches would be in trouble in case of failure. Prudential-Bache keeps that in mind.

Another idea concerns the back-up. The order entry function is the most critical one on the network. Prudential-Bache is thinking of a back-up that allows a faster data rate than 50 bauds (cfr the previous telex system). and provides the ERA display functions. They are going to use the packet switching networks installed in the different countries: they are testing it between New York - London (via a X25 link) and the German offices. That would be used as back-up only because of the cost with a heavy traffic.

Another idea was to imitate the Merril Lynch company's network (the main brokerage house in the world) in that sense that they have installed a second communications centre in Europe, with the same kind of network configuration as Prudential-Bache. This second communications centre is in Switzerland. The idea is that the Swiss centre backs up London and London backs up the other.
According to Prudential-Bache managers, it is not quite a good idea. It is difficult to get both centres updated at the same time. It takes hours to transmit the last updated data from one to the other and that is useless most of time, because of the low failure risk. Besides, the cost of another communications centre installation plus the necessary additional lines is prohibitive.

The second alternative that is tested for the moment in New York is the VSAT solution. This concept is the use of small dishes on branches premises . It is a broadcast facility: everybody receives everything but branches select what they are interested in. There might be a problem of data security and to solve it, Prudential-Bache would think of encyphering the messages even if it requires the encryption delay before the transmission.

Another problem with VSAT in Europe concerns the RTTs' agreements. Compared with a leased line crossing the border for which each national telecommunications company at each end gets half of the bill, they lose everything with that kind of system.

That is why it is more popular in the United States. Europe is not the best area to use this system with all the borders and different telecommunications companies. The terminals are rather cheap but the use of satellite channels is not.

The last alternative is an SNA network. This solution had been proposed before the installation of the existing network but has been rejected for many reasons. Two of them are that the Binary Synchronous Emulation cost is lower and that the multiplexer was already half-installed in London. The whole system would be cheaper.

The choice was between a multiplexer and a front-end processor in London. An SNA network requires this front-end processor and all the staff operators should be able to work on that and know the basic ideas of the operating systems (CICS, VTAM,...).

However,according to the London managers, it would be a good solution for ERA.
According to R.J. Cypser [CYP78], SNA provides the following attributes:

- it is highly transparent: the end-users are not concerned with the network topology and any stream of bits is allowed.

- It facilitates the masking of particularities that are not relevant to the users.

- It facilitates the provision of important services, including safeguards of data integrity, end-to-end data security, end-to-end flow rate control and user specific data formatting.

- The services are optionally selectable.

- It subdivides the responsability for SNA network management to suit the organization of the users.

The problem is that SNA, according to the managers, doesn't provide a "utility network" concept. The equipments, indeed, must be constructed by IBM from the host to the terminals in order to have a very reliable and changeable network. Otherwise, difficulties might appear. This is the major inconvenience according to them.

This is a short presentation of every alternative. Let us see if they meet the general network design objectives.

The first solution keeps the advantages of the current network, namely its good price/performance ratio, and tries to erase the major inconveniences that are the fragility due to London centralization and the slow and partial back-up. But the author thinks that the changeability objective is still not provided by this network.

The second alternative (VSAT) is the most undetailed one so far. Knowing the basic principle only, it is rather difficult to forecast the difference for the users and managers. Would the London communications centre still be useful or would the traffic travel directly from New York to the branches? The price/performance ratio should be rather good, the reliability would be critical because the transmission through satellite depends on the weather conditions for a part. We have seen that the traffic may be interrupted for this reason. The major question is whether this solution is feasible or not considering the international aspect of the network and thus the different national telecommunications companies agreements.

SNA would probably be a bit more expensive even if the basic equipments are already existent (however there might be problems with the end terminals from Reuter). The dependability and usability aspects would be provided by this kind of network architecture. The changeability with all the layers provided by SNA shouldn't offer any problem.

6.6. Choice possibility.

It is very difficult to advice one or another of the alternatives. Indeed, this kind of study may last many months and requires more informations than what was accessible to the author, especially the costs specifications.

The choice must meet the users and managers requirements and the general design objectives that we have mentioned as far as they can.

In order to make this choice, we can rely on the experience of the Belgian banks with their own networks. The SNA networks looks like completely satisfying from the CGER point of view.
The Générale has developed its own seven layers networks but that looks like a bit complicated according to Prudential-Bache requirements. They won't offer the time and money to develop these services by themselves.
The AG's situation is quite different from Prudential-Bache: the equipments are different and its main problem is the integration of the networks while Bache has enough with one network.

Prudential-Bache is interested in the back-up solution of the BBL's network that consists of using the national packet switching network. This back-up solution can match with any of the three alternatives.

The Prudential-Bache managers, when interrogated on this subject, don't agree on the alternative solution, hesitating between VSAT and SNA.

But it looks like the situation is going straight to an SNA network. Rather shortly, London will dispose of a IBM 3090 to deal with the London Stock Exchange trades together with the Stratus. BY this way and the addiction of a 3720 front-end processor connected to it, a SNA network is easily installed (see figure 6-1.).

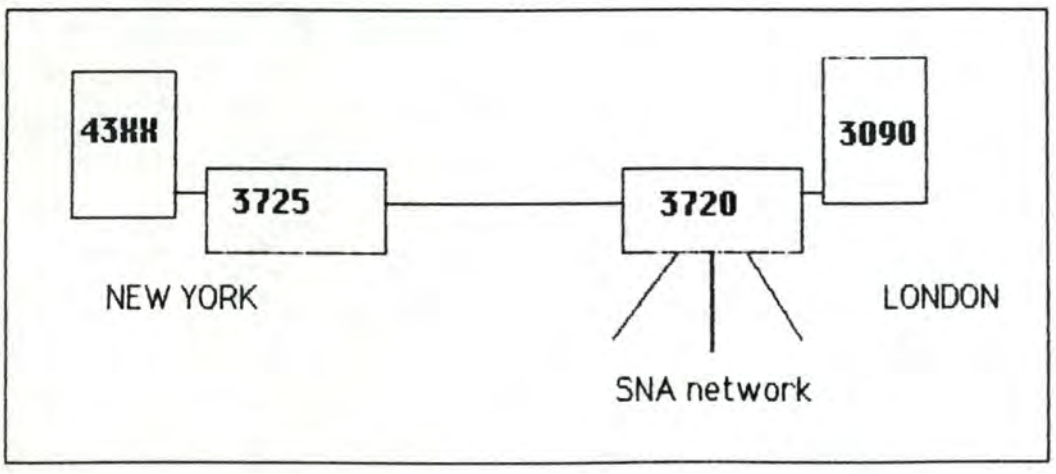

Fig 6-1. Prudential-Bache's SNA network.

This is why the author thinks that the best alternative that follows the CGER example, that matches with the IBM trend of the company, is a SNA network. It looks like meeting the users and managers requirements as well.

Conclusion.

The objectives of use, management and design of a financial network are the centres of this memoir.

After specifying what we call a financial network, we focus on an example of an international company who completes the installation of its new network in which the author has been involved. This company, Prudential-bache Securities, serves as the model for a network design research; this is why we specify first its purposes, activities and technically speaking, its actual network configuration with its advantages and inconveniences.
The users and managers are very important too : the use is the basic reason of a network, the management is the service offered to the users in order to provide the best work conditions. These concerns might not be forgotten in the design of a network.

To extend to scope to other financial networks and provide a basis to a comparison or design choice, the author made up a questionnaire that has been proposed to four major financial companies: the CGER, Générale de Banque, BBL and AG. This analysis leads to a comparison that stresses the common concerns regarding the use and management but also the differences between the configurations and design objectives. The four situations are different and thus present a good sample: a SNA network, a seven layers network designed by the company itself following the ISO standards, a X25 private packet switching which is in project and an effort of integration between networks with different functions and equipments. The author also wanted to check the ISO concern in these managers mind and it appears that they get interested in it and try to reflect it in their network design.

This sample shows what exists in the financial companies and help us in the design research concerning Prudential-Bache. The question is: considering the inconveniences of the existing network, which configuration alternative might offer the best service at the lowest cost ?

The chosen alternative must meet the use and management requirements. Among these alternatives, which are an improvement of the actual network or total changes like SNA or a VSAT network, the author and Prudential-Bache's managers agree for a SNA network, considering the equipments brand too.

An SNA network fills up the general design objectives and the way the London communications centre evolves (new mainframes, controllers) makes easier an SNA configuration.

These design considerations rely on the previous concepts and complete this study.

Bibliography.

[ANM86] :
ANM800, Advanced network manager,Infotron systems, Data communications product, January 1986. Private documentation.

[COMM86] :
Communications management," The Big Bang for City comms", Anonymous,February 1986.

[CYP78] :
Communications Architecture for Distributed System, R.J. Cypser, Addison-Wesley 1978.

[DCO861] :
Data communications," Private T1 networks call for powerful switches ", June 1986.

[EMS86] :
European Message Switch Operations manual,Bache Securities UK,1986. Private documentation.

[ERA86] :
Electronic retrieval assistant easy guide, october 1986. Private documentation.

[GEN87] :
Générale's documentation, 1987. Private documentation.

[INFO84] :
990 Network Processor, Infotron Systems, 1984. Private documentation.

[JUNK86] :
Data communications," A user implements a T1 network ", Bob Junkee, June 1986.

[MACC83] :
Téléinformatique, C.Macchi,J-F. Guilbert, Paris, Dunod 83.

[TELE85] :
Telemetrix: television session layer, 1985. Private documentation.

Figures table.

Tables.

ANNEXES.

ANNEXE 1.

Questionnaire

Questionnaire relatif aux réseaux bancaires.

Banque interrogée : .....
Personne interrogée : .....

Présentation

Je suis étudiante en dernière année de licence et maîtrise en informatique. Dans le cadre de mon mémoire, qui porte sur le management et le design de réseaux financiers, mon directeur de mémoire, Mr Van Bastelaer, et moi-même avons pensé qu'il pourrait être intéressant de comparer différents types de réseaux financiers.

Une expérience concrète de ce type de réseaux m'a été donnée lors d'un stage chez Bache Securities à Londres, au centre européen de communications.

A. En ce qui concerne le réseau à proprement parler

1. Quels sont les services offerts par votre réseau ?

2. Quel type de données supporte-t-il ?

3. Quelle est la topologie du réseau ?

c-à-d sa constitution au point de vue

- hardware (mini-ordinateurs, terminaux, multiplexeurs, imprimantes,.....)
- lignes (vitesse, analogiques, satellites,.....)
- étendue (nationale, internationale,.....)

4. Votre réseau est-il un reflet d'un souci de centralisation ou , au contraire, de décentralisation ?

5. Pourquoi avoir choisi ce type de réseau ?
(raisons techniques, économiques, ...)

6. Quelles sont les mesures renforçant sa fiabilité ?
Quel(s) système(s) de back-up utilisez-vous ?

7. Si un parallèle avec le modèle des 7 couches de ISO est possible, combien des couches présentées utilisez-vous ?
Quelle importance ont pour vous ces standards internationaux ?

8. Quelles sont les améliorations que vous envisagez concernant votre réseau ?

B. En ce qui concerne l'apport humain à la rescousse du réseau

1. De quelle taille environ est votre staff d'opérateurs (gestionnaires du réseau) ? Quel type de formation ont-ils reçue ?

2. Quels sont les moyens de détection de problèmes sur le réseau, qui pourrait les alerter ?

- pour des problèmes majeurs
- pour des problèmes mineurs

3. Quelle est la rapidité et le type de réaction vis-à-vis des erreurs ?

- si préprogrammée
- si intervention humaine nécessaire (avec aide software ?)

C. En ce qui concerne l'utilisateur

1. De quel type est l'utilisateur ?
(utilisateur classique, très pressé, avec une formation informatique)

2. De quels softwares dispose l'utilisateur ? Ont-ils été conçus par vous ?

ANNEXE 2.

User help desk functions.

Help desk functions.

The author would like to thank the AG for the documentation which is the basis of this user help desk functions summary.

Objectives.

- To maintain and improve the service level to the users of the AG's network through a fast and efficient management of the calls (for informations, complains, problems,...).

- To measure at every moment the received availability at the final user level.

- To measure the satisfaction degree among the users.

- To be the central and unique point of welcome for the users.

Actions.

- Uninterrupted control of the network behaviour during the work hours (internal control).

- Get all the calls from the users (external control).

- Take in charge, record and answer to every call: to inform the user in a fast and short way.
  Never forget to welcome the user.

- End every call either right then or later on.
  If a rapid action is impossible, call the user back within 30 minutes.

- If it is a call concerning an incident, make a first level diagnosis and take the relevant measures to reduce the incident consequences.
  - either the help desk is able to cure the problem immediately
  - or the help desk isn't able to : the incident becomes a problem.
    In this case, the help desk explains that to the user, makes contact with the team which can and must intervene to make a diagnosis and take actions to avoid or cure the problem.
    Internal teams: development, management, technicians,...
    External teams: the manufacturers, RTT,...
    Inform the user (< 30 minutes).
    Check whether the problem is really cured and let the user know (= end phone call).

- Establish and send information messages to the users.

- Record all the calls and all the incidents in a log with the user identification, his terminal, his application, the incident time, the type of incident.

- Ensure the opening, closure and restart of all the networks and the on-line applications (for instance, CICS, IMS, TSO,...) in the normal cases.

- Measure the daily response times and record them in a log.

Tools.

- the phones.

- the consoles:

    - observation consoles and monitors.
    - terminals to reproduce the user problem.

- Call reports.

- Log with incidents.

- Documentation about

    - the central system configuration, peripherals and networks.
    - the monitor architecture.
    - the applications list.
    - the users list.

- External intervening parties list with phone numbers.

- Internal intervening parties list:

    - Operating system specialists.
    - Applications specialists.
    - Technicians.

- Technical documentation about the utilization of the terminals.

- Documentation about the user messages.

Formation.

- Basic and readaptation formation for

    - the aptitude to the function (welcome minded).
    - executing the right actions.
    - knowing and using of the tools and the work methods.

Call report "Help Desk".

- Identifications (codes)

    - User id. (name, UID, telephone number)
    - Terminal id.
    - Application id.
    - Date / Time of call, incident time, call(s) back, ending.

- Kind of problem.

- Diagnosis and actions.

- Ending.

This report is an input for the incident management inside the management control used

- for the calculation and statistics about the availability.
- for the calculation and statistics about the satisfaction degree.
- for the propositions of correction, of optimization, of formation, of capacity planning.

ANNEXE 3.

SWIFT's network.

SWIFT's network.

1.Historics.

At the end of the Sixties, the big European and American banks met in order to rationalize and automate the messages transmission between the financial companies.

The result of these concertations was the fundation in 1973 of SWIFT company (Society for Worlwide Interbank Finanical Telecommunications). by 293 of the major banks in Europe, in the States and Canada. The headbranch is in La Hulpe in Belgium. The company has been funded in order to create and manage a telecommunications network that allows the exchange of financial and international messages between connected members.

The system is operational since the 9th of may 1977. From September 1977, 439 banks from 15 countries were connected on the network. The system is not exclusively limited to the banks: Euro-Clear Brussels and Cedel Luxembourg are also members in 53 countries. At the beginning of 1984, 37 of these countries were operational and exchanged 450 000 messages a day.

2. Objectives.

To allow the members to realize financial transactions thanks to an available, fast, standardized and secure system which can be controlled and monitored.

Availability: the system is open 24 hours a day, 7 days a week.

Rapidity: the transmission of a message takes a few seconds. The use of standards to exchange the data of a message allows an automatic treatment and avoids the problems due to a bad interpretation of words.

Security: SWIFT is responsible for the security on the network as far as the connection with the members circuit. All the transmissions on the lines are encyphered. Inside SWIFT's office, all the messages are stored in a coded form, the staff can't read them except the sender, receiver and type of message.

Monitoring: the archiving allows the user to get the details about its sending and receiving if he needs them.

Control: control procedures offer the members the facility of different input, control and checking level.
There is also a sequence control and reports of delivering status.

3. Network.

The SWIFT system is a network of transmission of international transactions that belongs to or is in service of its members.

The system consists of 4 commuters, installed in 3 centres located in the States, Belgium and Netherlands.

Regional processors, located in the different countries, are connected to the commuters via high speed (9.6 Kbps) leased lines. The banks are connected to the regional processor either via leased lines or the switched network.

For security reasons, each commuter is completely doubled. In case of complete failure of a centre, its traffic is taken in charge by the 3 other centres because they are linked to each other. The regional processors are equipped with at least one main line that links the regional processor to the commuter and a back-up line that allows the connection to any commuter. When the regional processor is out of order during more than 30 minutes, the banks which are linked to it, can switch to another processor via the phone network.

4. Terminals.

The banks can use different types of computers to send and receive SWIFT's messages. It might be a SID (SWIFT interface device) which is a specific computer, or any direct connection with a computer that belongs to the bank.