

**“TV Beyond 2000”**

*“WWMM Communication Services for the Christian community”*

**Executive Summary**

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## 1. INTRODUCTION

TV Beyond 2000 was a coupled paper study and pilot system implementation, leaded respectively under GSP and ARTES3 framework, as an answer to the requirements of CTV (Centro Televisivo Vaticano), on behalf the Vatican, who was asking for a unified infrastructure, capable to connect populations and religious institutions whatever their position over the world, and provide solutions for better and deeper communications with the community scattered over the five continents.

These activities have been leaded under the framework of the Jubilee 2000. This special event of one year duration, that should have reached anybody over the planet, was the object of a large amount of contents production: TV, radio, reports, text, public and private meetings, organised either for a regional audience by local representative entities, or at a global, world-wide, scale by the Vatican. Clearly, in the ideal context of a unified multimedia network, a bi-directional exchange between the core centre in Rome and remote places should have allowed anyone to assist live events anywhere over the world either in real or differed time. More, the storage of each production should have leaded to a one year memory of the events, accessible in differed time by anybody through internet. On another hand, a second request was that of real time private, secured, communication facilities – voice, videoconferences, mail, etc – between the head decisional persons inside each sub communities. To resume, CTV was asking for the whole set of possible multimedia applications, taking benefit of the announced convergence between classical media diffusion means and new interactive incoming ones ( multicast, internet and mobiles ), and for a really world-wide service.

This document is the executive summary of the two activities; more information can be found in the document “ TVBEYOND TV2000: Synthesis and Results “ which has marked the end of the two projects.

## 2. TV BEYOND 2000: THE STUDY

Starting from this request which was reflected in the GSP ITT launched by the European Space, Alcatel answered by the definition of an end to end infrastructure able to progressively support the whole set of services, as expressed below.

### 2.1 Services

The Christian community, represented by the Vatican, is a complex entity, that includes media providers ( TV, Radio , production of video, cassettes, newspapers, books... ) , universities, missionary centres and numerous sub-communities all over the world in permanent relation with intergovernmental, non governmental and governmental organisations.

On a service point of view, as a result, the ideal system shall provide both interactive and non interactive communications between the head quarters and remote communities, in between remote centres, with other public/private organisation, and with the consumers: if one requirement was to unify the three channels of TV/Radio broadcasting with Internet, the second was to provide more or less security services upon the same infrastructure, up to secured VPN solutions, to support and extend the private communications.

#### 1) Media provisioning

This service family answers the needs of a larger diffusion and larger access to contents, aiming at an integration of internet/ broadcast / multicast services. Multimedia contents are currently distributed by classical broadcasting means (TV and radios) or cassettes. These contents should also be multicast by IP/DVB satellite links directly to the user premises or to head networks, providing so a differed and permanent access to the information. Other services include production and encoding facilities, storage, file management, and all distribution / access means as described in the point 3.

Besides the service platform should host a convivial web site for informing and providing access to contents for all push, streaming, downloading services. The same platform should host the broadcasting means in order to unify the different distribution legs.

These services as a summary are those provided by the broadcasters and internet service providers, but here concentrated on those contents that build the community identity and provided under a unified platform.

#### 2) Corporate services

These services are designed by "corporate service family", i.e. all those internal communication services between the different customer's premises, and the different governmental and non governmental organisations with which they work, provided through secured one to one, one to many and even many to one configurations.

Following similar studies for multinational companies, Virtual Private Network services including intranet and extranet accesses, appear as the best way to provide a unified secured network, world-wide, to support all these private communications. Due to the coverage, an IP VPN is foreseen, supporting the integration of any access technology to cover the variety of the local telecommunication networks.

The same infrastructure can support interactive Voice, mail, fax, videoconference services but it is also open to mobile services, the PBX offering transfer capabilities plus CTI capabilities. Due to the variety of potential terminals ( from TV, computer, mobiles, ..) the interface with the information system is to be designed as the new age portals: multi access and multi terminal.

Web services and portal: the customer has already a principal web site that provides public information and a lot of independent web sites over the world. Web services unified by a portal could allow the customer to mask the distribution of its activities and information system by providing a unique entry point towards contents and services, acting as a bridge between the different individual web entry points.

Above these basic services, dedicated applications can be supported as medical or learning ones, with the advantage to be native world wide environments.

### 3) Core Services

The last set of services, generally provided to ISPs/ CSPs and Telcos, are building block of the overall infrastructure: they rely upon the integration of a core satellite distribution service and terrestrial infrastructure. These are :

- ◆ Contribution/ Distribution Networks and network optimisation services: mirroring, caching, storage and hosting services for an optimal access to contents in a worldwide context.
- ◆ Broadcast / multicast / internet services through a unified architecture: the objective is to feed the system PoP with contents that are elsewhere broadcast ( radio or TV ), to answer the requirement of a unification of these two services. The whole set of access technologies ( xDSL, cable, fixed wireless ) is otherwise to be taken into account and can be deployed on demand behind a satellite landing point.
- ◆ The unified VPN service, is part of the “corporate services portfolio”, it is a means also for the infrastructure in charge to serve the restricted community in its whole (1). On a network point of view, depending on the existence of a local terrestrial connectivity to the backbone, the service will integrate in some isolated cases two way and one way satellite systems. Such hybrid VPN are unified by the central management system which ensures the security and quality of service.
- ◆ Fast internet access and Trunk services: These services are deployed generally in less developed countries to offer respectively fast access to terrestrial backbones and a regional / national connectivity between PoPs. They are provided by satellite links as a complement of lacking terrestrial infrastructures.

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<sup>1</sup> *Restricted community: all organisations attached to and representative of the Christian community, with a direct or undirect link with the Vatican.*

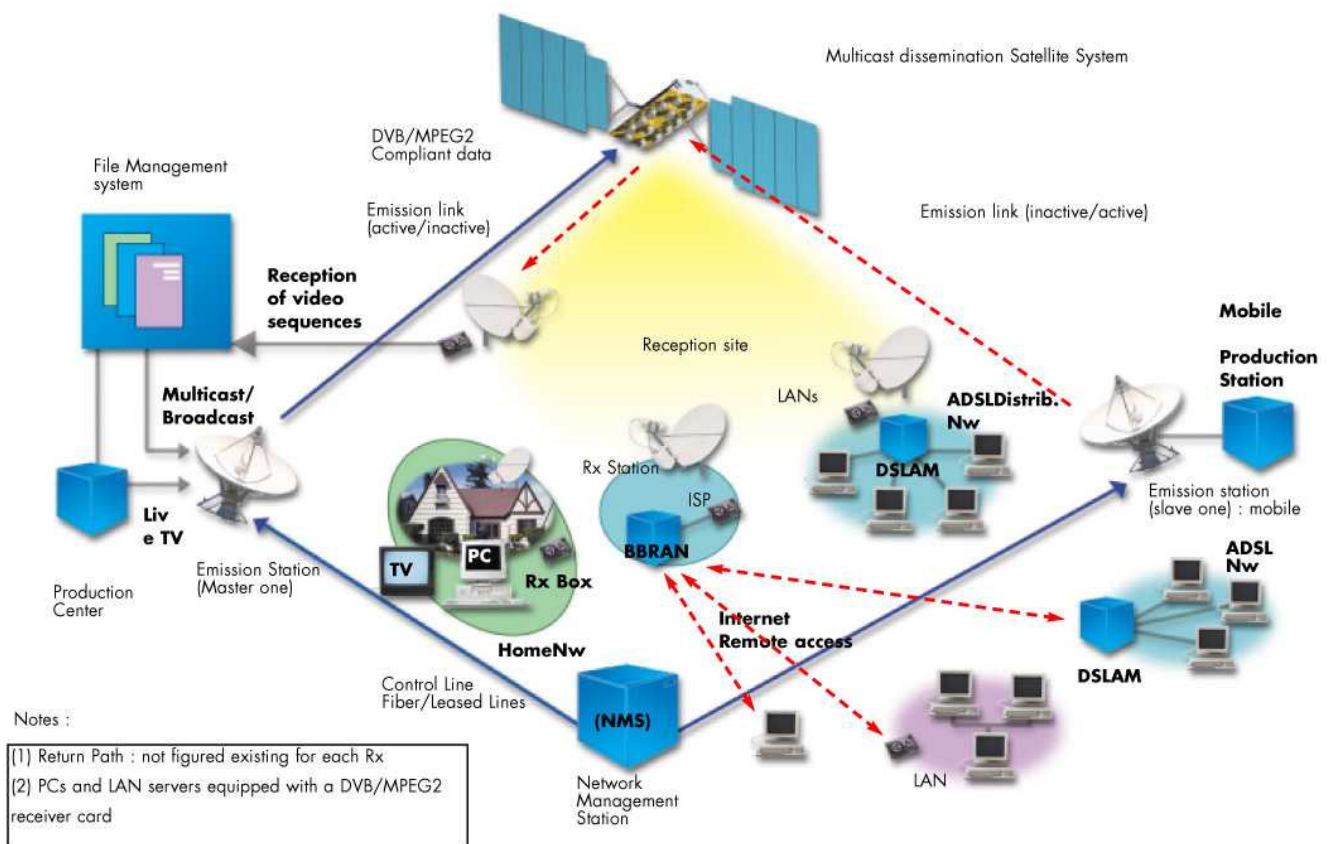
These last “building blocks” services, ready to deploy with or for the operators and media providers, offer chains of the often lacking networks.

Through this first study, some important starting points appear clearly, as especially the unification of the information system and of the management system: the set up of a central hosting platform with remote PoPs to outsource the management system, the applications and services, the portal and in some extent the contents is recommended, as opening for all other upper layer services with the guarantee of a seamless integration and a resulting One Stop Shop services.

**2.2 System studies**

Satellites rub out frontiers ; they can provide a real time communication link to any point in the five continents; they appear so clearly as the core infrastructure .

From the landing point, the local environment is taken into account to offer the most adapted access technology, being xDSL ( as shown below), cable, wireless WIP/LMDS or two way satellite systems. Such conjugated networks answer perfectly the first coverage requirement, even for isolated places or less developed countries, where the end to end communication link can be ensured by pure satellite systems or mixed satellite and wireless distribution networks, filling the lack of local telecommunication infrastructures.



**Figure 1: System approach**

For convergence needs between classical TV and new interactive video services all upcoming technologies are integrated by means of IP and MPE/DVB as drivers of the end to end communication chain. This allows to support both TV distribution, interactive TV and video streaming or simple video push services on the same "bus". In summary the Vatican requirements could be satisfied through a world-wide VPN infrastructure, build upon hybrid terrestrial/satellite IP VPN infrastructure completed by internet accesses. Such a solution answers both their internal communication needs and their wish to increase the communication with everybody through interactive/not interactive, real time/non real time services. Of prime importance are the contribution / distribution networks: for the customer which is also a content provider: these high speed legs of the infrastructure are part of the VPN. They are provided with all mirroring / cache / distribution facilities to improve the overall end to end content distribution chain. Contribution and distribution networks, are built on hybrid satellite and terrestrial networks according to the existing infrastructure, with the objective to optimise the feeding of the distributed Points of Presences.

### 3. TV BEYOND2000: PILOT SYSTEM

#### 3.1 Scope and context

It is clear that the previously described requirements could better be faced under a stepped approach of the overall system: partial answers to these requirements exist already even if their availability in a really world-wide context was still to be proved; on the reverse, some incoming technologies do not yet appear stable enough to start a real deployment ( mobiles for instance, two way at the date of the proposal).

In parallel to the study, Alcatel proposed so to set up early a live prototype of the infrastructure, able to progressively include the whole set of required technologies and services and able to evolve with new incoming technologies.

This activity was leaded with the objective to validate some of the concepts emerging from the paper study and prove, on a reduced but representative network, the feasibility of deploying a really world-wide service, at reasonable costs, and for a satisfying resulting quality of the services.

The system scope has so been defined as follows:

- The service portfolio was limited to video distribution services (MPEG1-2 push and MPEG4 streaming services ) but with a focus on the resulting quality, playing with the encoding/ decoding, distribution chain to evaluate the end user service.

The choice of the remote sites was achieved to be representative of the final conditions: fourteen sites have been selected, but covering all representative entities of the Christian community ( from isolated missionary entries to big university centres, embassies, media providers). Their positioning over the world was also representative of the whole scale of the telecommunication infrastructure levels ( from poor internet accesses to high speed leased lines ). At least, the choice offered a balanced implementation over the world ( Africa, South America, Asia and Boston ).

The figure below shows the distribution of the system over the world:



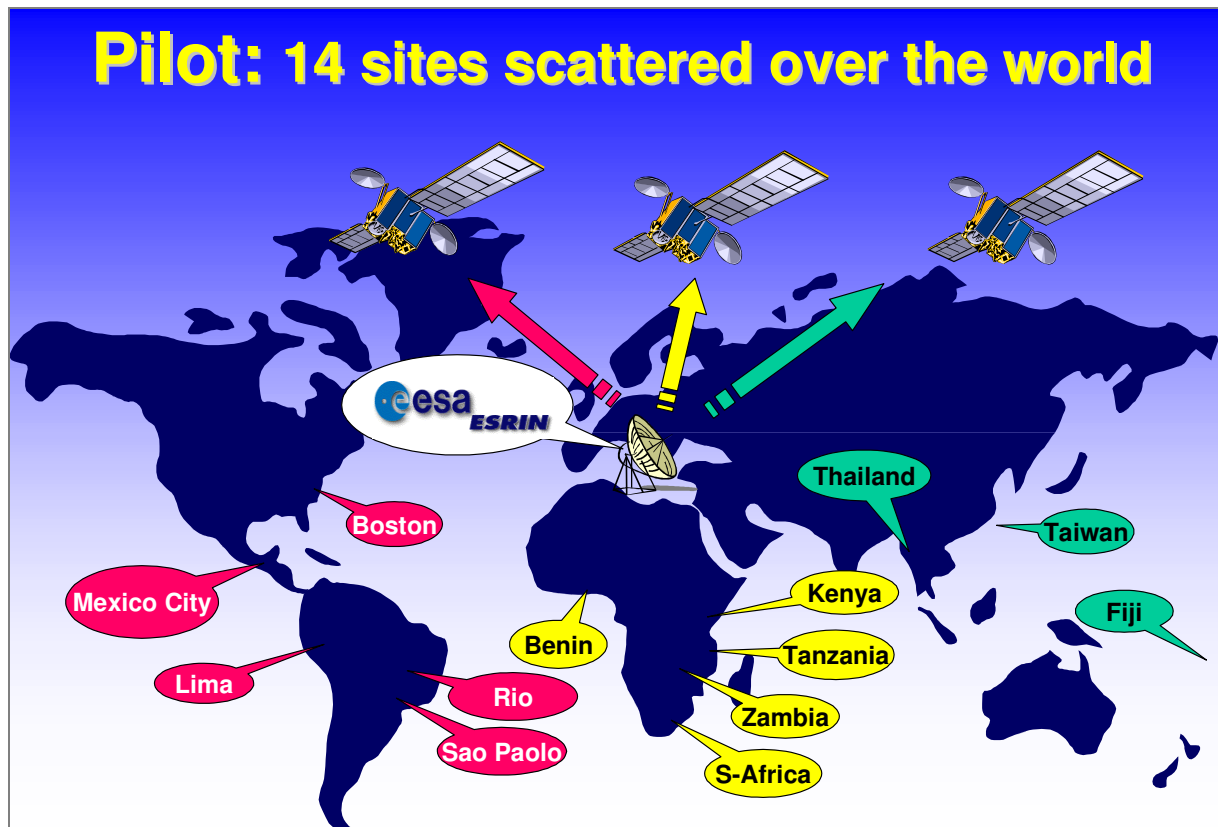


Figure 2 : TV beyond 2000 pilot stations positioning

The satellite constellation is built upon existing independent GEO satellite systems, all together providing the overall world coverage:

- Hispasat 1C for South America,
- Eutelsat W1 Africa Beam for middle and South Africa,
- Eutelsat W3/W2 for Europe.
- Asiasat 2 (3) for Asian areas, with a double hope via SATLINK in Israel (covered by W1).

The choice of the satellite systems has been guided by two criteria:

- Independence from any global operator, the objective being to deploy first over the most isolated areas of the world, the reverse of current market strategies.
- The integration of "regional operators" that have built their strategies and services on regional and cultural markets. This is the case of Hispasat, partly Globecast and Asiasat whose links with the regional deciders and the populations are essential to provide a global worldwide system in respect of the particularities.

### 3.2 Architecture and technology.

During this pilot step, the system skeleton has been set up: the uplink facilities of the ESA/ESRIN site in Frascati have been equipped by an IP/DVB transmission chain that includes:

- **the IP/DVB gateway**, the core of the transmission chain. It encapsulates the IP packets into MPE/DVB streams, which are then transmitted through the satellite to the n remote receivers, The gateway can operate in unicast or multicast modes which allows to deliver fast Internet services or VPN services besides classical multicast pull/push/streaming information services. Moreover, thanks to the UDLR technology, interactive services can also be performed upon hybrid configurations that allows for upper level collaborative working services, teaching, videoconferences, etc: as so the services scope could then be enhanced on demand and so the future integration of terrestrial networks is guaranteed.
- **the radio transmission chain** composed of Newtec equipments : a DVB converter and an amplifier.
- **a firewall** developed under Free BSD to protect the system against intrusions.
- **the data servers** : one for video streaming services and for the IP multicast push services.
- **One or n receive stations** : the A9722 satellite routers, that receive the MPE/DVB streams, extracts IP packets and forwards them to LAN, servers or end users. It is a one way equipment with classical return link connectivity, being through internet, leased lines, ISDN, mobiles..

The difference with other products of the same type relies – outside UDLR - on its advanced routing capabilities, that allows to distribute the received data to a server, directly onto the LAN or to a single computer, that can itself be connected to a TV set, a big screen for video applications. The equipment can be considered in that way as a middle, convergence point between different portfolios, allowing for a variety of end user profiles, from a consumer type with a single computer (or even TV set ) to enterprise's one with large LAN environments and was so answering the variety of the end user configurations: from big LAN to isolated places.

### 3.3 Tests and validation principles

To achieve the work, the system was built on a “active–reserve” principle with services and configurations first validated by Alcatel premises in Cannes and then reproduced by the ESA/ESRIN platform for a first internal validation step, achieved between the three sites of ESA/ESRIN, ESTEC and Cannes: Cannes provides a satellite coverage limited to Europe.

This internal test bed, integrated in the final pilot system, was also used as a reference point during the user validation phase, a method that has proven its efficiency in case of system failures, and is to be extended to distribute such reference points over the five continents.

## 4. BILAN OF THE ACTIVITIES

The study, started in April 2000 and the first pilot in September 2000 to end both in May 2001. This timing has allowed to set up the first pilot as described above, with the fourteen stations scattered over the most isolated places of the world.

### 4.1 Users feedback

In May 2001, the end of the activities have been marked by a top level meeting between ESA and the Vatican during which a very positive return from the users has been expressed:

- for the most isolated users, it has brought the first level of connectivity they were asking for.
- For the most exigent users – TV channels or universities – it has proven the level of quality that can be reached by such a low cost infrastructure.

On a technical point of view, the objective was to prove the feasibility of the “all IP and hybrids” concepts to provide world-wide telecommunication systems at reasonable costs; the choice of IP DVB satellite transmission chain, added to the usage of UDLR has a first major advantage : a total integration in terrestrial networks. UDLR is a protocol, an IETF standard, that hides the asymmetry of the forward and return links : being for the satellite transmission chain, or for the terrestrial return chain, UDLR acts as a middle-ware that allows to treat the two chains as a unique one.

More the usage of IP protocols and terrestrial connection schemes ( as PPP ) by the satellite chain allows to deploy end to end services as on terrestrial networks. Hybrid systems can so be envisaged where the best channel, ground or space, is chosen according to the two major criteria : service type and level of local infrastructures.

The second objective that was to prove the resulting quality of the received video files has also been attained: some transmissions have been reused by the customer to replay the received film in a church. The HDTV quality can be attained with MPEG2 multicast push services, where the terrestrial return link is used to send retransmission requests. The MFTP software suite used, that works on Non Acknowledge principles, discharges the transmit station for heavy treatments and guarantees in the mean time a good error correction ratio. More, this technique has allowed to use one reference station with a terrestrial connectivity, to manage the retransmission requests for all other stations under the satellite coverage. The quality will be the same for all stations.

### 4.2 Technical and prospective issues: towards 4G networks

The first conclusion of the paper study was its dimension: the project addressed the complete set of current research axes in the telecommunication and multimedia fields  
**In particular, the requirements cover:**

- The need for a worldwide coverage integrated communication system offering multimedia services both interactive and non interactive, with contribution /

distribution / internet – like accesses facilities , is expressed by numerous communities.

- Services are to be offered through a One Stop Shop model: customers and users wish to be discharged of technological complexity ; the system shall provide them with a panel of services and take in charge the definition and the delivery of all needed equipment and applications, their installation, the user support and maintenance.
- Such an infrastructure shall answer as a first requirement a balanced coverage of the world, and therefore will better take advantage of satellite capabilities to provide landing points anywhere over the earth, under reduced installation delays and at reasonable costs, filling the lack of local telecommunication facilities. On the reverse, all existing and incoming terrestrial communication means offer a comfortable complement to space systems. The infrastructure, defined as the most suitable way to achieve both low costs and coverage balance, is so clearly an hybrid network, built from space and ground segments. The question of mobility arises in a general climate of doubts; anyhow several systems emerge both space based, terrestrial based or hybrid that will have to enter in the composition of the system to provide both services and users mobility.

#### 4.3 The “pilot system” approach: towards a WW research infrastructure

The set of user requirements expressed ask for the whole set of actual multimedia services and technologies for both public, media providers and corporate; the Christian community appears so as a precursor, able to boost for an integrated and really world-wide one stop shop system. This is a unique chance to think global when all services are thought for developed countries, without considering the interest communities in their whole.

This anyhow can't be answered outside a research framework and a stepped approach to early answer the requirements: the overall system integrates each new pilot subsystem after the users' validation phase. The system if set up can in that sense be considered as a live demonstration platform of the European technology and as a live "Word-Wide Research Platform", a unique tool to maintain a technological advance.

The foreseen TVBeyond 2000 second step, was thought to provide telecommunication means in the most isolated countries through end to end wireless systems with the deployment of a restricted number of wireless loops: a first advance towards increased communication means.

#### 4.4 Opening to other communities

Taken in a global approach, the system studied for the Christian's community can answer the needs of various other big communities with worldwide activities and that all face the lack of telecommunication means in most areas of the world: Non Governmental Organizations (NGO) and Governmental/ intergovernmental ones ( embassies, governments, United Nations, ...) but also medical corporations, teaching and research organizations so that other religious organizations such as the Muslim.

Clearly, even if requirements of each still need to be detailed, precede works achieved with some of them prove already the validity of one concept :TV Beyond 2000 should evolve towards a shared and secured hybrid network, controlled by a distributed management system, offering the panel of multimedia based communication/dissemination services integrated in a unic services platform. Sharing, Security and Space techniques are certainly key « components » of the answer.

#### 4.5 Business Model : a reversed approach of the markets

Besides its high technological interest, the projects had another dimension brought by their social and humanitarian characters. The concept of virtual – interest- communities, built upon an interest centre and independently of distances are now recognised by the media, leading also to the concept of globalisation. Through the TV Beyond 2000 study this concept reaches a world-wide dimension, allowing to think a better balanced situation between rich business areas and less developed countries. By deploying new connectivity solutions, the system if deployed could pave the way for a local development of the most isolated places of the world, which goes in the sense of several international declarations.

To achieve this goal, with reasonable commercial objectives, both the business model and business plan are to be studied under this objective of a reversed or balanced deployment strategy between isolated and rich countries. The first studies lead also to the conclusion that this needs the support of governmental and non governmental organisations and an opening of the system to various user communities: the sharing of resources ( storage, networks, applications...) allowing for a more credible business plan. In other words, this should better be achieved through an European initiative

The business model studied, recommends the set up of a “ self-content consortium”, able to provide internally the whole set of competencies, technologies and contents ( the user group(s) is (are) the content provider(s)), through a joint venture created from industrials, operators, media providers and possibly non profit organisations. Such a scheme guarantees a unified service delivery, whatever the registration place over the planet. More this model adopted by the most famous consortium built around the media has proved its efficiency by the internal control on the overall value chain.

The role of ESA is obviously out of the scope of the study. However, ESA represents both the neutral organisation and the research driver, capable so to guide the future system evolutions in relation with the technological advances, for the benefit of users groups and not for an immediate profit. This appears to be the only one way to pursue the searched reversed attitude towards incoming countries.

#### 4.6 Cross connected programs

The project has highlighted some links with some research programs of the European Commission and especially:

- **GRID and Space GRID family**: Space GRID is the first of a succession of ITTs that targets the application to space activities of the GRID principles started inside an EC initiative. Two major axes are to be foreseen: GRID for Space , the current activity that looks at the impact on and interest for space applications, to apply GRID principles (

especially distributed computing and shared distributed storage resources); Space for GRID, which means on the reverse to apply space transmission capabilities to improve GRID infrastructures is a new research axis that appeared clearly through the TV Beyond 2000 activity: the transmission means set up, if open to various communities, apply all GRID principles but on an infrastructure that makes the best usage of space systems.

**- Cross connected programs of the EU:**

**a) Contents:** the program e-content of the European Commission looks at wide scale infrastructures and software to allow for collaborative works in multilingual and multicultural environments. In particular, being for research, medical, learning fields it asks for translation, directories,... in order to build unified information systems for the various communities.

**b) Economic development of incoming countries:** several programs intend to sustain the economic development of incoming countries through the support of the European competencies: EUMEDIS for the Mediterranean countries, INCODEV for African and South American ones. Anyhow, nothing at the day exists to present globally Europe as a technology provider and set up solutions for the deployment of telecommunication and services to these countries. There is so a positive cross connection to establish between these program.

## 5. CONCLUSION

**If continued, the activity can take a role in the development of incoming countries and drive in the mean time research activities for a better positioning of satellite technologies in multimedia service delivery. TV Beyond 2000 was a really complete activity.**