



V.I.E.S.

(VAT Information Exchange System)

A telematic network
for Administrative Cooperation

Commission of the European Communities

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Foreword

With the completion of the single market as from the first day of 1993, fiscal controls at frontiers were abolished. The elimination of these frontier controls results in some substantial practical benefits, such as improvements in the flow of traffic, simplification of procedures, the abolition of numerous documents and lower-priced goods.

Directorate-General XXI is the European Commission department with responsibility for customs and indirect taxation. DG XXI contributed greatly on the legal and technical fronts to the establishment of the single European market on 1 January 1993.

This document gives the background to the development of the VIES project (VAT Information Exchange System) which took place in the context of the abolition of fiscal frontiers. It has four principal aims:

- to describe the administrative background which gave rise to the need for the system;
- to describe the administrative set-up of the project and the various phases of its development;
- to describe the underlying philosophy as it applies to the system and to users' needs;
- to outline certain technical aspects of the system.

The reader should therefore be selective according to his requirements. The document does not pretend to cover every aspect of the project in detail, so readers requiring detailed information should consult the relevant project documentation. A bibliography of the documentation available is annexed to this document.

We should like to point out that the desired objective has been achieved as a result of close technical and administrative collaboration between Member States and the Commission. As far as we are aware, the linking of twelve European administrations by computer systems working to such a high degree of interoperability and integration represents a first in the Community.

1 : Project orientation

1.1. The administrative background

1.1.1. Single European act

In 1987 the Single European Act was signed by the twelve members of the European Community. The aim of the Act is to create a more favourable environment for stimulating enterprise, competition and trade, by strengthening political and economic connections between Member States, through the removal of physical, technical and fiscal barriers.

The principal objective was the completion of a Single Market area within the European Community, "without internal frontiers in which the free movement of goods, persons, services and capital is ensured", by 31 December 1992. A major element in achieving this goal was the elimination of the fiscal frontiers which then existed between the twelve Member States.

1.1.2. The development of the VAT transitional regime

Before the 1st of January 1993, private individuals and commercial traffic within the European Community were subject to customs controls at the frontiers between Member States. Apart from certain defined allowances, a VAT zero rate was applied to the goods in the country of exportation and VAT was levied on goods in the Member State of importation. It is important to realise that the administration of this system depended crucially on the existence of frontier-based procedures and controls to document and police the physical exit and entry of goods from national territory to national territory. But after 1/1/93, in the new Europe without internal frontiers, these mechanisms could not exist and had to be replaced with something different. The true removal of fiscal barriers would require that intra-Community transactions should be dealt with in the same way as domestic transactions (e.g. a German consumer purchasing goods in France should be charged VAT by the French supplier in the normal way).

The European Commission put forward its initial proposals in 1987 along these lines. However the proposed system, known as the "origin tax" system, was considered too ambitious in the short term by a majority of the Member States. Finally at the ECOFIN Council in November 1989 an alternative transitional solution was agreed. The guidelines of this solution were that, for a transitional period of four years to 31 December 1996, the existing "destination tax" principle of VAT zero rate at export and VAT charge at import should remain; **BUT** that the elimination of all fiscal controls at frontiers and the "origin tax" system, should nevertheless proceed as planned with effect from 1 January 1993. The destination tax rules were to apply in principle only to intra-Community transactions of a commercial nature between persons identified for VAT purposes; private individuals, with the exception of certain categories of transactions, such as purchases of new means of transport and mail-order selling, would have complete freedom to purchase tax-paid anywhere in the Community without any further tax liability being incurred by moving the

goods from one Member State to another. In these respects - no frontier controls and complete freedom for individuals - the spirit of the Single Market had achieved its first successes.

The Commission put forward new proposals during 1990 in accordance with the ECOFIN Council conclusions of November 1989. The proposals included on the one hand the new arrangement for intra-Community VAT based on a new principle of acquisition, together with the details of traders' obligations; and on the other hand, they set out the necessary arrangements for administrative cooperation between Member States' tax authorities to combat tax fraud.

The basic rule applied to the acquisition principle is that the sale of goods in intra-Community trade in one Member State gives rise to a corresponding acquisition in the Member State of arrival of the goods. The VAT must then be declared by the purchaser in the same VAT periodic return as used for domestic purposes, applicable to the reporting period during which the acquisition is made. The rules on the rate of VAT applied to the acquisitions and their value for tax purposes are essentially the same as those applied to similar domestic purchases. The essential point to retain is that these notions of intra-Community "supply" and "acquisition" completely replace those of export and import as far as trade between Member States is concerned.

1.1.3. Legal Instruments

In December 1991 and January 1992 two legal instruments which are relevant and which help to set the scene for the VAT Information Exchange System (VIES) were adopted by the ECOFIN Council. Council Directive 91/680/EEC (the so-called 6th Directive) supplements the common system of value added tax and amends the 1977 Directive which lays down the principles of Community VAT law, with a view to the abolition of fiscal frontiers. Council Regulation 92/218/EEC deals with administrative cooperation in the field of indirect taxation (VAT).

In simple terms Council Directive 91/680/EEC makes provision for the continued zero rating of intra-Community supplies of goods and ancillary services, providing the supplier satisfactorily satisfies two main conditions:-

- The supply must be made to an eligible person with the necessary VAT status in another Member State, and
- Evidence must be held to prove that the goods have left the Member State of departure.

In effect this means that the supplier must have confirmation that his customer holds a valid VAT identification number in another Member State; and must hold adequate commercial documentary evidence to prove that the goods were transported out of the Member State of the supplier.

The intra-Community customer is then, on the basis of the supplier's invoice, liable to account for the acquisition by declaring the VAT on the next VAT periodic return, simultaneously deducting the tax if so entitled.

The Directive also lays down the obligations applicable to traders, including:-

- Identification of persons dealing in intra-Community trade by a unique VAT identification number prefixed by a 2 alpha suffix related to the Member State of issue. **{N.B. VIES IDENTIFICATION DATA}**.
- The issue of an invoice for intra-Community supplies of goods and services showing the VAT identification number of both the supplier and the customer.
- Provision of two boxes on the VAT periodic return for declaring the values of intra-Community supplies and acquisitions, and
- A recapitulative statement made each calendar quarter (or less frequently in respect of certain smaller businesses in some Member States) by each intra-Community supplier, showing the VAT identification number and net turnover value of his supplies to each of his intra-Community customers for the period. There are some variations in respect of these requirements concerning transactions involving work undergoing process and repair, corrections to earlier declarations, triangular operations, exemption thresholds based on turnover and certain cases where goods are transferred. **{N.B. VIES TURNOVER DATA}**.

Regulation 92/218/EEC sets out the VAT control arrangements for administrative cooperation between Member States.

- *Article 4* provides that each Member State must maintain an electronic database to store and process the information collected from the recapitulative statements submitted by intra-Community suppliers on its territory. It goes on to stipulate that each Member State must be able to obtain "directly and without delay from each (other) Member State" access to information in the form of a quarterly list of the VAT identification numbers of all intra-Community purchasers in that Member State, together with the associated net total turnover value in relation to each of these VAT numbers. On request the values given can then be further broken down into the individual amounts declared by each supplier in the Member State which collected the data. This information can then be used by the Member State receiving it to compare with the value of intra-Community acquisitions declared on the VAT periodic returns, and ultimately checked against the purchasers' accounting records.
- *Article 6* makes provision for the maintenance of an electronic database by each Member State, containing the VAT identification numbers of its traders; such information would extend to the name, address, and, where appropriate, the date of cessation of validity of the number. Again the information should be provided "without delay" between tax administrations. This provides the facility to make an immediate check on the validity of a VAT identification number in another Member State and can be used by the tax administrations as a first control check on the integrity

of their traders who have made intra-Community supplies at VAT zero rate. In addition Member States must ensure that traders themselves are given the facility to confirm the VAT status of their intra-Community customers.

In addition *Article 5* provides for a follow-up request system in respect of additional information relating to specific intra-Community transactions, where the computerised exchanges of information are insufficient for resolving a control problem. The requested authority shall at least provide the applicant authority with invoice numbers, dates and values in relation to individual transactions between persons in the Member States concerned.

1.2. Project organisation and development

1.2.1. Planning and Timetable

It was immediately apparent that an agreement reached in December 1990 in respect of an implementation date two years ahead (1 January 1993) represented an unforgiving timetable. Although there had been development work on trans-European networks for many years, nothing on the scale demanded by this project was available to build on and consequently it was recognised that the project would have to start from scratch. If the Commission had waited for the necessary legislation to be adopted before initiating the project - a process which took a further thirteen months - implementation of a computerised exchange system by January 1993 would have been unrealistic and impossible.

It must be borne in mind that the difficulties to be overcome were not only of a technical nature. Information technology in the field of fiscal compliance varies considerably from Member State to Member State, in terms both of use and of development. Linguistic problems had to be dealt with, with nine different languages operating in the twelve Member States; and data exchanges involving twelve different national currencies had to be taken into account.

The Commission immediately set in train a fact-finding study during the early months of 1991 as a first step on the road to a computerised VAT information exchange system. Meanwhile arrangements were put in hand for a full feasibility study of the proposed system.

1.2.2. Fact-finding Study

The fact-finding study was launched in advance of a full feasibility study in order to identify more precisely the user requirements of the system and the possible technical options for satisfying those requirements. The terms of reference for the fact-finding study were:-

- The establishment of the overall technical objectives of the proposed system and telecommunications network.
- The agreement of a high level user requirement for the project.
- Estimation of the volumes of data that the systems need to support.

- Identification of possible technical options for satisfying the user requirement and achieving the established objectives.
- Initial estimation of the likely order of costs to the European Commission and development timescales.

The study was structured into three phases. The first phase was the preparation and issue of a questionnaire to all twelve Member States; the questionnaire dealt with basic information such as details of hardware to be used, availability of telecommunications lines, data security requirements and estimated volumes of data. The second phase involved a series of interview visits to Member States to expand upon the replies to the questionnaires. The third and final phase included the analysis of the research carried out and the production of a report.

The two essential elements of the project which were identified at this stage were the setting up of the necessary databases in the Member States; and the establishment of a telecommunications network between those databases allowing the exchanges of information. The report of the study went on to list the numerous user requirement issues which would need to be resolved independent of whichever technical solutions would eventually emerge; these included identification of intra-Community suppliers, VAT identification number construction rules and formatting, treatment of late and amended recapitulative statement information, and retention periods for data.

Recognising the ongoing need for regular contact with those concerned at an operational level in the Member States during the course of the study and beyond, each Member State was asked to nominate a suitable official as the principal contact and liaison point for the Member State. The person concerned had to be in a position to deal directly with questions of a technical nature concerning both VAT control and related computer systems, or have ready access to such information. This list of contact points established the first communication link between the Commission and Member States for the VIES project and it continues to play an important part in maintaining regular contact between all the parties involved in the project.

1.2.3. Feasibility Study

The contract for the feasibility study was awarded to a consortium led by LOGICA, working together with BULL, OLIVETTI and SIEMENS-NIXDORF. The study was organised into four phases and was conducted in the second half of 1991.

The most important constraint on the feasibility study was that any solutions proposed had to be biased towards a system fully operational on 1 January 1993. At the same time it had to be borne in mind that the actual operation of VIES for the first six months of 1993 would be limited to the retrieval of **VAT Identification data**; there would be no **VAT turnover data** available until 30 June 1993 at the earliest, since the turnover data for the first calendar quarter (31 March, 93) was not due to be exchanged until the end of the second quarter.

Phase 1 : This was concerned with establishing the current situation within the Member States and the Commission with regard to plans and functional requirements for VIES, building on the work which had been carried out during the fact-finding study. The information was built up from a series of interviews held with all Member States following completion of a detailed questionnaire covering functional requirements, Member States' computer systems, storage and retrieval facilities for turnover data and VAT identification data, data protection issues, possible design concepts, VAT numbering systems and organisational structures. The associated report gave a consolidated view of the situation in all twelve Member States.

Phase 2 : This dealt with conceptual solutions for the transmission and storing of data on the basis of Phase 1 research. The project team developed and evaluated a number of potential scenarios for the solution to each of the three technical areas of VIES:-

- the applications software to support the VIES functions
- the network to provide the international communications between the Member States
- the gateway to provide the means for the computer system in each Member State to connect to the network.

Phase 3 : Under the title of "Recommendations and Design" this phase moved on from the solution concept established in Phase 2 by progressing the design of the various components and establishing initial plans for the implementation, operation and organisation of VIES. The topics considered were the production of a single user requirements document; development of the chosen concept; production of an outline of the necessary organisational framework to build, run and control the system at each site; and production of a plan for the implementation of the system at each site.

Phase 4 : This final phase was run in parallel with Phase 3 and analysed the risks involved in the proposed solution whilst at the same time identifying counter-measures to manage the risks.

Throughout the feasibility study collective working sessions with the Commission, the Consultant and Member States' representatives were organised in Brussels for consultation and development of the solutions emerging from each phase of the study. Unanimous agreement was reached in the working sessions on the fundamental architecture for the implementation of the system using a Value Added Network (VAN) based on the National Gateway Solution. The final decision on the design concept took account of Member States' wish to retain maximum control over the network and avoided questions concerning confidentiality which a more centralised system might have posed. The National Gateway solution has the major advantage of uncoupling the Member State's computer systems from the VIES network and allowing individual Member States the maximum of flexibility in the development of their own computer systems; it thus requires the definition of a simple interface inside the Gateway suitable for use by all Member States.

As part of the effort to keep the project running while the contract selection procedures for the implementation stage of the project were in progress, an extension of the feasibility study contract was negotiated to produce detailed specifications for the interface in the

Gateway. The work was completed on time on 28 February 1992, and concentrated on two subjects:-

- Specification of the VIES/Member States interface
- Turnover data correction management.

1.2.4. Implementation Phase

The contract for the implementation stage of the project was issued in March 1992 to a consortium led by SOF-X/Marben, and comprising NCR as the supplier of the hardware, and Interpac (Belgium) as the Value Added Network (VAN) operator. The contract contained provisions for supply and delivery of the necessary hardware, development of the appropriate software and provision of the network (X25) connectivity. The major milestones were identified as:-

- Hardware installation by 1 June 1992
- Network, installation by 17 August 1992
- Test System installation by 31 August 1992
- System installation by 2nd November 1992.
- Pilot phase up to the 1st of January 1993;
- Operational stage starting the 1st of January 1993, concerning VAT identification data and 1st of July 1993 concerning VAT turnover data.

The contract covered the implementation stage of the project and technical management for the operational period to 31 December 1993. In addition to visits from the central consultancy project team, specialised individual in-house consultancy has been supplied to each Member State as required to assist with all aspects of the development of the project. The Commission technical project team also makes regular support visits to Member States.

The project has met all its deadlines successfully. There have been minor slippages to the deadlines set but none to date have been sufficiently crucial to threaten the main objective of the abolition of fiscal frontiers on 1 January 1993.

1.2.5 Operational phase

The project went live on the due date for answering queries on the VAT identification data. The network is managed by a central location called VIES technical centre. This centre has the necessary tools to monitor the network performance and to provide remote maintenance facilities.

During the first three months of operation, VIES has processed up to 350.000 requests per month for verification of VAT identification numbers of intracommunity traders, made by the Member States administrations. The mean service availability has increased from 80% to 95% during the same period.

Development work continues in the Member States to prepare for the exchange of turnover data by July 93; this work is progressing satisfactorily and there is no identified threat to the success of this exchange of information.

1.2.6 Structure and organisation

At Community level

The Standing Committee on Administrative Cooperation (SCAC) was established under the provisions of Article 10 of Regulation 218/92. The Committee consists of representatives of the Member States under the Chairmanship of a Commission official. The principal aim of the Committee is the development and implementation of an effective system of administrative cooperation between Member States' tax authorities for the post-1992 period, including the introduction of the computerised VAT Information Exchange System (VIES).

A technical sub-Committee, chaired by the Commission's technical project manager, and comprising the technical project managers of all the Member States was set up under the authority of the SCAC to manage all activities relevant to the success of the VIES project.

Part of the remit of the SCAC was to agree the user requirements and applications within the VIES, to decide on the use of a follow-up request system under Article 5 of Regulation 218/92, and to consider the procedural and organisational arrangements for administrative cooperation. The SCAC and its technical sub-committee have held regular meetings in Brussels, where a great deal of progress was achieved. Both committees met separately but a progress report by each to the other was a regular item on both committee agendas. At the outset the SCAC covered a wide range of implementation issues relating to the VIES applications, including numerous questions on data collection procedures for turnover data and VAT identification numbering systems, as well as opening hours and access times for the availability of the information.

At Commission level

Within the Commission the project's management structure comprises a Steering group chaired by the chairman of the SCAC. The Commission's technical project manager and the contractors report to this group at regular intervals concerning the progress of the project.

The Commission's technical project team is working full time on the project. Its activities comprise development and operational tasks, as the production of statistical reports on VIES usage and performance; control of the contractors activities and quality assurance of the deliveries, including proof reading and testing; organisation of the technical sub-committee meetings; and co-ordination with the Member States. For this latest activity the Commission's team comprises two 'travelling' agents who hold bilateral meetings with the Member States project teams. These meetings have allowed close communication and co-ordination with

the Member States. The problems that the Member States encountered in relation with the central project were known immediately and solved in a timely manner; and personal relationships were established which favoured the co-operation of all partners.

At Member State level

A technical project team was created in each Member State to undertake the developments relevant to intra-community VAT and more specially, VIES.

The other crucial structural element for the management of the control of intra-Community VAT was the creation of a Central Liaison Office (CLO) in each Member State, according to the provisions of Article 2 of the Regulation. The CLO needs to be a distinct entity identifiable to other Member States and to the Commission as their principal communications link for all exchanges of information covered by VIES as well as the follow-up request system. In short, their role is to ensure the efficiency and flexibility in communications between their national control administration and those of the other Member States.

1.3. Control philosophy and user requirements

1.3.1. Control philosophy

Under the provisions of Article 6 of Regulation 218/92, the control authority of each Member State is able to obtain confirmation of the validity of intra-Community VAT identification numbers by means of direct access to the VAT Identification data bases of the other Member States. In response to a valid number, the applicant authority will receive a screen display giving the associated name and address of that number, together with the date of issue and, where appropriate, the date of cessation of the validity of the VAT identification number. Member States have all already exchanged construction rules in relation to each of their intra-Community VAT numbering systems. A coding verification programme has been written and tested against valid examples of numbers for each Member State, thus providing the possibility of a first control check by each national administration on the validity of a foreign number submitted by its own trader. The result of this should be that only "clean" VAT identification numbers will be transmitted with the VIES turnover data.

Trader access to the VAT identification number verification system will be through national administrations who will give only an affirmative or negative response (yes or no) to an enquiry as to whether a particular VAT number is valid or is correctly associated with a specified name and/or address for a given date. (N.B. For security and data protection reasons, the national administrations will not supply the name and address in relation to a valid number). The methods implemented in the Member States to deal with trader enquiries differ significantly; some have implemented on-line systems to automate the access of the traders to the information; others have implemented administrative units that communicate with the traders inquiries by phone, mail or fax. In either case, the "yes or no" answer is all that will get through to the trader making the enquiry.

Member States have prepared data collection forms for the standard calendar quarterly recapitulative statement in line with the requirements of Directive 680/91. Agreement has been reached in the SCAC for the treatment and handling of process work, triangular operations and corrections to earlier declarations. A number of Member States have indicated that they wish to implement a system of non quarterly recapitulative statements as provided for under the Directive; the turnover data from the non quarterly statements will be included as part of the next available quarterly totals - a flag will be transmitted with the data in such cases to indicate the presence of non quarterly statement information.

Member States will take the information available under Article 4.2 of Regulation 218/92 automatically (i.e. the total value of all intra-EEC supplies to each purchaser within the Member State); they will verify the validity of the VAT numbers of their traders and most of them will make some form of comparison of the turnover values against the corresponding intra-Community acquisitions declaration box on the VAT periodic returns. Furthermore, Member States have agreed that when they receive bogus VAT numbers amongst the turnover data (i.e. numbers which may have passed the construction rules test but do not appear on the applicant Member State's VAT register), they would alert the Member State from which the data originated. The data available under the provisions of Article 4.3 (i.e. the value of supplies by individual suppliers) will be requested by the Member States on a selective basis.

The importance of the follow-up request system within the administrative cooperation arrangements must be underlined. The VIES system will only be useful in identifying irregularities and the follow-up request form will be the definitive tool in making specific transaction verification requests in relation to these irregularities as an aid to identifying possible VAT fraud. All Member States were content with the form design developments within the SCAC, and were unanimous in their desire to migrate to a computerised system of exchanges as soon as possible. (GB has already planned for a computerised system of outgoing follow-up requests from local VAT offices to the CLO which, after carrying out the necessary management controls, will send hard copy on to the requested Member State). The preparations by Member States for the follow-up request system include the need to issue precise instructions for control staff; and to develop a computer management logging system for incoming and outgoing requests.

1.3.2. User requirement

In line with the ECOFIN conclusions of December 1990 two categories of data interchange requirements were identified.

The first category, using the recapitulative statement information submitted by their traders, requires each Member State to make available the following information to other Member States without delay by computerised means:-

- total values of purchases by individual customers' VAT identification numbers in the relevant Member State for each calendar quarter (Level one turnover data)
- a breakdown of those values by suppliers' VAT numbers, on request. (level two turnover data)

The second category requires Member States to provide a computerised facility whereby other Member States may verify that a particular VAT identification number is valid (identification data).

All information exchanges will be carried on the network (i.e. there will be no need for tape transfers). Response times for information regarding requests for both VAT identification numbers and turnover data, which will be available on-line for at least 5 years, have been agreed as follows:

| Request | Response time |
|-------------------------|---|
| VAT Identification data | 10 seconds |
| Turnover data:- | |
| Bulk transfers of data | 1 day |
| Individual enquiries | 30 seconds to 5 minutes (depending on degree of detail). |

Only exchanges of VAT Identification data will be available on the initial system; exchanges of turnover data will not commence until 1 July 1993, when such data first becomes available.

The feasibility study was instrumental in identifying other requirements, both administrative and technical, concerning mainly the privacy of personal and commercial data of the traders and the storing of data locally, avoiding duplication, bearing in mind the volumes and daily update rate. It was also required that the data exchanged in VIES should be accessible anywhere in the national territory of the Member States, to allow regional tax offices access to information concerning intra-community trade.

1.3.3. Future requirements

There are two important additional developments which are in the course of implementation. The first, as already described in section "Control philosophy" concerns a computer facility for the follow-up request system. The second is an information exchange or messaging system to deal with cases of VAT fraud or suspected fraud.

This concept was achieved by supplying the Member States with a telematic environment consisting of software and hardware, and by establishing connections, in electronic and in software terms, between each of these telematic systems and the Member State's computer system.

The telematic system, or "gateway", supplied by the Commission can be seen as a sort of communications node. The role of this node is to carry out the successful conveyance of a message from or to the neighbouring national computer system and to correspond with a node belonging to the same system in another Member State. In doing so it acts as a gateway, a feature which is often found in telecommunications networks and consists of providing an interconnection between heterogeneous networks by means of equipment for converting protocols and address prototypes, etc.

As the chosen system enables distribution of the information system, each Member State has the possibility - if it so wishes - of keeping its own databases on its own computer system and not even having to install them on its communications machine. The Member States' ability to work together on a homogeneous basis - interoperability - is assured by the utilization in common of an application protocol based on an exchange of messages and by the creation of a telematic environment which carries out the conversion of telecommunications protocols required for any pair of correspondents to establish contact and which ensures the conveyance of the application messages.

The whole existing, or developing, infrastructure used in a Member State to give its civil servants access to its computer system is maintained and keeps its potential for use. To the user, the system for exchanges between Member States seems like an extension of his own country's hardware set-up.

2.3.1. Hardware

Each Member State possesses its own computer system for the management of information on its own traders and for assembling data destined for its fellow Member States. Its national users are connected into this system, i.e. the civil servants responsible for assembling and processing data from other Member States. If it so wishes, the Member State may extend access to business people in that state as part of a "VAT registration checking" service on Minitel or another such means.

Each Member State communicates with the others by means of a gateway, a special-purpose computer located close by its own national computer system. The Member State's own service is responsible for the software installed on its national system and for the special part of the software which links its system to the gateway. A VIES software package which is standard for all members of the system also runs on the gateway.

Since there is one gateway per Member State, they communicate with each other by means of an international communications network.

If the Member State does not want to have its system closely linked to the gateway, it may assign another special-purpose computer for connection with the gateway or install its applications on the gateway itself.

2.3.2. The communications system

The standard software on all gateways has several modes for data communication.

- **Synchronous mode** establishes a communication between two remote applications, which are connected "point to point" and hold a dialogue. This procedure is similar to a telephone conversation. In this case the response times must be as short as possible.

- **Asynchronous mode** carries out a procedure which is similar to the mailbox principle: an application leaves a message in a software "mailbox" and the message is then forwarded to the addressee without further intervention by the originating application. The destination application is subsequently informed about this message. Here the two applications have no "point to point" connection. The response times, which vary between 30 seconds and several minutes, are not crucial in this case.
- **File exchange** is made possible by a combination of the "asynchronous" mode and file transfer facilities so that the details of the transfer transaction are extraneous to programming of the application.

These services depend on standardized communication protocols based on the OSI model (Open System Interconnection):

- the synchronous service under the OSI-TP protocol (OSI Transaction Processing);
- the asynchronous service under the P1 and P2 protocols of the X400(84) standard (Message Handling System);
- files are sent under the FTAM protocol (File Transfer Access and Management).

2.3.3. The data exchange model

An application protocol uses these diverse means of communication between the Member States' applications by specifying the dialogue that they may hold when exchanging predefined messages.

The message includes a predefined, fixed header; certain elements in the header specify the nature of the body of the message which comes after the header and the desired mode of communication for its conveyance to the correspondent Member State. Basically, a message is an item for conveying from one point to another - the concept of message has therefore no bearing on the mode of conveyance used, whether it is synchronous or asynchronous, and likewise for the files conveyed.

Now that they are in possession of the basic item, the message, and interfaces to the telematic system for ensuring its conveyance from sender to receiver, unless errors have been duly detected, the corresponding applications go about their business by accepting a dialogue protocol: this protocol refers to the respective roles of the sending and destination applications.

This is where the client-server model, referred to above, comes into play: a message sent by a client application represents a request and the reply to this request, sent by the server application, will be conveyed by another message. A series of conventional values, also conveyed by message, indicate the success or failure or give warning messages about the interaction process. Access to the telematic system for establishing and holding this dialogue is achieved by means of high-level, "send-message" or receive-message" type functions, which conceal the complexity of the means used to ensure the smooth functioning of the telematic exchange.

2.3.4. VIES applications

Because of the separation of applications and the communications services that the gateway has at its disposal, it is possible to bypass the actual conveyance involving the international network and to use a local test mode available only on a gateway (and on the Member State's computer system, if it is connected into it). Test applications were developed for both client and server: a client test application for verifying the reply from a server developed by a Member State and vice versa, i.e. a server test application for replying to a Member State's own client application.

Test applications are also available in two modes: the first test mode is defined as purely local, as explained above, while the second enables the client and server programs installed on the Member State's computer system to be linked with a central reference point.

A test environment set up in this way enables the Member States' applications to be tested both locally and with a central reference point. Once the applications have been tested like this, they can communicate in real mode with any other approved application on the telematic network.

Another application that has been developed has produced client and server programs for exchanging VAT identification data. This was done to provide the best possible guarantee for the successful exchange of such data as from 1 January 1993. This application, or derivatives developed by the Member States to adapt it to their own operational requirements, was put into use by four Member States on 1 January 1993.

The creation and maintenance of a complex telematic network requires a full-time technical backup - thus leading to the necessity for a technical management role for VIES. This involves the setting up of a body with staff specializing in installation of software, dealing with queries, incidents and unavoidable system defects. It also requires the creation of remote management facilities for telematic systems.

2.4. Technical aspects in detail

Because of the technical and organizational design concepts chosen, i.e.:

- the adoption of a client-server mode of operation; and
- the adoption of a clear definition of responsibilities and of supply of equipment between the Member States and the Commission,

the basic interaction between any two Member State correspondents can be represented by the following diagram, which shows the various components at work in a VIES transaction between a Member State A (for Applicant), making a request for VIES information, and a Member State R (for Requested), to which the request is addressed:

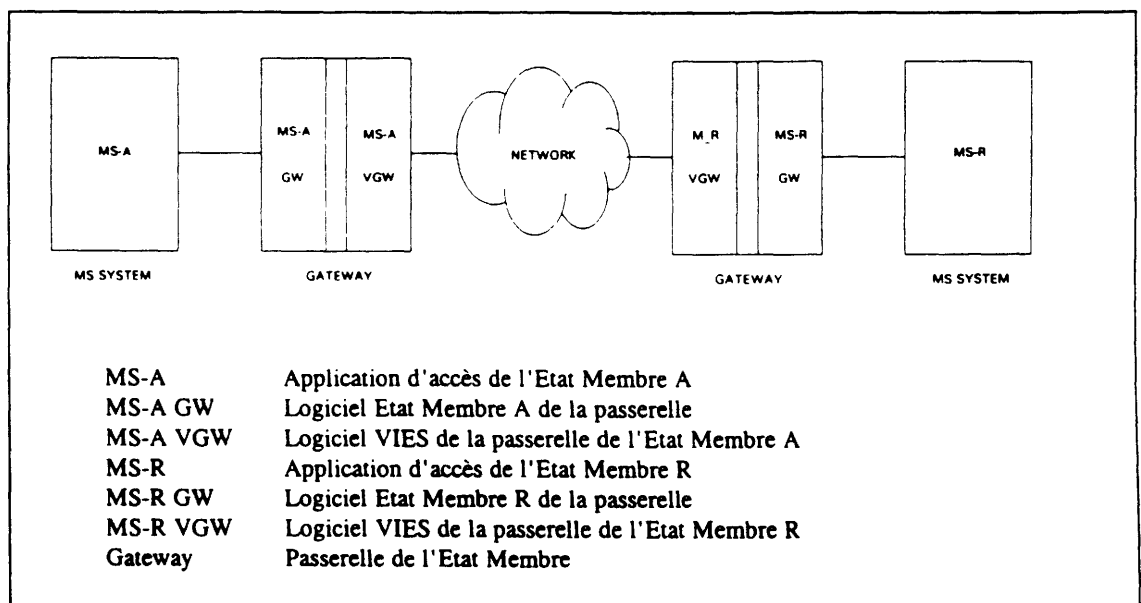


Fig. 1 VIES software and hardware components

This diagram provides the key for looking at the components in closer detail.

Attention is drawn first to the MS System and Gateway components.

The applications for assembling, accessing and processing VAT Registration and Turnover data have been developed by the Member States according to their own specifications, but taking account of the constraints imposed by VIES. For each type of data, each Member State has developed:

- software for data assembly and storage in a database (production application);
- software for preparing requests concerning data assembled by the other Member States, sending these requests to VIES and receiving the replies from VIES (access application);
- software for receiving VIES requests, preparing the replies by identifying the data requested in the database and sending the replies to VIES (dissemination application);
- software for analysis of the data contained in the replies received from the other Member States (local storage of data, comparison of data received with other available data, etc.) (processing application).

The production and processing applications must be located on the Member State's computer. The access and dissemination applications may be located either on the Member State's computer (as shown in Fig. 2), the gateway or split between the two.

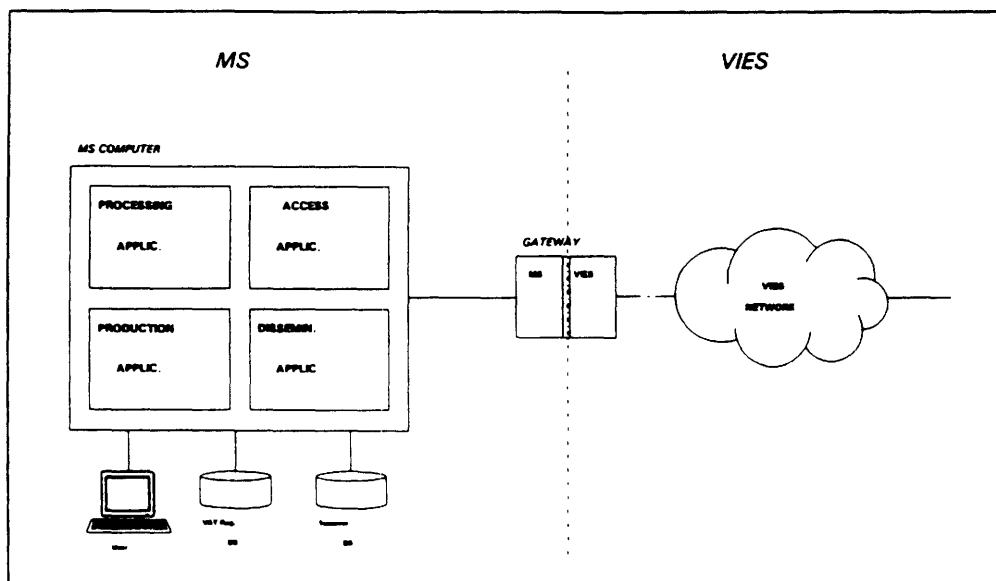


Fig. 2 General applications architecture

The Member States are wholly responsible for the production and processing applications according to the equipment available and their own national procedures. No further details will be given here.

A common software, VIES, is provided on each gateway, located on the right-hand side of the Gateway box shown in Fig. 2. This software imposes a specific format on the information for transmission and, likewise, a specific interpretation of information

received. Provided that the part developed by the Member State obeys these constraints, the Member States' hardware may be linked.

There are two elements at work when the machines of any two Member States are linked:

- the application protocol element, which defines a set format for the information and a set procedure for the exchange of information presented in this way, and
- the element of integration of different computer systems, with particular attention to the implementation of the various communications protocols which apply between the telematic equipment used for linking any two Member States' applications.

The first element presupposes the definition of a vector for all information, the "message", and a protocol for exchanging these messages between two corresponding gateways, and beyond that, between two Member States' machines. The protocol consists of the formal definition of a dialogue between two correspondents for the exchange of service messages, control messages and data used by a higher level of application.

This element implies that the message plays the role of a conveyor of requests, replies and any control information required for the proper functioning of the exchange protocol. The message is not necessarily intended for a particular exchange protocol and even less so for a particular application - the exchange of information on indirect taxation (or, in other words, VIES) is just one of several possible applications. Moreover, the means of communication used, which determine the timing of the conveyance of messages, have no bearing on the definition of the message as such.

The second element, i.e. relating to the integration of systems, concerns two main questions:

The first question involves the choice between the gateway and the national system for the location of the production, dissemination, access and processing applications (see Fig. 2). This impacts profoundly on the choices, which the Member State alone has to make, for data management and whether they should be based on criteria of performance, security or ease of development. The option chosen by a Member State for the location of the software applications determines the choice of communications protocol: e.g. if the dissemination software is located on the gateway and the production software on the national system, the file transfer type protocol should be used in order to allow the dissemination database to be loaded from the production database. If, on the other hand, the dissemination software is located on the national system, the transactional type protocol should be used so as to allow online communications between the gateway and the national system.

The second question involves realising that distinct communications protocols are involved (see Fig. 1):

- a. between machine MS_A and its gateway MS_A GW: the protocol used is the one which suits the machine and technical support team of MS_A best: e.g. on IBMs it will be designed for transactional exchanges on LU6.2, on DSA for BULLs, on TCP/IP for UNIX-based machines, etc.
- b. between the VIES gateways (MS_A GW and MS_R GW): the protocol used is standard and will be described in greater detail below;
- c. between the MS_R GW gateway and MS_R's machine: the same applies as under a. above.

2.4.1. Definition of the message

The message has the following structure:

Message = header + body

The header of a message contains all the information required for its identification, thereby allowing the receiving application to process it correctly. It contains a fixed number of fields with various roles which fall into three different categories:

1. The message context: this sets out fully the type of significance to attach to the message.
2. The message address: this sets out fully the message's points of destination and origin.
3. The message authentication: this contains the information required to identify a specific message, either for reasons of security or to distinguish it from others with the same context and origin/destination.

The body of a message contains the information which is meaningful for the application (in this case VIES). With the aid of the context field in the header, the receiving application can activate the appropriate function for interpreting the body and then present its contents to the processing function.

2.4.2. Communications protocols

File exchanges

The size of the items conveyed by messages - i.e. the body of a message - is the criterion which comes into play, above a certain threshold, to decide whether to assign the largest items - i.e. files - to an appropriate conveyance procedure to ensure that they are conveyed under optimal conditions. The procedure works by deciding for itself to send back parts of files which have not been correctly received and to operate the function for restarting at the last point of acknowledgment of a transfer when the X25 service has been interrupted. The OSI protocol used for this task is the FTAM. The interface for accessing this service is set up (in terms of requests to transfer, warnings of availability, end of task warnings) on the basis of header/body messages as described above. As a result, the Member States' applications need only handle VIES messages and can ignore commands which are specific to the FTAM protocol.

Transactional exchanges under synchronous mode

These exchanges are dealt with by the synchronous communications mode operating according to the OSI-TP protocol. The response times given by this service are quick but the items conveyed may not be larger than 32 Kbytes in size. Also, the reliability of the service from the user's point of view is affected by the fact that all the elements of the information system must be accessible during the dialogue for the request to be satisfied. This leads to a less than 100% reliable service.

In VIES, this service reaches response times of less than 5 seconds for applications messages with a size of less than 200 bytes. The average total availability has been growing steadily since the beginning of January. In March it was as high as 95%.

Store and forward exchanges

Synchronous access satisfies the need for rapid transactions by limiting the volume of data which makes up the messages and limiting the perceived reliability of the service. Another communication method, asynchronous access, was introduced to guarantee responses to requests entered into the system. In this mode of communication, there is no dialogue between the Member State applications. They communicate instead on a "store and forward" basis. A request received by the system is forwarded to its destination when the intermediate components are available, with rejection for reasons other than those connected with an application being impossible.

The OSI protocol for this exchange mode is X400. Size limitations are sharply reduced, and the service is reliable. Response times are, however, greater than those obtained by the synchronous service, and generally exceed thirty seconds.

2.4.3 Application protocols

Basic principles of the message flow

- . a Member State gateway application transmits requests one by one to the VIES gateway
- . multiple requests are sent as a succession of single requests
- . the Member State gateway application always receives a reply to the request, either in the form of data or of a warning message
- . if the reply to a request can be contained in a single message (a VAT number check, for example) the reply will be either a message containing the data required, or a warning message signalling a delay (if the data cannot be transmitted immediately)
- . if the reply to a request is to be sent in the form of a file of data, the reply received will be a message indicating that the file is being prepared
- . if there is any error in transmission, the gateway initiating the transmission will send back a warning message in reply.

Exchanges between applications

Exchanges use both synchronous and asynchronous access via programming interfaces which are independent of the application messages.

The transmission of messages may involve a number of successive stages (see figures 1 and 3):

- . from MS_A to MS_A GW: an interaction of software operating on MS_A's hardware and software operating on the MS_A gateway; both are managed by MS_A;
- . from MS_A GW to MS_A VGW: an interaction between software developed by MS_A and the standard VIES software common to all the gateways;
- . from MS_A VGW to MS_R VGW: a complex interaction (but which is invisible to the Member States' programmers) which involves a string of standardized OSI-based software applications and then access to a physical network via X25;

the message is sent to country MS_R. The message is then made available to the appropriate (synchronous or asynchronous) server through interaction between MS_R VGW and MS_R GW. With the server procedure, the message may be processed immediately, with access to MS_R's hardware to locate the material needed for the reply. Following the completion of processing, the server sends a message which follows the same route back to the client.

This explanation is illustrated in figure 3, which shows the sequence of messages in a normal request-response transaction (a VAT number check, for example) between the components shown in figure 1.

The first sequence shows an error-free transaction, while the second illustrates an instance in which a network problem prevents transmission of the request message to the destination gateway.

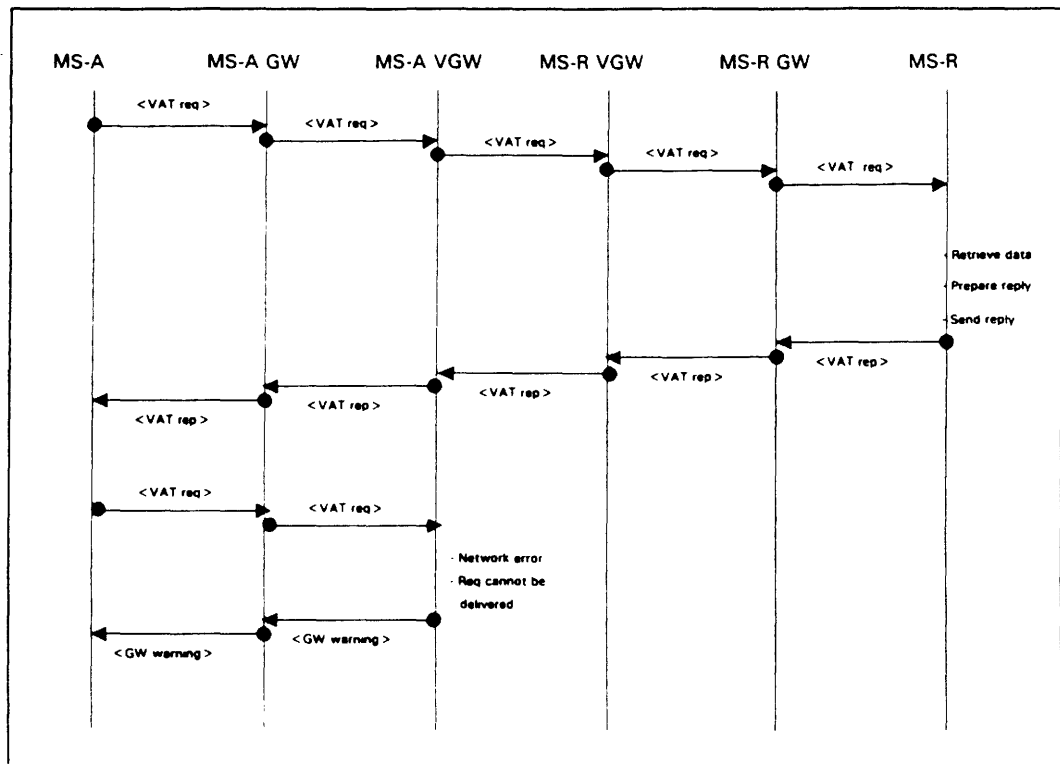


Figure 3 Processing of a standard request

Specific example of file transfer

The transfer of a file is managed differently from that of a message. The process is, however, designed to present Member States' programmers with a simple layout and is suited to handling synchronous and asynchronous messages. The complete route is the following (figure 4):

- a. The client program dispatches a request (L1F1 in the diagram) to the server program, using the route described previously.
- b. The request is acknowledged (L1F1 ack), indicating that it is being handled by the server at the point of receipt.
- c. The server at the point of receipt prepares the file required. It then generates the asynchronous application message < File Ready > .
- d. The message is received by the File Transfer Monitor, a special gateway server at the point of dispatch.

- e. The FTM at the point of receipt performs the operations necessary to transfer the file from the dispatch gateway using FTAM protocol.
- f. Once the transfer of the file is complete, the FTM transmits to the application on which the original request was made the asynchronous message <File Ready>, with details of the file which has been transferred. The file can then be relayed to the Member State's computer system.

Figure 4 shows this process (the label "L1F1" refers to a transaction which requires a file transfer to be made):

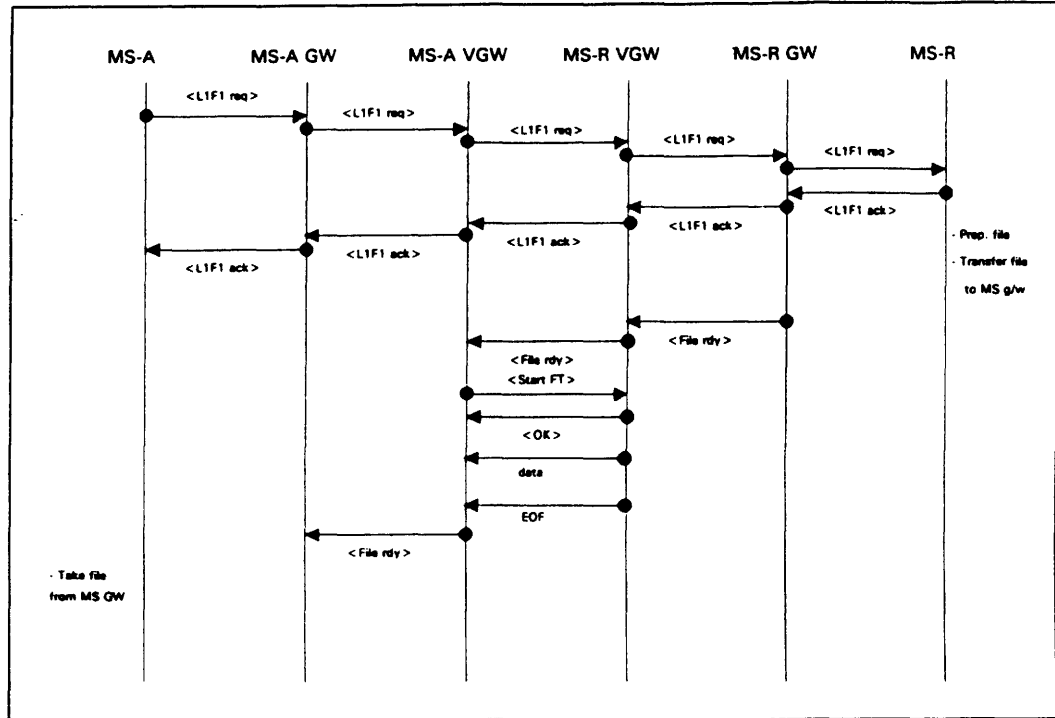


Figure 4 Processing of a request resulting in a file transfer

The file-transfer protocol makes partial resumption of the transfer possible if an error occurs, rather than forcing a return to the beginning of the file. If the VIES network has to transfer large files of data, automatic compression on dispatch and decompression on receipt take place in order to reduce transmission time.

Specific example of transfer mode conversion

For added convenience, allowance was made when designing the applications for the possibility that a synchronous message might not find a synchronous server in operation at its destination. In such instances, mode conversion from synchronous to asynchronous communication is available. For this to take place, an attribute in the message header must be present to authorize the conversion.

The conversion happens in the following manner: when the synchronous message is presented to the OSI/TP monitor at its destination, the monitor determines the type of transaction requested. If at that point:

- . the transaction is deactivated, or
- . the transaction is not picked up by a suitable synchronous server,

the monitor assigns the transaction to a special server termed the "synchronous/asynchronous converter". The converter then delivers the message to a mailbox if no asynchronous server suiting the type of transaction represented by the message is available, and informs the sender that the message will be processed asynchronously.

2.4.4 Overall design of the system

This is shown in figure 5:

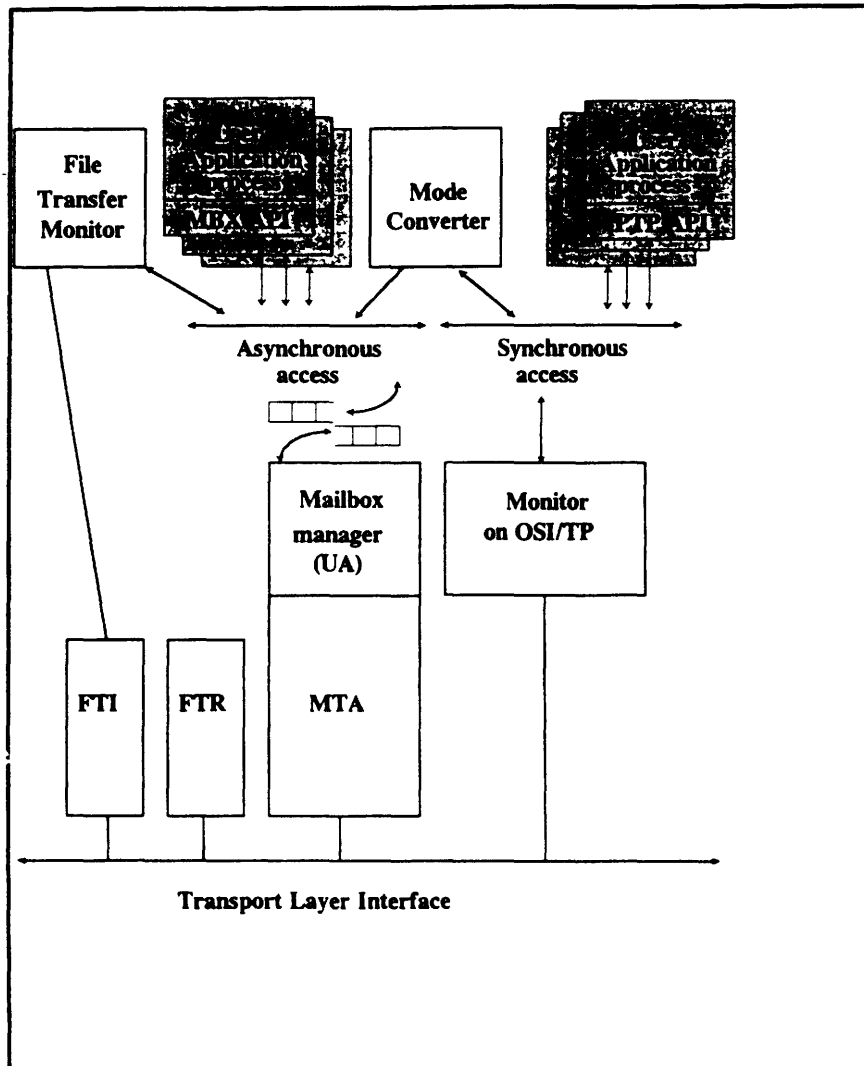


Figure 5 Architecture of standard VIES software

The following is a brief summary of the components of this structure:

TLI library: the Transport Layer Interface presented to the UNIX user (one of the standard facilities of UNIX System V4).

Monitor on OSI/TP: the module which distributes synchronous communications to subscriber servers. A number of servers for the same body of requests may exist side by side; the monitor deals with activating them as they become available.

PTP API (synchronous): the API (application interface program) for application processes which use synchronous communications (also termed PTP, process-to-process).

MTA + UA module: the module which organizes asynchronous communications.

MBX API (asynchronous): the API for application processes which use asynchronous communications (also termed MBX, MailBoX access).

Mode converter: the module which deals with converting synchronous to asynchronous communications.

File Transfer Monitor: the module which triggers a file transfer from a remote site (the latter will have signalled through an asynchronous message that a file is ready for transfer).

File transfer modules (FTI and FTR): these are operated (locally or remotely) by the FTM to make physical transfers of files.

2.4.5 Management of the system

A systems management environment was designed in order to enable supervision of the telematic network to be exercised at all times.

The management modules take care of all the functions needed to run the VIES software. The main functions are:

- . running and stopping the VIES software on the gateway;
- . configuration, supervision and control of the VIES software on the gateway;
- . collection of statistics;
- . handling of errors.

The functions are accessible to a local operator in the Member States, and to operators at the VIES Management Centre with authorization from Member State operators.

The components of the architecture are:

- . the Gateway Process Manager (GPM);
- . the Management Centre Communication module (MCC);
- . the Management Centre and Gateway User Modules (MCU and GMU).

They are described below.

Figure 6 shows the overall architecture of the management modules:

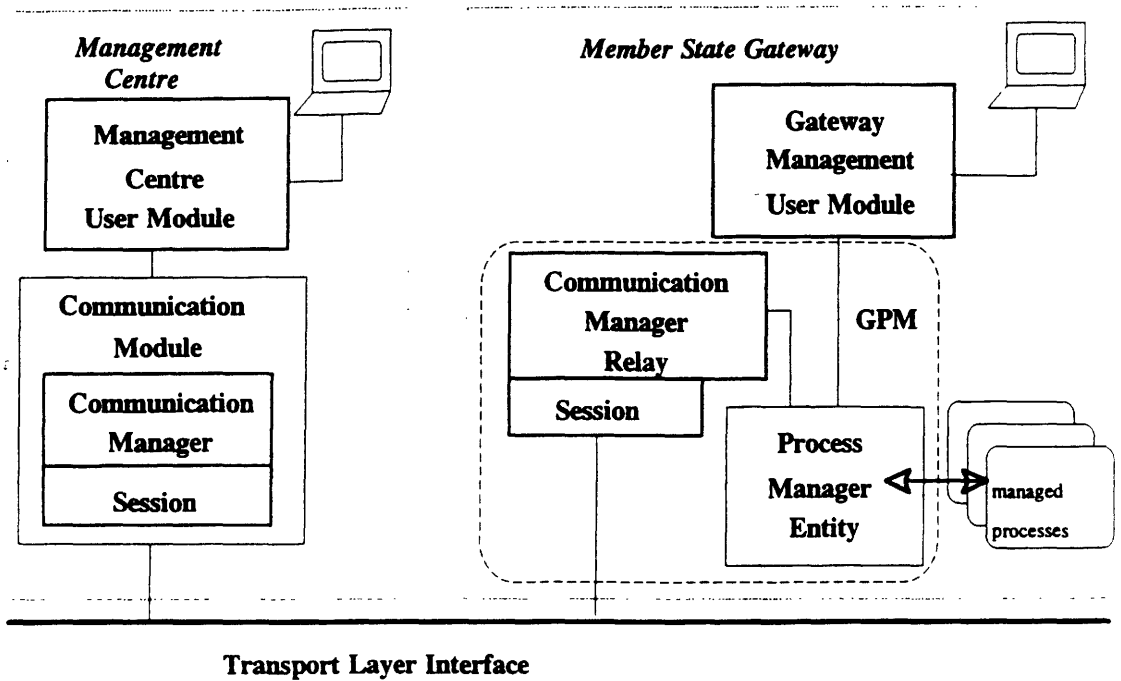


Figure 6 Management module architecture

GPM module

This module:

- supervises the various gateway processes;
- directs administration commands and responses to or from the local User Module;
- directs administration commands and responses to or from the Management Centre User Module.

It consists of three entities:

- the process manager entity, which manages the processes triggered within the VIES system;
- the communication manager relay, which deals with communication with the Management Centre through the Session entity (in OSI terms);
- the Session entity itself.

The Management Centre Communication Module

This allows the Management Centre User Module to communicate with the Member State gateways through the Gateway Process Manager (GPM). It consists of two entities:

- the Communication Manager, which manages communication with the gateway;
- the Session entity itself.

The User Modules

The User Modules are the components which constitute the man/machine interface. They give the operator access to the management services of the GPM and to the specific commands for the processes managed through the GPM. They supply all spontaneous messages to the operator, such as error messages, generated by one of the processes they manage.

The User Modules differ according to location (local gateway or Management Centre). The Management Centre interface must be able to access any Member State gateway. Access rights granted by Member State operators determine which functions are accessible to the Management Centre User Module. The gateway management interfaces are designed to operate with this gateway only.

The GPM manages three types of process:

- .communication;
- .management services;
- .applications.

Communications processes are:

- . OSI/TP;
- . X400;
- . FTAM, which is itself divided into FMS (which supervises all the files dispatched) and FMR (which supervises all the files received);
- . the Mode Converter (for conversion from synchronous to asynchronous mode).

The management services cover the processing of statistics and handling of errors.

Two processes handle basic statistics on the nature of the messages and files exchanged and the processing of this data to provide figures for a particular period:

- . The statistics collector receives and records data on traffic and spontaneous messages generated by the communications processes for each item, file or message passing through VIES. It also periodically records the length of queues of items awaiting processing.
- . The statistics analyzer extracts statistics from the files compiled by the collector according to the category (duration, nature of item, direction of transmission, etc.) selected by the operator.

Handling of errors involves collecting error details from communications modules and applications. This allows operators to analyze such errors by category (those occurring over a specific period of time or errors in order of seriousness). There are two processes for this purpose:

- . The error collector receives and records errors from other managed processes and applications processes which report errors using the appropriate application signals.
- . The error analyzer groups and displays the errors compiled by the collector according to the category (point in time, module, seriousness of error, etc.) selected by the operator.

The application processes programmed into the system supply the applications (clients or servers). Supervision is made possible by the fact that they are programmed into the system at the stage of "static configuration". The GPM deals with running, stopping and inspecting the functioning of these processes.

2.5 Conclusion

As part of the VIES project, DG XXI has developed a telematic system to make the computer systems of the Member States interoperable. The system can easily be expanded to applications other than VIES since the telematic system itself is independent of the content of the messages it carries.

The management facilities of the network result in a good service. It is now geared to making widely different computer systems interoperable as part of a distributed systems architecture.

Two important functional developments are being examined: the first is to find the best way to generalize the use of the X400 subsystem in order to provide person-to-person mail facilities for the administrations connected to the system, the second to generalize the existing routing principles in order to allow the network to be extended to new telematic nodes and new applications.

ANNEX : VIES DOCUMENTATION

- **VIES Feasibility Study report** (FS)
- **VIES Feasibility Study Extension report** (FSE)
- **VIES Project Procedures and Quality Assurance Standards** (PQS)
- **VIES Functional Specification Report** (FSR)
- **VIES Software Design Specification Report** (DSR)
- **VIES High Level Design Document** (HLD)
- **VIES Low Level Design Document** (LLD)
- **VIES Test document** (TED)
- **VIES Software Installation Guide** (SIG)
- **VIES Software Upgrade Guide** (SUG)
- **Application Interface User Guide** (UG)
- **VIES Application Operations Manual** (OM)
- **VIES Initial System Administration Guide** (AG)
- **VIES Test System (mode 1) Administration Guide** (TAG)
- **VIES Technical Center Exploitation Plan** (TCE)