Integrated Project 26950 : SatSix
Deliverable 3000-11
Exploitation Plan

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Abstract:

This document describe how the different partners will exploit the results of the SATSIX project in their roadmap produced, their services (operators) and seeks university.

First, a detailed business plan with market player feedback and market analysis feedback is presented with the identification of potential users, services and market stakeholders (mobile operators, satellite pay-TV,…)

Then, the document describes how SATSIX partners will exploit the results of the project in term of equipment (roadmap, evolution), future research study and expected training.
Finally, the document will detail the logic and justification of the validation process of each functionalities addressed in the project, i.e. why choose simulation and/or emulation and/or trials.

Keyword list : Satellite, IPv6, DVB-RCS, Terminal, WiFi, WiMAX, Results exploitation, Roadmap.

Executive Summary

This document describes how the different partners will exploit the results of the SATSIX project in their roadmap produced, their services (operators) and seeks university. This report identifies the key exploitable technologies arising from SATSIX, and discusses their applicability to various markets and domains (Collective, Corporate and Residential areas). It will have to include: A detailed business plan with market player feedback and market analysis feedback there is potential users and market stakeholders (mobile operators, satellite pay-TV,…).

In this report, we first describe the project and the expected results. Then we examine the different exploitation opportunities in Collective, Corporate and Residential areas. Finally, the document describes how SATSIX partners will exploit the results of the project in term of equipment (roadmap, evolution), future research study and expected training

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1 INTRODUCTION

1.1 SCOPE

This report identifies the key exploitable technologies arising from SATSIX, and discusses their applicability to various markets and domains (Collective, Corporate and Residential areas).

This document describes how the different partners will exploit the results of the SATSIX project in their roadmap produced, their services (operators) and seeks university.

1.2 RELATED DOCUMENTS

RD1	SATSIX Annex 1 : Description of the work
D1000-2	"Residential Applications scenario", Deliverable 1000_2 SATSIX project.
D2000-1	" Network Architecture", Deliverable 2000_1, SATSIX project.
D2000-2	" Satellite Access Architecture", Deliverable 2000_2, SATSIX project.

1.3 TERMINOLOGY AND DEFINITION

Digital Video Broadcasting Return Channel by Satellite (DVB-RCS):	Protocol for an interaction (or return) channel in satellite links.
Digital Video Broadcasting via Satellite (DVB-S):	Protocol for broadcasting TV signals and by extension data over satellite.
Multicast	Communication capability, which denotes unidirectional distribution from a single source access point to a number of specified destination, access points.
Quality of Service (QoS)	Measure of the parameters of a network that influence perceived quality of communications, including the delay, jitter, bandwidth, and packet loss that packets sent by the application experience when being transferred by the network.

1.4 ABBREVIATIONS

ARC	Access Resource Controller
ASM	Any Source Multicast
ATM	Asynchronous Transfer Mode
BA	Binding Acknowledgement
BBframe	Baseband Frame (of DVB-S2)
Bps	bits per second
BSR	Bootstrap Router
BTP	Burst Time Plan
BU	Binding Update
CAC	Call Admission Control
MN	Mobile Node
MPEG2	Moving Picture Experts Group layer 2
MR	Multicast Router
MRD6	Multicast Routing Daemon for IPv6
NCC	Network Control Center
OBP	On-Board Processing
OBR	Out of Band Request
PER	Packet Error Ratio
PIM-DM	Protocol Independent Multicast – Dense Mode
PIM-SM	Protocol Independent Multicast – Sparse

	Mode
CCID	Congestion Control ID
CN	Corresponding Node
CoA	Care-of-Address
CRA	Constant Rate Assignment
DAMA	Demand Assigned Multiple Access
DCCP	Datagram Congestion Control Protocol
DLB	Dual Leaky Bucket
DR	Designated Router
DRA	Dynamic Rate Adaptation
DSCP	Diffserv Code Point
DVB	Digital Video Broadcasting
DVB-RCS	DVB-Return Channel Satellite
DVB-S	DVB-Satellite
DVB-S2	DVB-Satellite Second generation
DVMRP	Distance Vector Routing Multicast Protocol
FCA	Free Capacity Assignment
FSM	Frame Sub-Multiple
GC	Group Controller
GM	Group Member
GSAKMP	GSA Ket Management Protocol
GUI	Graphical User Interface
GW	Gateway
HDLB	Hierarchical Dual Leaky Bucket
HA	Home Agent
HoA	Home Address
ICMPv6	Internet Control Message Protocol version 6
IETF	Internet Engineering Task Force
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
KD	Key Download
LKH	Logical Key Hierarchy
MF-TDMA	Multi-Frequency Time Division Multiple Access
MAC	Medium Access Control
MIB	Management Information Base
MIPL	Mobile IPv6 for Linux
MIPv6	Mobile IPv6
MLD	Multicast Listener Discovery
PLATINE	PLATe-forme d'INgénieriE accès réseau
QoS	Quality of Service
RA	Router Advertisement
RBDC	Rate-Based Dynamic Capacity
RCST	Return Channel Satellite Terminal
RESV	Resource Reservation
RP	Rendez-vous Point
RRM	Radio Resource Management
RTJ	Request To Join
SC	Service Class
SE	Satellite Emulation
SDP	Session Description Protocol
SIP	Session Initiation Protocol
SLA	Service Level Agreement
SOF	Start of Frame
SSM	Source Specific Multicast
ST	Satellite Terminal
TBTP	Terminal Burst Time Plan
TC	Traffic Class
TF	Traffic Flow
TFC	Traffic Flow Conditioning
TFRC	TCP Friendly Rate Control
TS	Transport Stream
UDP	User Datagram Protocol
ULE	Undirectional Lightweight Encapsulation
VBDC	Volume-Based Dynamic Capacity
VLC	VideoLan Client
VoIP	Voice over IP
WS	Work Station
XML	Extensible Markup Language

2 OVERVIEW OF EXPECTED RESULTS

2.1 PROJECT OBJECTIVES

The main objectives of SATSIX are :

- to lower the cost of broadband satellite access, through the development of new satellite access techniques and the integration of wireless local loops (WiFi and WiMax),
- to develop recommendations, testbeds, trial networks showing how satellite broadband access shall integrate Next Generation Networks, based on IPv6, and support new multimedia applications.

The SATSIX project will thus focus on satellite systems that offer attractive solutions to the access segment of wider networks in several main scenarios, that allow:

1. for all types of users, to access the Internet and other widely distributed networks (e.g. Virtual Private networks - VPN's) directly or via local networks (WiFi or WiMax, LAN etc.)
2. for corporate and SME users, to set up (virtual) private networks via a backbone including satellite systems inter-working with terrestrial networks where necessary.

The project aims at demonstrating that satellite systems can be very good drivers for the deployment of IPv6 in the Internet, and could even play a key role. They can offer a cost effective and rapid solution for ISP's to provide native IPv6 connectivity and services to geographically spread early interested users.

2.2 EXPECTED RESULTS

SatSix project will foster the development and emergence of a variety of new applications that take advantage of IPv6 technology, for both corporate and consumer users. Commercial but also Open Source applications will be tested and benchmarked, using emulated and real satellite access.

The expected results will be the following:

- Impact of integration of IPv6 protocol (encapsulation,…) into DVB-S2 / DVB-RCS
- Integration of dynamic multicast service into satellite networks
- Security features for satellite network applications (Key management, DRM,…)
- Definition, selection and validation of header compression techniques
- Definition of resource allocation strategy and QoS enforcement for the different scenarios
- Integration of mobility management into satellite networks
- Integration of innovative applications into satellite network
- Definition of inter-networking aspects (Sat + WiFi, Sat + WiMax)
- Definition of hybrid satellite systems [OBP + Transparent payload]
- Critical path validation through emulated and live testbeds
- Provide recommendations to standardisation bodies

The engineering activity within SatSix will provide requirements and architectures for the development of the prototypes used during the experimentation. SatSix contributes to define the end user solution efficiently by coupling prototypes specification and trials.

Killer application is the key factor in IPv6 deployment. In this way, innovative applications and service can be quoted such as voice substitution, innovative P2P applications, support of new customer categories, videoconference, monitoring systems, TV over IPv6, etc.

3 EXPLOITATION PLAN

3.1 CORPORATE SCENARIO

3.1.1 Market Analysis

There are a number of factors in the global growth of satellite delivered IP networks. The ubiquity of and reliance on IP by Corporate and Government customers over the past 10 years has certainly been fundamental. Many Fixed Satellite Services (FSS) companies now offer a satellite IP networking solution, as do a larger number of VSAT service providers. The main advantages of the satellite delivered IP networks are summarised below :

- Deliver business grade broadband to any location allowing customers to standardise information flow and performance across their network,
- Enable business continuity, backup and emergency recovery of terrestrial network,
- Provide cost effective delivery of IP multimedia for corporate communications, training, software upgrades and similar needs.

According to Euroconsult (European Satellite Consultancy organisation), there were about 1,75 million VSAT terminals in operation around the world in 2005 and 600,000 of them could be classified as delivering broadband service to Corporate and Government customers. In the corporate and enterprise VSAT segment, future growth will be driven by the ever increasing number of small and medium enterprises (SMEs) and the associated demand for easily deployable, reliable broadband connections in areas underserved by terrestrial services. While rural telecommunications are also expected to play a big part in the future growth of this market segment, the consumer and small office/home office (SOHO).

This is an especially strong driver in the region, as many rural and suburban communities in the emerging markets of the region are still underserved by terrestrial communications infrastructure. As governments have universal access programs as well as funds and subsidies set aside to achieve this goal, initial capital expenditure is partially offset by these developmental subsidies. By providing telephony, video, Internet access, and education programs, satellite service providers have a chance to establish themselves as the complete as well as only communications provider to these communities, and margins beyond the short term can prove profitable.

The global satellite broadband market is expected to nearly double in terms of sites between 2005 and 2010. This outlook supports the “Euroconsult” forecast that shows strong growth in global transponder demand for IP data. Looking at regional trends, North America dominates the global broadband market today and its leadership is expected to remain unchallenged through 2010. Asia broadband sites are forecasted to show the most rapid growth of any single region, more than doubling by 2010 to over 200,000 sites. Approximately 29 percent of VSAT sites are used for traditional corporate networking functions such as internal networking, information broadcast, or Internet access, and it is this 29 percent that represents the most lucrative segment for service revenues, as corporate customers typically engage in a complete solution of managed services. Given Asia’s vast geography (8 time zones), and some 3,6 billion people (60% of the world population), this still represents very limited penetration. E-gov projects are another big driver of satellite IP services in Asia.

In other parts of the world, work from home or in a mobile environment is also skyrocketing. For example, European telecommuters are expected to grow from about 9 million in 2005 to about 20 million in 2010. Of this remote-user population, 40 percent will primarily use virtual private networks (VPNs) over dial access.

These telecommuters and mobile workers, whose numbers are increasing each year, share one need: secure, remote access to resources on corporate networks from any location. Combined with the use of VPN, these broadband services provide telecommuters and mobile workers economical, high-speed

access to corporate networks from homes, hotel rooms, small offices, and other locations that previously were limited to low-speed dialup services. An increasing demand from users and an expanding range of access technologies are boosting the demand for remote access VPNs and managed VPN services from service providers.

Large enterprises (1000 or more employees) view IP VPNs as extensions to existing network infrastructures. To meet the requirements of large enterprises for access to corporate applications, remote access VPN services must support strong security and compatibility with existing network designs. At the same time, VPNs must offer ongoing cost savings and scalability.

Midsized businesses (100 to 1000 employees) want remote access VPNs to deliver increased bandwidth for remote users and the ability to add new users quickly. Security, quality, and ease of management are also important criteria for midsized businesses in choosing remote access VPN services.

Small businesses (1 to 99 employees) are extremely price-sensitive, are interested in managed services because they often lack in-house expertise, and prefer bundled solutions. Remote access VPNs for these businesses must offer reduced costs for network access, equipment, and maintenance, and must simplify management of remote users.

Small businesses remain an underserved segment in the entire IP VPN market, although this segment is very large and offers huge revenue potential. Many service providers have been reluctant to address the small-business segment because of relatively low profit margins plus high costs for sales, marketing, and support.

3.1.2 Expected Services

The demand for remote access VPNs is growing because of two market factors. First, as workers become more mobile and workplaces more dispersed, businesses need to support secure, reliable, and ubiquitous access to corporate intranets. Second, the availability, affordability, and capability of broadband wireless technologies (Satellite and/or WLL) are also giving businesses compelling reasons to adopt a remote access VPN that operates over the Internet. Among these reasons are faster network performance, increased productivity, and improved access to value-added corporate applications such as voice over IP (VoIP), managed security, workforce collaboration, distance learning, enterprise resource planning (ERP), videoconferencing, multicast, and secure content delivery.

Considering VPN deployment, there are four (4) common solution sets that usually meet the corporate needs:

- Remote access,
- Site-to-Site (Intranet) connectivity,
- Extranet applications,
- Security solutions.

Security is the key in Remote access, Intranet and Extranet applications, as a means of ensuring that users only access information for which they have been approved. Corporate community has developed application specific security mechanisms in numerous application areas including electronic mails, network management and Web access.

3.1.3 Strategic Advantages

Although enterprises can readily recognize the benefits of remote network access, it has become more challenging to employ the internal resources and expertise for building and managing the required infrastructure. These challenges increase as the business grows and the number of remote access users multiplies. As a result, companies are interested in managed remote access VPN services for several reasons. Respondents in a survey conducted by InfoWorld and IDC cited the following factors:

- Better network support from service providers than can be provided by internal resources
- Cost-effectiveness with 24-hour management and maintenance by the service provider

- Improved security services with access to the provider's security expertise
- Improved service reliability
- Fast implementation
- Reduced need for technical training of internal IT staff
- Scalable services that meet business growth

Managed remote access VPNs enable teleworkers, mobile workers, and small remote offices to connect cost-effectively to enterprise intranets or extranets using a service provider's shared infrastructure, a partner's network, or the Internet. These VPNs maintain the same security and management policies as private networks. User access can be made on-net or off-net, enabling ubiquitous connectivity worldwide.

By offering broadband connectivity, DVB-RCS systems become a platform for the widespread deployment of VPNs. It is therefore expected that low cost services through satellite will open up new branch office and remote access markets for VPN vendors.

3.2 COLLECTIVE SCENARIO

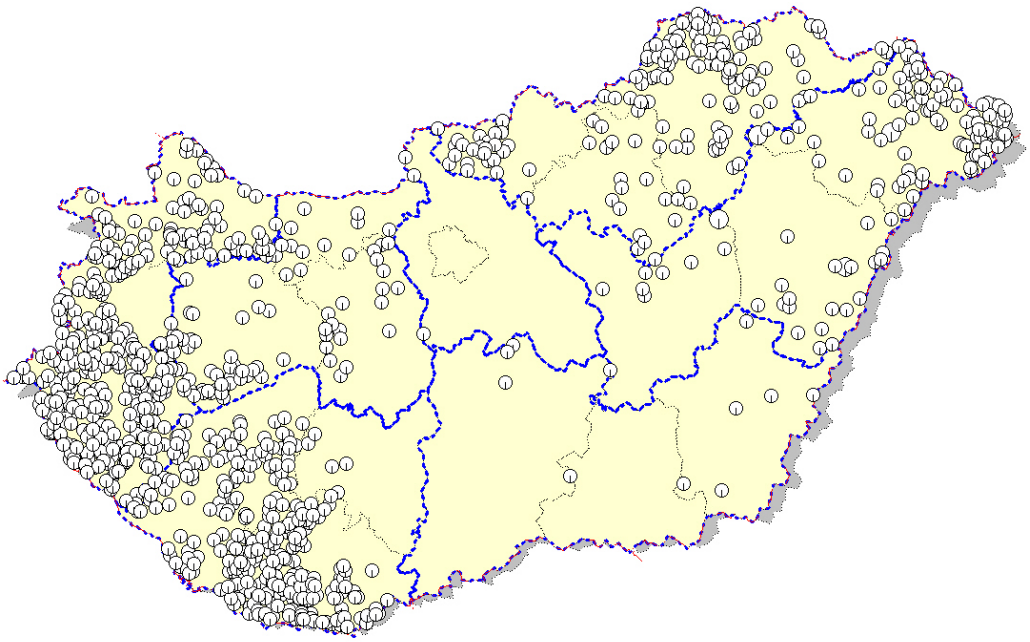
3.2.1 Market Analysis

The mobile phone subscriber base has reached an enormous 2.2 billion, with developing countries accounting for a huge majority of new users, more than 84 percent in 2005. Constantly rising demand for cellular services combined with under-developed terrestrial infrastructure presents a substantial opportunity for the satellite industry. The potential is particularly high in Africa, Asia and South America, with mobile operators in these regions increasingly turning to satellite to deploy their cellular networks outside major cities. These regions are expected to experience strong growth driven by network expansion into rural areas of India and China, and are poised to become the biggest market for satellite backhaul by 2010.

In fact, high levels of cellular technology penetration in all major cities and most big towns are driving mobile operators to proactively target rural and far-flung areas in an attempt to create new growth avenues. A major challenge in this respect is the need to lower operating expense (OPEX) since the communities served in these areas would typically be low-income ones. Internet protocol (IP) solutions have played a key role in making this possible by enabling a new wave of bandwidth reduction methods.

Recent developments in bandwidth reduction have helped bring down satellite backhaul expenses considerably, by almost 80 percent. This has significantly increased the appeal of satellite connectivity for many cellular operators, since it is proving to be more cost-effective than terrestrial fiber or microwave technologies. In fact, satellite connectivity combined with innovative technologies such as distributed local switching and pico-cells now represent one of the most cost-efficient ways of taking the cellular revolution to remote rural locations. However, with competition from terrestrial solutions fast increasing, the challenge for satellite backhaul solution providers will be to rapidly deploy these next-generation technologies, as only this can give them the competitive edge they need to succeed in the long term.

Due to the fact that in Eastern Europe and in Hungary there are many rural areas where the broadband Internet connectivity is not available, the shared satellite connection - combined with the WiFi / WiMax last mile access – can offer a cost-effecitve and easy-to-deploy alternative of the terrestrial networks in this places.



Hungarian settlements where the broadband connectivity is not available (2006)

The figure above shows those Hungarian settlements, where the broadband connectivity is not available. Comparing with the geographical map of Hungary, it is clear that the main reasons for the lack of broadband are the following:

- The economical state and the number of the habitants would turn terrestrial solutions unprofitable.
- The geographical situation hardens the deployment of alternative broadband solutions such as microwave connectivity (hills, forests, etc.)

According to HDT's market analysis, the collective solution may prove profitable when targeting the two following client segments:

- Residential communities, who would like to make use of the electronic governmental and business services. While a satellite connection would not be affordable to a unique user in the rural areas, using shared access and centralized settlement of the bill, a village community can be real target for such technology. Considering the fact that there are several ongoing EU programs for providing even chances for the underdeveloped areas, this market area seems real promising in Hungary.

- Companies that operate in rural areas, and have several endpoints relatively close to each other, for example surveillance systems.

Detailed explanation of the possible services for these client segments is included in chapter 3.2.2.

3.2.2 Expected Services

The use of satellite links to backhaul cell phone and other handheld wireless device traffic enables service providers to reach more customers and gain new revenue streams. For developing countries in particular, this ability to quickly and seamlessly deploy cell phone infrastructure to previously unserved areas can be crucial for supporting and enhancing economic development. Backhauling via satellite is becoming more attractive thanks to satellite equipment vendors that offer reliable, affordable and flexible solutions which can readily extend the reach of existing cellular phone and wireless broadband networks. At the same time, the idea of using satellite links to meet the growing

demand for new third- and even fourth-generation Internet Protocol (IP)- based services -- known as 3G and 4G services -- including mobile broadband and TV is gaining acceptance in hybrid networking circles.

The lower satellite backhaul costs per GSM telephone call are being achieved via more efficient backhaul architectures using voice compression and silence suppression along with new interface optimization techniques linking the GSM network's base station controller to any number of remote base transceiver stations. Satellite also can facilitate the migration from a high-bandwidth application-agnostic service provisioning such as Internet trunking to much lower-bandwidth, application-aware scenarios, says Rousseau. There is also some implementation of two-tier backhaul architectures that lower satellites' entry points via extensions with wireless backhaul technologies like local multi-channel distribution system or fixed WiMax.

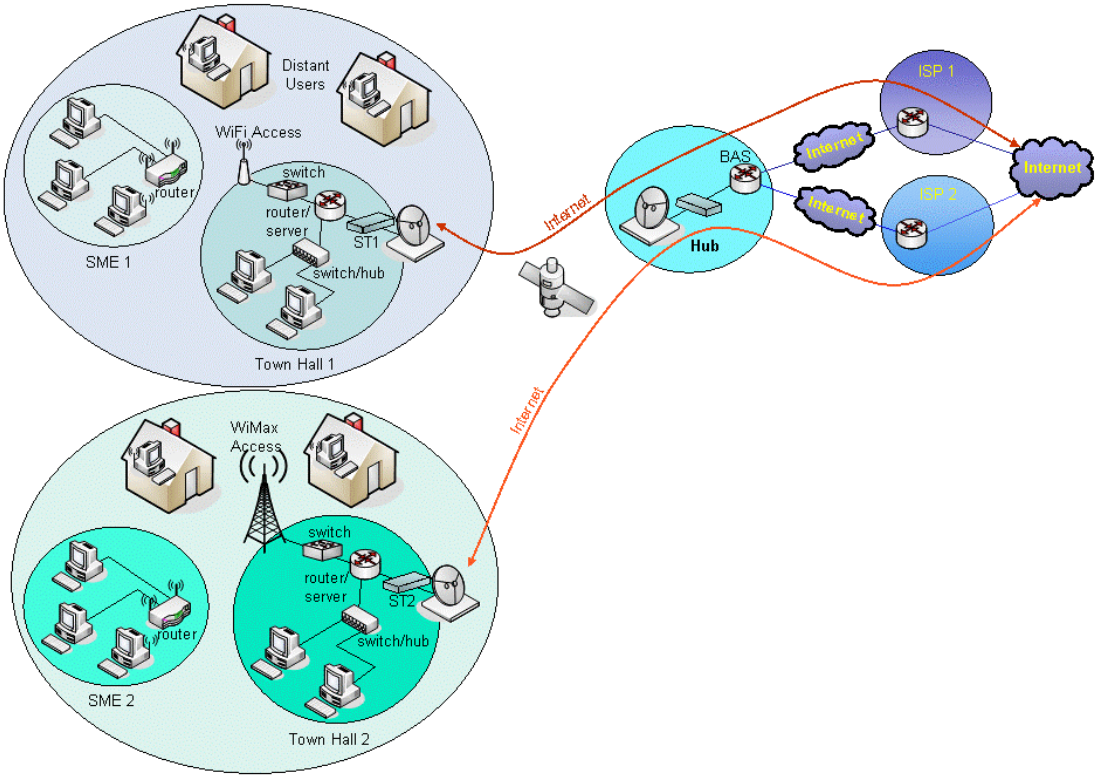
As operators seek more bandwidth at the cheapest price they can exert huge pressure on a backhaul solution that needs to address all the inefficiencies of cellular network communications. Besides packetizing network traffic -- reducing bandwidth requirements by as much as 50 percent without affecting voice quality -- and dynamically assigning bandwidth based on voice and signalling traffic volumes, the use of DVB-S2 technology includes advanced bandwidth allocation techniques to assign features that prioritize calls and data traffic. The continuing evolution in mobile and wireless networking standards makes it extremely important that operators and service providers implement scalable, extensible and upgradeable backhaul systems. Adopting packet-switched IP for transport makes upgrading the system for advanced services a lot easier as well.

Expected services for shared satellite connection with WiFi / WiMax last mile

The collective scenario for communities in rural areas of Hungary would consist of the following participants:

- Satellite provider (HDT) who deploys and operates the shared satellite link.
- Last mile provider who deploys and operates the access to the shared link via WiFi or WiMax technology. This can be HDT itself, or a third-party company.
- An assigned organization (typically the local government) who appears as the single point of contact for the providers, dealing with client-side project management of the deployments, and the bill settlement issues. It is important part of the collective scenario that HDT should be in business relation only with one central organization, not unique residential users.

The collective scenario for the rural areas is show in the following figure:



Even shared satellite connection may only affordable for the communities of the rural areas, if it is also sponsored by the government or the EU programs. In line with the Hungarian governmental purposes, the following areas are expected to be real services for the collective scenario:

- E-governmental services
  - Documents management
  - Tax
  - Licenses
  - Legal services
  - Vehicles related taxes and procedures
- Transportation
  - Time schedules
  - Online purchase of tickets
- Bill settlements
  - Utilities (water, electricity, etc.)
  - E-banking
  - Telecommunications (mobile account settlement)
- Entertainment
  - Sporting bets
  - Event tickets (cinema, theatre)

3.2.3 Strategic Advantages

Mobile operators need to connect their remote transceiver nodes with regional controllers over a reliable connection while keeping costs in check. This is not easy to do when demand for new services and competitive pressures require mobile operators to continuously expand their networks and increase bandwidth capacity at cell sites, thereby driving up operating expenses. The development of Wi-Fi and the growth of WiMax hotspots will only increase the need for satellite backhaul. The Wireless market is quickly moving towards an all IP- based architecture, so there will be the opportunity with IP-over-satellite solutions to simplify architectures and solutions through reuse of existing terrestrial wireless technologies for the satellite backhaul market. The use of IP technologies

in transitioning away from channelised services will give greater flexibility for service performance and enhancements as well as growth. There are numerous challenges that need to be addressed including the fact that long procurement and deployment cycles often can conflict with a company's operational needs and undermine efforts to actualize networks in a timely fashion.

The strategic advantages of the satellite based collective scenario are the following:

- Compared to the wired and microwave solutions, the VSAT deployment offers cost serious cost reduction in the rural areas.
- As the collective scenario should focus on the rural areas, it would possibly enjoy greater support from the governance, which helps in reducing the costs for the communities.
- The shared satellite backhaul makes the access affordable to the members of a community, while a unique subscriber may not tolerate the costs of a dedicated link.
- As the VSAT installation and relocation is quite simple compared to the terrestrial infrastructure, this solution offers good opportunity to test the needs of a rural area, and to relocate the hotspot if it is not needed any more (moving frontiers).

3.3 RESIDENTIAL SCENARIO

Residential user scenario is directly related to the "Triple Play" concept, which should be the main goal to reach in order to compete with other solutions like ADSL or Cable in low-density population areas. The principle of the 'Triple Play' concept is to provide the three basic access services (Television, Internet access and Telephony) through one single satellite communication network.
As a matter of comparison, in 'terrestrial' communications, telecom operators are offering today "Dual play" by providing both voice telephony and ADSL internet access over the same network (via traditional telephone copper cables). Some cable TV operators are competing with them by offering a "Triple-play" over their coaxial cable networks. Similarly, the 'Triple Play' satellite service is expected to offer the three access services together to remote communities, at an affordable cost.

A graphical view of the scenario is depicted in the following figure. In the transparent mode (red), users make use of the Hub & NOC station to communicate one to each other, whereas a direct communication will be achieved if a regenerative mode is used (green).

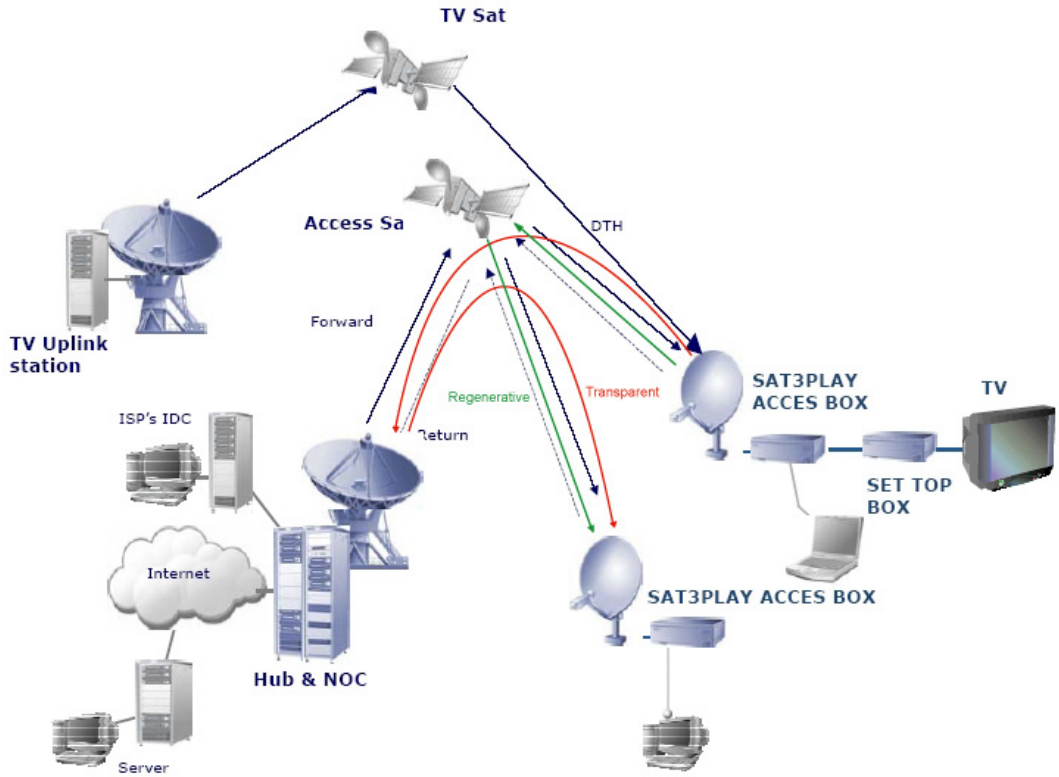


Figure 3.3-1 Satellite triple play network architecture

3.3.1 Market Analysis

In non-metropolitan areas worldwide, the availability of high speed terrestrial broadband services (i.e., those delivered over cable or DSL) is often spotty. Satellite delivered networking is therefore a fundamental piece of the broadband mosaic. European Satellite Industry pushed the DVB-RCS standard. This standard fully specifies the layered architecture and protocols for the transmission of IP packets between a central HUB station and remote satellite terminals using standard Ku/Ka-band bent-pipe geosynchronous satellites.

Today, there is a large worldwide interest for a definition of a return channel via satellite comparing to terrestrial return channels, and there are several reasons for that. Firstly, the "normal" consumer does not want to be bothered by technical set-ups with interconnections between TV, PC and telephone. A solution where all the technical equipment is concentrated within one box, as in ADSL box, will certainly be appealing for many people. Another reason to choose satellite services is the increased traffic in the terrestrial networks, which often results in blocking or reduced quality of service.

A typical scenario to be supported is the Triple-Play, the simultaneous delivery of the three main services: high-speed Internet, television (Video on Demand or regular broadcasts) and telephone service over a single broadband connection which represents a means for reducing cost and providing enhanced services for the final user.

In a first approach, what is important in the coming years for the satellite community concerned by broadcast and broadband services will be to be able to keep their existing infrastructures for TV broadcast. Consequently, triple play via satellite solution will rely on integration of voice and data over IP, with native TV.

The goal is to deliver user-centric Triple Play services to a residential satellite networks user.

3.3.1.1 Satellites and the digital Divide

Satellite applications excel in crossing the digital divide, as we define it. Rather than the social question of who can afford broadband Internet access, we concern ourselves with reaching areas and locations where terrestrial networks fail to reach at all. Running fibre or microwave links to thousands of islands in an archipelago nation like Indonesia or throughout mountainous territory of China, Afghanistan, and Colombia is simply impractical—no commercial organization is going to do this. Likewise, a small population on a Pacific or Indian Ocean island cannot expect to receive service from a traditional telephone company or TV broadcaster. For them, the satellite is the best means of delivering services.

However, this isolated or not very accessible areas are less populated, so satellite operators starts with a market niche smaller than terrestrial operators. Other inconvenience for satellite service providers to take into account is that not every satellite reach all the word, each satellite has a specific coverage and can't give access to different areas.

3.3.1.2 The future

Based on extensive analysis and modelling, NSR expects that DVB-RCS solutions will continue to experience incremental growth over the next four to five years. An accelerated standardization and testing process, cost reductions, the expected inclusion of DVB-S2 and broader market acceptance for standards will drive this growth. However, while standards- based solutions will experience increasing shares of the overall market, proprietary platforms will still represent the majority of deployed sites by 2008.

The cost of deployment is independent of geographic distance within the satellite footprint. Satellite access is less affected by local terrain than many alternative broadband technologies. This makes it an ideal technology to use in rural areas where it has the potential to be more cost effective than the alternative wire line or terrestrial wireless systems.

3.3.2 Expected Services

The DVB-RCS system delivers "always on" IP services and is targeted at residential, SOHO, and enterprises markets. The primary services offered to the residential segment are broadband Internet access (for enabling applications such as e-mail,, Web browsing, and file transfer). Additionally IP Multicast services such as audio/video streaming and distance learning can be offered through the system.

End-users benefit from the lower cost and extensible nature of the DVB-RCS standard. The separation between satellite dependant and independent layers in the terminal greatly eases the introduction of enhancements such as Performance Enhancement Proxies (PEP). These proxies counteract the effects of satellite delay and significantly improve users experience. The support of secure multicast felicitates applications such as audio/video streaming and distance learning.

In this chapter the requirements of residential scenario services are described. This applications are the basis of the satellite access residential Triple Play. Applications include Digital TV, in particular Television over IP (TVoIP) on DVB-S2 and video broadcasting (SDTV and HDTV) directly over DVB-S2, as well as Interactive TV. Other applications, in relation with a general Internet access) are:

- Web Browsing
- VoIP Telephony & Videoconference
- P2P applications

Next, we are going to study the most significant requirements of the characteristic applications in the scenario analyzed in this deliverable, the residential scenario.

3.3.2.1 Digital TV

One of the main uses of satellite networks nowadays is the provision of Digital TV Services. In this kind of applications, audio, video and data are broadcasted to final users by satellite in a one-way communication. For interactive applications, two-way communication is needed.

Digital TV also provides new opportunities for public TV to, for instance, provide interactive education and training programs never before possible under the current analogue standard of broadcasting. Digital TV is the biggest change in the TV medium since the advent of television itself.

Comparing with the analogue system, Digital TV is a very different technology; all DTV programs are sent as data, this data is used to carry from a simple picture to a very complex picture. In transparent satellite DTV a TV station sends the data to the satellite, and the satellite returns this same data over-the-air to the coverage area, where the parabolic antennas receive and transmit the information to the IRD, which translates instantaneously the received data and presents it on the TV.

Other strengths of Digital TV are:

- Digital high resolution quality picture and CD-quality sound.
- It's reliable no matter what the weather is.
- Provides Dolby digital sound.
- Access to on demand contents.
- Access to Pay Per View channels
- Picture-in-picture capabilities without additional hardware.
- Interactive program guide with parental controls, program reminder features, program summaries
- Ready for HDTV.
- Time shifting: watch prime-time shows when it's convenient for you.

3.3.2.1.1 Broadcast channel

Digital transmission over satellite has evolved considerably due to the development of new modulation and error correction schemes. DVB-S2 gathers together the most advances satellite transmission techniques, improving previous generation (DVB-S, EN 300421) to a point where it is so close to the best possible (the Shannon limit) that no other system will be needed in the incoming decades.

DVB-S2 was designed with a great flexibility, covering a wide spectrum of applications like:

- Broadcast services. This services are actually covered by DVB-S with a constant modulation and codification scheme, however, DVB-S2 provides added flexibility thanks to the VCM mode (Variable Coding and Modulation), that allows implementing different protection levels for each service: for example very robust standard television together with not so robust HDTV. The standard defines also BC-BS services (Backwards Compatible Broadcast Services) adding interoperability with DVB-S decoders; in other words, they allow DVB-S receivers to decode part of the DVB-S2 signal, through the use of hierarchic modulation schemes.

- Interactive services. DVB-S2 was designed to used with actual return channel standards, be it over satellite (RCS) or via RTC, and can operate in modes CCM (Constant Coding and Modulation) and ACM (Adaptative Coding and Modulation). DVB-S was developed for redifussion applications where constant error protection is constant, in other words, the system is optimized for the worst case: worst case, worst minute, and worst location. On the other hand, DVB-S adaptative mode or ACM turns out to be very adequate for interactive applications or point to point, as it allows each reception station to control its traffic protection. Specifically ACM allows FEC (forward error correction) scheme adaptation and frame by frame modulation, according with channel propagation conditions (rain, clear sky…) by means of sending channel conditions of each reception station over the uplink, so each user could operate with very low C/N relations and maximum speed, which involves undeniable economic savings.
- Digital Satellite News Gathering (DNSG) allowing point to point communications or point to multipoint communications of multiples MPEG transport streams using CCM or VCM modes.

3.3.2.2 Interactive TV

Interactive TV is, essentially, video programming which incorporates some style of interactivity - be it with data on video, graphics on video, video within video, or retrieving video programming and possibly recording it on a digital hard disk drive for further use. To the viewer, "enhancements" appear as graphical and sometimes purely informational elements on the screen overlaying (some technologies actually incorporate the data enhancements in the video MPEG stream such as HyperVideo). These enhancements will be part of the television program. In some cases, the viewer may want to access information that is irrelevant to the current programming such as news, stocks, scores, weather, and so on. To understand what these graphical elements look like, visualize the way semi-transparent banners with statistics printed on them during basketball games, car racing, or golf tournaments appear on TV now.

Some of the services offered nowadays by Interactive TV are:

- News - the latest local, national & international in-depth news reports 24 hours a day. On Satellite and you can also select video updates from our multiscreen menu.
- Sport - up to the minute sports news and results (displays the latest scores as they happen).
- Weather - high quality weather maps with comprehensive 24 hour and five day forecasts for home and abroad.
- Entertainment - the latest celebrity gossip, plus an video catch-up service (on Satellite) keeping you up to date with last night's episode.
- Interactive programmes - Extra interactive features including play along quizzes, voting opportunities and extra audio and video services.

Digital TV allows the transmission of small applications to be executed in the user’s set top box. Programmed in a language with a specific API (Application Program Interface) that communicates with the multimedia commands using the return channel, this applications make possible a communication between the final user and the interactive service providers.

Although DVB standard defines the mechanisms for data transmission with DSM-CC (Digital Storage Media - Command & Control), each specific API used during the application development transmits different data, making most proprietary APIs developed (OpenTV, Mediahighway, WinCE...) not interoperable. This makes interactive applications developed with different APIs not interoperable. This scenario requires standardization that is why the DVB GROUP has developed an open Java API named DVB-MHP.

The Multimedia Home Platform (MHP) defines a generic interface between interactive digital applications and the terminals on which those applications execute. This interface de-couples different

provider's applications from the specific hardware and software details of different MHP terminal implementations. It enables digital content providers to address all types of terminals ranging from low-end to high-end set top boxes, integrated digital TV sets and multimedia PCs. The MHP extends the existing, successful DVB open standards for broadcast and interactive services in all transmission networks including satellite, cable, terrestrial and microwave systems.

The architecture proposed tries to maintain the existing infrastructure by just adding a RCST shared by a whole building or even a neighbourhood, depending on the traffic generated by the users, using common infrastructure or SMATV structures. The interactive application makes use of this RCST uplink to the satellite to communicate users with the service providers. The link from users to the RCST can be seen as a small terrestrial network, allowing users to keep their set-top boxes, which mainly consist of DVB-receivers with a IP terrestrial return channel. The following figure shows clearly this structure:

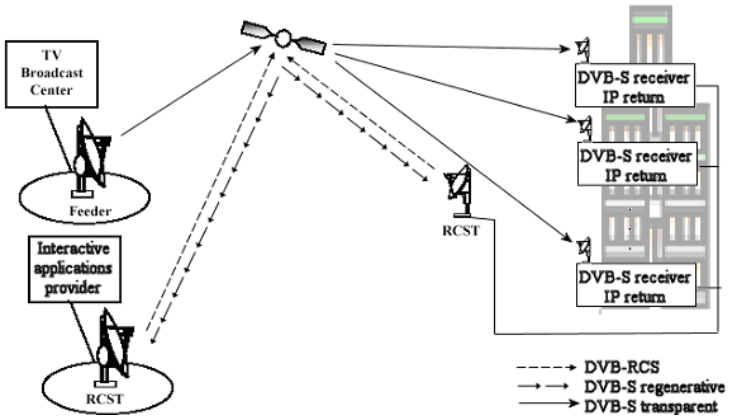


Figure 3.3-2 Interactive TV scenario

Examining the figure, it can be seen that applications can be transmitted via the broadcast centre or the interactive application provider, first of which was the one that has been in use up to date. DVB-S/S2 is used for downstream in both cases, whether it is emitted in transparent or regenerative mode, so, in both cases, DVB-S2 has to be supported by user's receiver. For upstream, the regenerative capability of the OBP is used in the second case. The return channel (via IP) is completely independent from the forward channel and can be either regenerative or transparent. In the latter case, the interactive applications provider must be connected to the hub via a satellite or terrestrial link, or being embedded in the broadcast centre.

3.3.2.3 VoD

Video-on-demand (VoD), allows clients to watch a video of their choice at the time of their choice. The universal broadband networks, provided by satellite systems, and the increasing capacities of low cost secondary storage in the consumer market have stimulated VoD in the recent years.

A distinction is generally made between "true" VoD and "near" VoD. A true VoD service does not require the user to wait for the video, i.e. the start-up latency • 0. True VoD is often considered inefficient and too costly to offer as a service. Broadcasting protocols can only provide near VoD service. Another term that is often seen in the literature is interactive VoD, i.e. a service with VCR-like functionalities (Play, Stop, Forward, Rewind, Pause). Broadcasting protocols in general do not adapt easily to provide interactive operations.

The popularities of movies follow a Zipf distribution with a skew factor of about 0.271. That is, about 80 % of the requests are for the top 10 to 20 movies. Therefore, It is usually to separate the movies into the most popular ("hot-set") and less popular (cold-set). A periodic broadcast scheme is usually used for the hot-set whereas some form of batched multicast can be used for the cold-set.

The basic VoD architecture is composed by:

- Service provider (SP) side: where VoD servers are allocated.
- Satellite network: This connects clients with SP.
- Client side: it is characterized by the IP set-top box, that is the device that enables a television set to receive and decode digital television broadcasts.

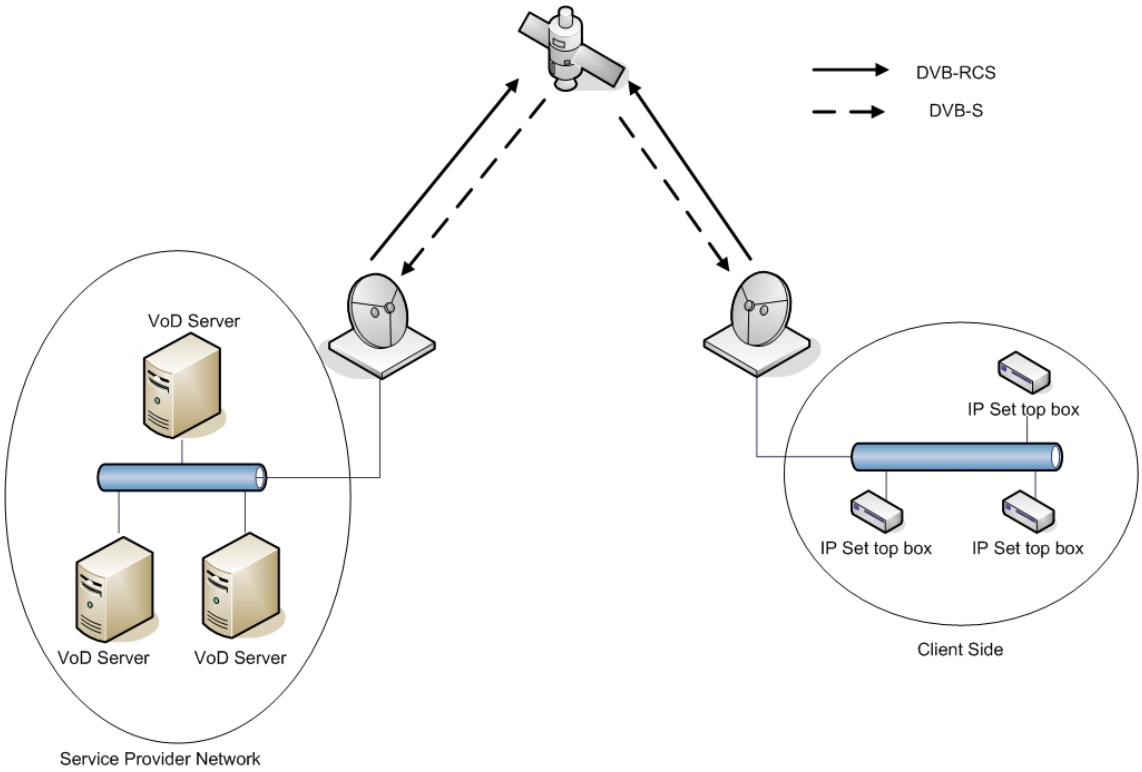


Figure 3.3-3 VoD basic architecture

Bandwidth depends on the quality selected, but 2 to 5 Mbps are a typical range.

VOD service proposes to provide subscribers who are connected through a set-top box (STB) with the possibility of ordering at any time the video of their choice and starting immediately to watch it on their television set. The Video on demand (VOD) server may be outside the satellite network. The video on demand requirements are collected in [D1000-2].

3.3.2.4 Others Triple Play applications

3.3.2.4.1 VoIP

VoIP is a very broad application category designed fundamentally to transmit voice conversations over a packet data network using the Internet Protocol. The specific network infrastructure could be either the public Internet or a corporate Intranet. According to Newton's Telecom Dictionary, there are several potential benefits to moving voice over a packet data network using IP:

- Saving some money.
- Achieving benefits of managing a voice and data network as one network.

- Having IP phones, “adds, moves, and changes” will be easier and cheaper.
- Simplifying call setup, tear down, and transfer of calls.
- The key attraction is added (and integrated) new services, including integrated messaging, bandwidth on demand, voice e-mails, and the development of “voice portals” on the Web.

3.3.2.4.2 Web browsing

Web browsing enables a user to display and interact with text, images, and other information typically located on a web page at a website on the World Wide Web or a local area network. Text and images on a web page can contain hyperlinks to other web pages at the same or different websites. Web browsing allow a user to quickly and easily access information provided on many web pages at many websites by using these links.

3.3.3 Strategic Advantages

In this section the provision of residential services by means of satellite technology is compared to the provision of the same services by means of other technologies, to conclude finally in what cases DVB-RCS/DVB-S2 is the best option.

3.3.3.1 Opportunities in a Residential Scenario

Nowadays there is a fierce competition scenario between the more settled cable and satellite operators and the newer TV over DSL operators, which is expanding very quickly. The Quality of Experience should be improved in satellite networks to better compete with terrestrial networks, for example Channel Changing in satellite networks has to be reduced.

An important obstacle of satellite networks is the limited bandwidth, which will be eluded with the use of DVB-S2. DVB-S was developed for broadcasting applications where the physical layer protection is constant for every service and constant in time. DVB-S2 will do what DVB-S could never have done for new applications: delivery of HDTV and IP based services and professional applications.

- Combining the DVB-S2 ACM technology with multi-spot Ka band satellites, current satellite capacity prices for Fast Internet connections can be reduced by a factor of 10. This may re-open the competition with terrestrial ADSL, at least in rural areas or in developing countries. The DVB-S2 ACM technology allows FEC/modulation adaptation according to the propagation conditions (rain/clear sky, beam centre or beam contour…).
- For professional TV links, DVB-S2 combined with ACM can allow the development of extremely small fly-away terminals (90 cm antenna and about 10 W HPA power) while offering excellent picture quality (3-8 Mbit/s MPEG-2 or AVC video).

3.3.3.2 Opportunities for DVB-RCS

A primary reason for consumers to buy a new PC or upgrade the operating system is to use broadband enabled multimedia applications like audio/video streaming and file sharing. Broadband implies an “always on” connection which frees up a telephone line and facilitates the connection of multiple home computers to the Internet. The availability of lower cost DVB-RCS broadband over satellite services opens new markets for vendors in this category.

With a cheaper workforce than in many Western European countries and a growing economy, it makes good business sense for multinational companies to open divisions within Eastern European and ascension countries. These companies require broadband Internet services to connect and relay data to and from offices at different locations. Today only satellite can deliver this efficiently in many parts of Central and Eastern Europe. Several other types of companies find two-way satellite solutions attractive including:

- Companies that are unable to gain access to terrestrial broadband solutions
- Government and academic institutions wishing to transmit large quantities of data, such as telemedicine or distance-learning applications, to other institutions
- Small companies who require real-time information in specialist areas
- Professional Internet users requiring large amounts of bandwidth

Besides, in a residential scenario, DVB-RCS presents itself as a promising solution and a flexible way to connect users, especially to reach them in rural areas currently not covered by terrestrial xDSL solutions.

Internet access, VoD, Digital TV and software download are some of the services available for end users with DVB-RCS technology: Thus, no matter where the user is located, he will be accessible and will be able to access to any source of information.

3.3.3.3 DVB-RCS Benefits

The benefits brought by Digital Video Broadcast- Return Channel via Satellite (DVB-RCS) are:

- Being based on the Digital Video Broadcast – Satellite (DVB-S) standard for the downlink (network to terminals), DVB-RCS technology can easily mix broadcast, multicast and two-way traffic, enabling attractive service mixes to be delivered to users.
- For the uplink, DVB-RCS provides efficient transmission and achieves excellent carrier loading factors based on contention-free advanced resource allocation mechanisms adapted to various types of traffic (up to 4Mbit/s).
- Full compatibility with all Internet Protocol (IP) based applications.
- Approved in 2000 by the European Telecommunications Standards Institute (ETSI), DVB-RCS is now a fully implemented and tested multi-vendor technology.

3.3.3.4 Competing with terrestrial technologies

In this section, the scenario competitiveness compared to other technologies (in different aspects) is going to be determined.

Access network technologies are in constant evolution. While there is a general agreement about the necessity of optic fibre technologies in core networks, the access to the customer has a lot of different alternatives more or less optimum depending on the scenario.

Satellite communications networks, due to its inherent characteristics, compete with terrestrial wired technologies or terrestrial wireless technologies depending on the proposed scenario.

Applications related to communications backup and trunking are nowadays mostly covered by terrestrial wired technologies (mainly xDSL or HFC access networks), because they can offer better

costs, bandwidth, or QoS, but this kind of cable accesses have an important lack for residential users, they cannot offer the required flexibility to establish a new link in a short period of time.

In those scenarios cost is not decisive and the key point is to provide a reliable and flexible access network, able to be configured dynamically.

To provide wide coverage (access to communication services in isolated and non developed areas) and mobility, satellite communications systems will have to face different wireless terrestrial technologies. UMTS, WiMAX, or future terrestrial radio access technologies, will try to cover the lacks of the wired accesses, but even competing with them, satellite technology will be suitable for:

- Areas where the population density is very low and the potential number of customers is not profitable enough for investment justification.
- Areas where the geographical conditions make it difficult to deploy and maintain terrestrial radio access technologies (very mountainous zones, deserts, oceans, polar areas, etc). In this kind of areas both CAPEX (the amount of base stations required is very high due to lack of direct visibility, long time required for the deployment) and OPEX (the location of the base stations make it difficult hardware failures repairs or upgradings), make the terrestrial alternatives not much competitive.
- Undeveloped countries.
- Unstable areas where it is difficult to maintain telecommunication infrastructures due to wars, guerrilla warfare's, delinquency, etc

One of the most important benefits that satellite technology can provide it is the bandwidth optimization due to the use of broadcast and multicast transmission modes. Satellites have an inherent capability to broadcast, thus, all users under the satellite footprint can receive at the same time any type of multimedia content sharing the same bandwidth. In an European coverage, that means users in any place of Portugal (European South-west extreme) can receive contents in equivalents conditions that users in Moscow at the same time and without any kind of highlighted difference, just probably the size of antenna.

But if IP systems are considered, the higher feature of satellite unidirectional transmissions comes by the hand of the IP Multicast mode, which allows the distribution of contents (audiovisual for example) to groups defined inside the satellite footprint, using for each group the same bandwidth that one IP unicast transmission just for one user. Multicast mode reduces dramatically the use of bandwidth and in consequence the cost associated to the service is reduced in the same scale. Obviously, it is possible to offer multicast using some terrestrial technology based on terrestrial radio communications of cable, but that implies all the nodes in the network must understand IP Multicast protocol, meaning the existence of a dedicated network for the transmission to the customer and it implies a high investment in infrastructures.

Countries less developed are using satellite technology as the first and base resource to mitigate "the digital divide"

3.3.3.4.1 Global coverage

High cost of PSTN or HFC deployments may not be affordable to some developing nations, especially in rural areas that have a much lower subscriber density. Such kind of wired technologies cannot be available either in isolated areas of developed countries that present geographic challenges (mountains, deserts, etc…). In the other hand, terrestrial wireless technologies try to solve the isolation problem reducing the important cost of cable deployment, but in some rural or remote areas (deserts, oceans, mountains,...) it would be necessary to cover distances of at least some tens of kilometres to connect subscribers to an access node (it would be necessary to install a large number of base stations

and interconnect them to the customer location and to the access node, provoking unapproachable costs).

A satellite system is the unique technology that is capable of guaranteeing a communication connection to any location. Specially indicated to cover remote/rural areas, it is also a good solution to deliver broadband or communication services in a cost-effective manner to areas lacking backbone infrastructure like non developed countries.

Focusing in Broadcast TV application, it will provide global TV emissions. A wide set of channels will be available and local languages will also be transmitted to preserve local cultural heritages. This application will be matched to the creation of global TV channels, which can contribute to the extension of a real and common world culture.

A satellite broadcast system is the unique mean capable of achieving a television service with global coverage. Apart from that point, as has been proof during last decades, satellite operational and deployment costs are quite reasonable for this kind of applications. Satellite allows broadcast, multicast and unicast TV, native format or IP encapsulation. The synergy in all these fields reaches a maximal value thanks to the flexibility and inherent capabilities of satellite.

Interactive TV application can be explained as an extension of Digital TV. A user will be able to interact with the media content sending text messages, participating in contests choosing the options through his remote control, etc. This application will increment the set of services available through the TV service and constitute a new source of incomes

3.3.3.4.2 Flexibility

If there is an imperative communication need, a reliable link has to be established as soon as possible. Terrestrial technologies waste an important amount of time to connect a determined location to the existing network backbone. New wired, but also wireless, links require a lot of time to obtain their corresponding legal permissions, to deploy their telecommunication infrastructures (cable or the base stations along the communication path), and to be finally provisioned.

A deployed satellite communication system, able to be dynamically managed and provisioned, can establish a link between any 2 points on the Earth in minutes, outperforming by far the capabilities of the other technologies. Thus every critical communication can be effected without consuming precious time.

3.3.3.4.3 Robustness

Terrestrial links are very exposed to service cuts. Due to natural disasters, terrorist attacks, war actions, power cuts, or similar incidents wired and wireless networks suffer frequent service interruptions, provoking uncountable losses and distress.

Satellite communications are not usually affected by this kind of events. Only the control/hub station is on the Earth's surface, and it can be located, designed, built and managed to overcome all those incidents. Furthermore, as the atmosphere and the space are hostile environments, satellite systems are design with the most reliable technology and to work all time during their operational life.

Therefore, we can consider that a satellite communication system can work on all weather conditions and can face other menaces with much more success than other technologies, providing not only a key communication tool but also support for decisions on crisis situations.

4 VALIDATION JUSTIFICATION

4.1 OVERALL LOGIC

The main trade off for the validation process is the choice of the validation means (i.e. from simulation to demonstration on real equipments) with regard to the features maturity.

The second criteria is the development effort and/or the availability of third party stacks or components.

In fact, mature technologies will be validated using as most as possible real equipments, or emulation testbed whereas new incoming innovative features will rely on simulations or emulation means.

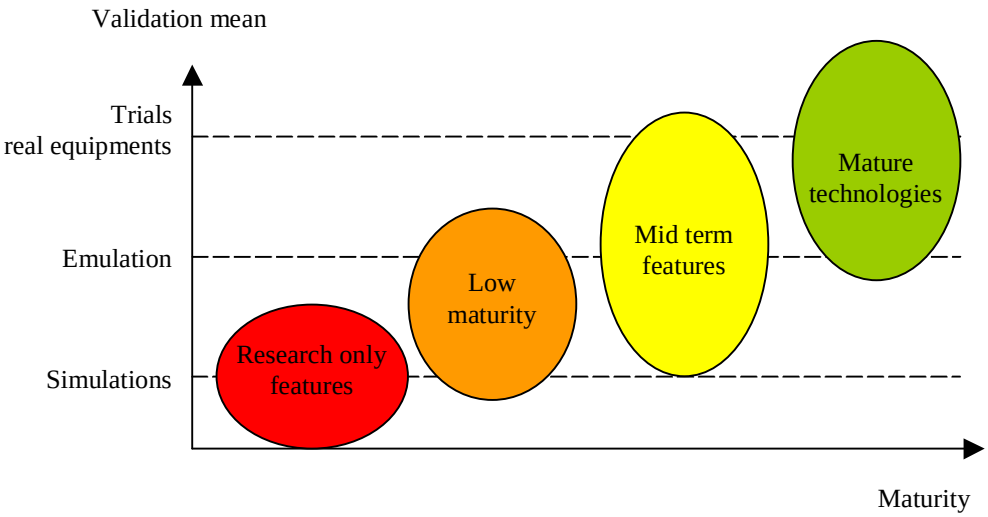


Figure 4.1-1: Validation mean vs maturity

4.2 COVERAGE MATRIX

[technical item coverage]

Layer	Technical items	Simulation (WP2500)	Emulation (WP3100)	Trials (WP3200)			
				TAS-F (France, Cannes)	HDT (Hungary)	TAS-E (Spain)	TID (Spain)
Network (WP2100)	IPv6		**X**	**X**		**X**	
	Wll inter-working				**X**		
	Dynamic QoS-NGN component		**X**	**X**			
	Dynamic QoS-IP scheduling	**X**	**X**	**X**			**X?**
	Dynamic QoS-IP/MAC interaction	**X**	**X**				
	Multicast			**X**		**X**	
	Dynamic multicast	**?**	**X**		**X**		
	Application/network Security			**X**	**X**		

	IPv6 mobility		**X**		**X**		
	HMIPv6	**X**					
	PEP & mobility						
	QoS & mobility		**X**	**X**			
	Multicast & mobility		**X**				
	DCCP	**X**	**X**				
	PEP/RRM interaction			**X**			
	XCP & quick start	**X**					
Access (WP2200)	Adaptive physical layer	**X**	**X**	**X**		**X**	**X**
	MAC scheduling	**X**	**X**				
	SIP/RRM interaction		**X**	**X**			
	Adaptive RRM	**X**	**X**	**X**			
	Adaptive CAC	**X**					
	DVB-S2 forward link scheduling		**X (ULE)**	**X (MPE)**		**X**	**X ?**
	L2 security-data plane		**X**				
	L2 security-control plane						
	Key management		**X**				
	WLL security				**X**		
	ULE		**X**			**X**	
	GSE						
	ROHC						
	SI-SAP						
	C2P					**X?**	

Table 4.2-1: Technical items for each scenario

4.3 DETAILED JUSTIFICATION

4.3.1 Network features

IPv6 is obviously a major requirement of the SATSIX project. Indeed, the emulation testbed is developed taken into account a support of both IPv4 and IPv6. Concerning the trials, it has been decided to demonstrate IPv6 native support in 3 trials due to development constraints issues:

- The 4 trials platforms only support IPv4 at the beginning of the project
- The 4 trials platforms use different kind of terminals and Hubs, preventing any generic IPv6 terminal/GW development

Wll inter-working is one of the key features of SATSIX. Due to the maturity of the wifi technologies and the opportunities to use real WiMAX equipment in Hungary, the demonstration of both DVB-RCS/Wifi and DVB-RCS WiMAX will be performed in the trials.

Dynamic QoS-NGN component are validated in 2 phases. First a global architecture including SIP proxy, QoS agent and QoS Server is validated using the emulation platform. Second, a subset of this architecture will be used in the TASF trial to configure dynamically the access and IP layer thanks to SIP proxy information.

Dynamic QoS-IP scheduling relies on the Linux Traffic Conditioner, more precisely the HTB and HDLB schedulers. The validation of the new HDLB scheduler, developed in the frame of SATSIX, relies on both simulation and emulation whereas the more mature HTB scheduler will be tested using the whole set of validation tools: simulation, emulation, real equipment (i.e. the SATSIX terminal).

The dynamic QoS-IP/MAC interaction feature need to be integrated in the global QoS framework and thus will be validated using the emulation testbed. Moreover, its integration in the SATSIX terminal has been discarded due to the impact on the QoS kernel components of the terminal (and their configuration).

IPv6 Multicast will be validated using various means: a simulation model to perform a validation at system level, the integration of multicast router in the emulation testbed to validate the software components (and their coupling with mobility) and the use of these multicast routers in the TASF and HDT trial environment.

The dynamic multicast feature will be demonstrated using the emulation testbed since the development of the SATSIX terminal is based on the scope of the IPv4 TASF Hub that only supports static multicast.

Application/network Security feature is, as described in D2000-1 a mature technology with lot of available stacks/products/tools and thus will be validated only in the frame of the trials.

IPv6 mobility is now a quite mature feature with several implementations available and will be validated using both the emulation testbed and the HDT trial platform.

HMIPv6 is still a research activity and since no stable stack are available at the beginning of the project, it has been decided to perform simulation to validate the enhancement provided by HMIPv6.

The interaction between PEP & mobility is a recent research activity, and lead to complex development as described in D2000-1. That is why this functionality is not validated.

The interaction between QoS & mobility using SIP will be validated using both the emulation tesbed and the SATSIX terminal/Hub.

Multicast & mobility is still a research topic. 3 solutions to provide coupling between mobility and multicast has been investigated in D2000-2. The availability of an MLD proxy prototype allows to test this feature in the emulation testbed.

The SATSIX project has heavily contributed on DCCP stack development. First, simulations allowed to validate the congestion control in a satellite environment. Then, these output were used for the development of the validation of the real stack in the emulation testbed.

The PEP/RRM interaction can be considered as a another way for the MAC-IP traffic regulation. This interaction is part of the TASF PEP product.

XCP & quick start are in early phase of conception and thus can only be validated using simulation means.

4.3.2 Access features

Adaptive physical layer feature will rely on both emulation and real equipments means (as part if the DVB-S2 standard).

The MAC scheduling is included in the emulation testbed in a very configurable way, and is obviously embedded in the real equipments used for the trials.

The SIP/RRM interaction will be first validated in the emulation testbed and demonstrated in the TASF trial.

The adaptive RRM algorithms will be validated using simulation means and then used in the emulation testbed.

The adaptive CAC algorithm is still a research topic and thus the algorithm will be only validated using simulation means. Moreover, the small number of terminals in the emulation testbed or in the trials prevent any interesting result using these validation means.

The **DVB-S2** forward link scheduling will be validated using the emulation testbed, and obviously part of the DVB-S2 trials.

The L2 security-data plane will be validated using the emulation testbed. The L2 security control plane is defined in the D2000-2 document and will not be tested since it implies a precise emulation of the DVB signalling tables not performed in the emulation testbed. Moreover, this function relies on the same mechanism provided for the user plane and thus not requires further investigation in the emulation testbed. Finally, this function is a more longer term evolution of the access and thus cannot be demonstrated using real equipments.

WLL security will be demonstrated in the HDT trial since this is a mature technology.

ULE will be validated using the emulation testbed, that is the perfect mean for access stack validation. Indeed, the integration of ULE in the SATSIX terminal/Hub implies a major modification of the code. Moreover, the ULE stack will be also demonstrated over a real terminal in the mesh trial..

GSE won't be demonstrated in the emulation testbed because its emulation requires major modification of the core access components. However, the integration of the ULE stack within the platform can be seen as a first step to the generic stream encapsulation.

ROHC is not included in the frame of the experimentations since the analysis and definition of ROHC in SATSIX focuses on the means to use and configure ROHC and does not tackle any specific adaptation to the satellite context.

The validation of **SI-SAP** is not considered in the frame of SATSIX. In fact, the abstraction used in the emulation testbed prevent the use of SI-SAP and the equipment used to develop the SATSIX terminal does not support SI-SAP interface.

C2P

TAS –France will focus on the introduction of Future Internet in the satellite communications. The results obtained within SATSIX project have a strong impact on the R&D activities of TAS-F. It will allow the definition of new systems which integrate solutions from different technological fields (as for example RCS and Wimax aspects).SATSIX will permit to extend knowledge in IP over satellite, especially over DVB-S2 and DVB-RCS. These advances will continue to Enhance its market penetration through the development of cheaper and better performing satellite access equipment as well as collective access terminals

5 PARTICIPANTS USE PLAN

5.1 THALES ALENIA SPACE FRANCE

TAS –France will focus on the introduction of Future Internet in the satellite communications. The results obtained within SATSIX project have a strong impact on the R&D activities of TAS-F. It will allow the definition of new systems which integrate solutions from different technological fields (as for example RCS and Wimax aspects).

TAS –France will exploit the results of this project for the two applications described below. Activities of development are in progress in-house for all the "collective" applications. They are based on two standards:

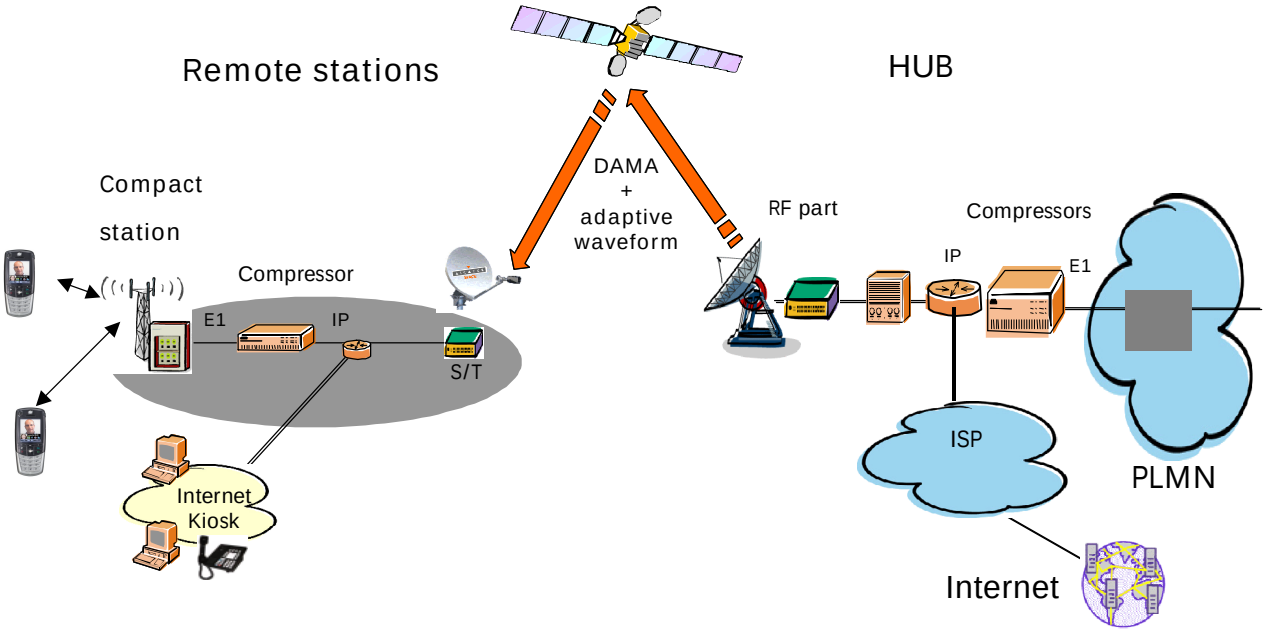
- DVB-S2/RCS for the satellite links in order to minimize the costs of the use of the "transponders" (DVB-S2) and of the satellite terminals VSAT (Compatibility DVB-RCS between terminals from different manufacturers)
- Protocol IP (v4/v6) for the transmissions of the data between the access and the "core network". The IPv6 protocol will give access a greater number of address and also to introduce parameters of security into the connections between the access terminal and the "core network".

5.1.1 Backhauling solution

Today most Mobile Subscribers are located in developed countries and in urban areas of developing countries. Amongst all the population that has been left out, 4 billion people don't have access to any telephone service. In the absence of sufficient telecom infrastructure, satellite solutions are necessary to connect the remote mobile areas back to the core infrastructures. The satellite connections by construction, are independent from the distance. Satellite solutions can be used as soon as:

- The area to cover is far from any concentration point, or when more than 2 microwave hops would be needed to reach the village.
- Every time there is only a limited number of potential subscribers to connect in a service area.

All VSAT's communicate over the satellite to a larger station: the HUB. VSAT terminals are capable of transmitting anywhere from a few kbits/s to 4 Mbit/s (Inbound channel to the HUB). On the reception (outbound channel from the HUB), they share a single DVB-S2 satellite carrier which operates between 2Mbit/s to 48Mbit/s or higher, and on which all outbound traffic is aggregated and multiplexed together. In association with the compressor, each terminal is capable of requesting the satellite capacity necessary to the number of communications.



Satellite Backhaul Architecture

A HUB collects and routes the communications with the remote sites to the proper compression equipment. The HUB allocates the satellite capacity in real time on a call by call basis . The TASF advanced satellite solution is based on DVB-RCS S2 technology combined with efficient compressing techniques, it contemplates two levels of enhancement :

- Use of adaptive coding over satellite: which is bound to provide about 30% capacity improvement on the satellite throughput (Mbit/s).
- Integration of the compressor into the terminal base band equipment,

The main benefits of IP multiplexing results from:

- The voice activity statistic, which offers a bandwidth gain in the range of 35 % to 65 % (silence suppression);
- The network dimensioning is based on the real traffic per site and not the installed capacity
- The statistical multiplexing gain in the aggregation network.

5.1.2 Telemedicine network

Telemedicine offers a basis for a cost-effective health-care system in geographical remote areas in such developing countries minimizing the disparity between rural and urban areas. A national-wide telemedicine network connects all regional hospitals and health centres with the urban public and government hospitals. The network includes a web based telemedicine system which provides basic services for medical tele-consultation. The architecture supports the provision of IPv4/v6 interface that enables seamless integration of national telemedicine component for the doctors currently practicing anywhere in the world.

The benefits of such network are :

- Achieving e-health commitment closer to underserved rural areas,
- Minimising long distance travels of rural people to urban areas,
- Faciliting information exchange and experience sharing among medical professionals practicing in remotely located clinics,

- Providing medical information to the medical practitioners which will help them to keep themselves up to date with the current technology.

Telemedicine allows health professionals around the world to establish faster communication and exchange information with clients and regional authorities regardless of geographical locations. Telemedicine may allow rural dwellers to get healthcare delivery similar to the urban counter parts. A mobile telemedicine system provides a platform for data acquisition, transmission and delivery to healthcare providers through 2/3G-based wireless networks.

SATSIX will permit to extend knowledge in IP over satellite, especially over DVB-S2 and DVB-RCS. These advances will continue to Enhance its market penetration through the development of cheaper and better performing satellite access equipment as well as collective access terminals.

5.1.3 Research

Regarding the research aspects, SATSIX will be a major contribution for Thales Alenia Space. The innovations defined in the frame of the project will be used and extended in various domains:

- QoS: SATSIX will be a reference system with either optimized features adapted to the satellite context and can be seen as a pre-IMS solution. The follow up of the SATSIX QoS architecture will includes satellite IMS architecture, or solutions derived from the EuQoS project.
- Compression: the adaptation of ROHC to the satellite context will be continued and extended
- GSE: the integration of the ULE stack as well as the representation of the adaptive physical layer will open the door to specific studies related to the scheduling issues, or the DVB-S2 on the return link.
- Mobility: the coupling of IPv6 mobility with multicast will permit to continue research activities on the network mobility.

As a matter of fact, the emulation testbed is a major component for the research activities on Thales Alenia Space. This platform benefits from specific internal development, the SATIP6 heritage, several development made in collaboration with CNES, and has been greatly enhanced thanks to the SATSIX project. This platform will be a key for research on future satellite systems.

5.2 CNRS/LAAS

LAAS is a research laboratory of France national research centre. So, our exploitation activities are mainly aimed at developing our research knowledge and implementing new technical solutions, enhancing our research activities and introducing new dissemination actions and training capabilities.

The research undertaken in SatSix project has lead to the development of a new testbed emulating as well as possible a full DVB-S2/RCS satellite communication network. This kind of emulator is very important for our research work, allowing us to try new solutions to optimize the integration of a satellite system into an Next Generation Internet for instance.
It contributes to the research knowledge of CNRS/LAAS allowing the work related to satellite systems to be seen and known not only in France or Europe, but also in other countries all around the world.

Our knowledge on QoS-enabled architectures is widely demonstrated and is useful also for our other research work related to IPv6 networking, QoS, ad hoc and sensor networks and mobility services.

Work in SatSix has developed simulation results, led us to implement some of our proposed architectural specifications.

The SatSix Project has provided training opportunities for new researchers at CNRS/LAAS. It also provided dissemination of new results, production of new course material, and tutorial material to a wider audience at conferences, workshops, and specific training (as detailed in the SatSix deliverables). This has lead to improve our understanding of satellite system specificity, and improved visibility within the satellite community of the constraints introduced by satellite systems compared to classical wired terrestrial broadband networks.

5.3 UNIVERSITY OF ROME

This project will give the opportunity to the partners to form a real company pool; in this respect, the University of Rome “La Sapienza” (UoR) finds a great motivation in developing research studies in this environment having the privilege of sharing with other partners research interests and efforts.
Beside providing UoR with enhanced expertise in networked embedded systems, the experience gained in this project will give the opportunity to UoR to reinforce the already existing collaborations and to create new links with universities, SME, research centres and manufactures.
The UoR research group intends to exploit the results of this project for didactic and teaching purposes. In particular, many master degree and PhD theses are already profiting from the documentation and the background coming from SATSIX. Moreover, project results are being exploited to upgrade and update the programs of several courses and to hold thematic seminars on these matters both at the University of Rome "La Sapienza" and in the surrounding companies.
In particular, participation to this project will allow new generation engineers to acquire know-how on defining and solving resource management problems not only in satellite networks but also in generic networks, thanks to the fact that UoR makes use of control-theoretic methods and operations research methods: in particular, the resource management algorithms are developed based on a model providing an abstraction of the network.

In particular, the following researches are benefiting from SATSIX:

1. *Bandwidth on Demand (BoD)*: the BoD approach followed in past projects (GEOCAST, SATIP6) was enhanced and rendered adaptive with respect to both the characteristics of the traffic feeding the Satellite Terminals and the whole traffic currently loading the satellite link. As a result, the BoD policy is aggressive and aimed at reducing the queuing delay in the ST buffers when the link load is scarce, and is conservative and aimed at achieving a high utilization of the link bandwidth when the link is congested.

2. *Connection Admission Control (CAC)*: a Markov Decision Process (MDP) based approach is being followed in SATSIX. Some innovative techniques have been introduced:

- Alternative Linear Programming formulation: the proposed new formulation of the MDP problem is proposed, which is much more scalable with respect to the standard formulation. In particular, the scalability improves with the number C of traffic classes supported by the network: the reduction of the new problem size with respect to the standard one is $O((C+1)^2 / 2^C)$, i.e., the problem size of the proposed LP grows quadratically with C whereas the size of the standard LP grows exponentially with C.
- Policy aggregation techniques.
- Policy and state aggregation techniques.
- Definition of the MDP problem associated to the CAC problem considering the variable link capacity due to the adaptive coding-modulation functionality provided by the DVB-S2 standard.

3. *Frame composition*: the DVB-S2 standard can adapt the coding-modulation schemes based on on-line measures. The problem of composing the most suitable frame (i.e., of associating the most appropriate coding-modulation schemes to the frame carriers) has been modelled and solved both by operations research methodologies and by heuristics.

Finally, dissemination will is assured by extensive publications especially on the major international reviews and conferences and by the participation to the main events organized by the European Union as well as by other institutions.

5.4 SINTEF

5.4.1 Company profile

SINTEF is a multidisciplinary independent research foundation based in Trondheim and Oslo, Norway. The foundation receive only minimal state funding (around 3%), earning the majority of the income from contract research for industry and the public sector in Norway and internationally. SINTEF is the largest independent R&D organisation in the Nordic countries, employing around 1700 people. Contract research carried out by SINTEF covers all scientific and technical areas, and ranges from basic research through applied research to commercialization of results into new products and business ideas for both the domestic and international markets.

5.4.2 Non-profit exploitation plan

Research and development within wireless communication and internet technology is a priority area for SINTEF ICT, and development of wireless communication solutions for national and international cooperating partner is a core business. Our strategy is to maintain generic technology platforms in selected areas from which a variety of products and business ideas can be developed. SINTEF will use the results from SatSix within the field of wireless networking and Internet technology to significantly increase the level of competence in relevant industrial projects, and prepare the scientific background for new projects, especially in the context of and autonomic networking.

The outcome of the project will be published in national and international papers.

SINTEF collaborate tightly with NTNU (University in Trondheim) and the results will be disseminated at educational level as well.

5.5 UNIVERSITY OF SURREY

In the past 15 years, UniS has actively undertaken research on satellite communications, and has involvement in a number of EU and ESA satellite communications projects. Within SATSIX project, UniS has contributed to the network architecture design of the new IPv6 based satellite systems, the advanced algorithms development and analysis, especially on QoS, security, multicast aspects, and cross-layer design. The knowledge, methodologies, and know-how obtained from SATSIX project can be developed further for the benefit of future R&D endeavours in satellite communication systems. With UniS having links with a number of international satellite and mobile communication companies, the research outcomes, simulator and testbed can be used to provide consultation and technical support as well as training. The research outcome has being disseminated via publications at international journals and conferences. Also being an academic institution, this knowledge can be fed into teaching materials as part of the University curricula, as well as topic setting for PhD and MSc student projects. Furthermore, the technical knowledge acquired can be exchanged with other research institutions besides being fed into relevant standardization bodies, such as ETSI BSM.

5.6 UNIVERSITY OF ABERDEEN

As a public education institution, the exploitation activities are primarily aimed at developing open source solutions from the work, increase of the research portfolio and dissemination/training opportunities that arise from the research undertaken in SatSix.

The SatSix project has lead to the development of new simulation tools (within ns2) and extended critical evaluation of networking issues at the Internet and transport layers. Specifically this has provided an opportunity to validate research results and investigate new topics of research relating to DVB-RCS and DVB-S2. This work on satellite communications contributes to the research portfolio

of the University and complements other research in IPv6 networking, sensor networks and location-based services.

The work has made a direct contribution by the University to Standardisation of protocols at the Internet and Transport layers in DVB, ETSI, and the IETF. At the transport level, this work will ensure seamless operation of the DCCP protocol where satellite links form a part of the next generation internet. Future work at the University of Aberdeen will focus on the introduction of Future Internet in the satellite communications, IPv6 networks and challenging network environments.

Work in SatSix has developed simulation results, stimulated architectural specifications and made significant and important contributions in the following areas:

- IP over DVB - contributing to the design and specification of the GSE protocol within DVB and standardisation in ETSI. This work has stimulated new research, as evidenced by recent outcomes from the EC SATNEX NOE, and the range of related technical publications on ULE and GSE.
- Integration of IP and satellite networks - Definition of supporting functions within IETF, and contribution to ETSI-BSM on issues relating to IPv4 and IPv6.Architectural work on relating DVB to the IPv4 and IPv6 protocols, enabling new functions such as security extension and compression extensions - both of which have been proponed as topics for future research and final standardisation.
- Multimedia Transport - contributing to simulation and evolution of IETF-defined transport protocols to ensure that these protocols can offer acceptable performance for real applications in a satellite (and WLL) environment. This work has developed new research - to continue beyond SatSix - and is impacting key standards within the IETF TSV and DCCP working groups. New specifications, such as the updated RFC3348 specification, Faster Restart, QuickStart, and CCID-4 have all been changed to better reflect the needs of the environment presented by satellite. These changes will ensure that end-to-end multimedia transport will not require tuning and/or PEP devices as they are deployed in satellite networks.
- Implementation of Protocols - The SatSix project has directly contributed source for production-quality code to the Linux open source project for the Datagram Congestion Control Protocol. This contribution from UoA will ensure the codebase is efficient, up to date, and well suited for a range of network environments. The introduction of high quality code early in the development cycle will eliminate the need for tuning in satellite networks. The University was able to publish its first MIB specification in the IETF (RFC5097, this was a result of detailed analysis of UDP-Lite in the early stages of the SatSix Project).
- Training – The SatSix Project has provided training opportunities for new researchers at the University of Aberdeen. It also provided dissemination of new results, production of new course material, and tutorial material to a wider audience at conferences, workshops, and specific training (as detailed in the SatSix deliverables). This has lead to improved understanding of Internet technology within the satellite community, and improved visibility within the networking community of the requirements introduced by satellite systems.

5.7 TELEFONICA I + D

Telefónica I+D (TID, http://www.tid.es/) is a 100% subsidiary of Telefónica S.A, being Telefónica's R&D arm. The company employs over 1100 persons, 93% of them holding a University degree, being the most important private company in Spain devoted to R&D.

5.7.1 Telefonica Units that benefit from the SatSix outcomes

To strengthen the national and international position and market share of its business units, Telefonica pays special attention to new technologies. Research and development is essential to identifying those factors which are going to shape the future development of Telefonica's businesses, this is why Telefonica Investigación y Desarrollo (Telefonica I+D, Telefonica's R&D arm) was set up to lead the group's activities in this field.

Telefonica I+D's mission is to help improve Telefonica's competitiveness through technological innovation, broadening the range and quality of services on offer and making it possible to reduce operating costs. Its natural customers, therefore, are all group companies. Therefore, Telefonica I+D, as the R&D subsidiary of the Telefonica corporation, has close relationships with all the different business units of the Group. All of them are very interested in the results of research projects that can evolve into interesting new services for their customers. In this section we will cover all the business lines that could benefit from the SATSIX outcomes. As can be seen, services developed within SATSIX can enjoy from joint commercialisation from more than one company of the Group, given the high level of complementarity among them and the synergies that can be exploited.

Telefonica has also important assets in the satellite sector. Telefonica Services Audiovisuals (TSA) is the company within the Group that provides services and systems of audiovisual communications, based on satellite systems. SATSIX outcomes on the provision of IP conferencing over next generation satellite (regenerative payload, OBP) can be tested over the first commercial deployment of such systems, with a first trial and a subsequent commercial service.

Telefonica Moviles (the wireless operator of the corporation) holds several UMTS licenses around Europe (Spain, Germany, Italy…). Currently UMTS deployments are trying to open the market, slowed down due to economic downturn and technology delays. However nowadays, the need for mobile broadband connectivity will push forward the technology and the outcomes of SATSIX on SIP technology and QoS issues in error prone transmission environments, will definitely help to avoid the current technology limitations.

Finally, the participation in this project implies a closer relationship with the consortium partners, that will serve as a platform for future business arrangements among the parties. Specifically, for each of the partners involved:

1) Satellite network manufacturers, with interest from the Telefonica side through the units related to satellite systems;
2) Universities, that cover the basic long term research needs that complement a commercial company R&D activities. Further collaboration based on direct research contracts with them is envisaged;
3) Contacts with SME's, outside the consortium, with IP multimedia applications and products that can be commercialised as part of the new service offerings for broadband IP of the different business units of the corporation, mainly the service providers and telecom operators.

5.7.2 Exploitations plans

As a consultant of real time communications (like VoIP) and audiovisual interactive services (like digital TV), Telefonica I+D is strongly interested in the research of multimedia satellite services, as a cheaper alternative to terrestrial ones. Particularly, SATSIX project will enable the provision of satellite based conference services (audio and/or video), with the inherent advantages of satellite links: cost and universality, reinforced with the multicast advantages of satellite networks.

Telefonica I+D exploitation plans can be mainly divided into two areas. The first and most important one with the biggest impact in the industry is the commercialisation of SATSIX related services through the different business units of the corporation, which currently offer services to more than 115 million customers and have a potential market of around 500 million. On the other hand, Telefonica

I+D also has its own product portfolio. Regarding the first, three specific services are considered: one in the field of broadband IP access through satellite for the mass market, including conference services over broadband IP networks with a focus on QoS, bi-directional Internet access over satellite and triple play services.

5.7.2.1 Broadband IP services over satellite

The importance of satellite connectivity is of special interest to serve rural areas. In those areas currently Internet connectivity is of very bad quality (error prone) and low bandwidth. For example, only in Spain there are at least 260.000 fixed phone lines that are served by analog mobile access. The service is called TRAC, which is the Spanish acronym for Cellular Access Rural Telephony with a maximum bandwidth for data of 2400 bps. In January 2004, Telefónica of Spain launched commercially bi-directional IP broadband access services over satellite. There are several access models with a downlink from 256 Kbps up to 2 Mbps and a uplink of 256 Kbps with a monthly fee from 45 to 615€ and 3000€ for the equipments and their installation.

Again this a clear example of the commitment of Telefonica to exploit the key achievements of SATSIX, in this case related to satellite scenarios. SATSIX will cover the technology gap required to diminish the costs and technical limitations, thanks to advanced satellite platforms. Once basic connectivity platform has been setup, in the same line as with ADSL lines, the next step is to provide value added services in order to obtain additional sources of revenues from end customers. In the other hand, SATSIX could provide to Telefónica the technology to upgrade their services offering higher IP broadband access to the clients that are demanding more bandwidth or faster communications over satellite.

In this promising scenario, Voice over IP services over satellite access offer the attractive of allowing to get rid of the legacy equipment and lines (TRAC or copper), permitting instead to offer the basic telephony service integrated in the broadband satellite access. But not only that, the bandwidth available will enable value added services that can be directly charged to the customers. The first service that comes into mind is naturally videoconference services.

SATSIX will help to migrate these broadband services already provided through ADSL lines to the satellite market. Key achievements of SATSIX like those in terms of QoS for high delay environments will be critical for the success of these services. Next generation satellites allow to further exploit the advantages developed in SATSIX thanks to on board processing capabilities.

5.7.2.2 Triple play services using SATSIX Network

The multiplicity of services provided by the SATSIX system raises several profitable exploitation business plans. One of the models that is expected to be between the most promising business plans in the current market is the combination of services in a package as in the Triple Play model. Triple Play relies on the assumption that an integrated solution will increase opportunity costs for customers who may want to choose between service providers. Interoperability is not a design target.

The Triple Play proposal with SATSIX may offer a bundle of digital television, Voice over IP and data transmission services with a good quality of service. Regarding the TV service, SATSIX has a generous forward wideband delivery channel. A pertinent approach is that offering a high number of multicast TV services which are received by the RCST and prepared to the final user in an IP Set Top Box. This would work in a subscription scheme, with the content channels ideally split into packages to be selected by the final consumer. Voice over IP services would be added to the offer. For this service an IP telephone, or a standard telephone with an adapter or a computer would be plugged to the RSCT instead of the Set Top Box. For the data transmission service (actually a regular Internet service) the final equipment would consist of a computer or the TV set. The RCST would act as a common physical connection to which the correspondent service terminal would connect. SATSIX infrastructure and number of services favour services concentration packages like Triple Play, giving a

chance to play a role different than that of the conventional satellite operators. New satellite features and more services in a package will cover more likes and needs of clients, some of whom cannot be reached by the terrestrial platforms Triple Play offers.

It is remarkable that these requirements can be optimally fulfilled by the SATSIX project system, rendering a unified, infrastructure-sharing, ubiquitous Triple Play solution. The key issue of this model is that it presents an interactive system concept as an additional functionality of current broadcasting systems, that is able to incorporate the Triple Play Concept. The model was conceived for symmetric and asymmetric interactive services supporting broadcast to the home TV services.

Regarding SATSIX services, Telefónica is strongly interested, through the list of business units above, in expanding the coverage of multimedia TV set based services (like Imagenio) as much as possible, a goal that is massively fulfilled by the satellite medium and the interactive multimedia new features of SATSIX.

5.7.2.3 IPv6 SatSix services

Telefónica Wholesale, in response to competitors and customers requirements, owns commercial IPv6 services since January 2004 (Madrid, Sao Paulo, Londres y Amsterdam). The strategy is 6PE in the Global MPLS network

Telefónica Empresas has also commercial tunnelled services since January 2004.

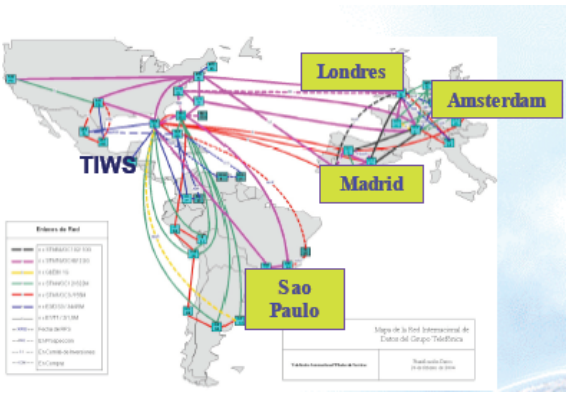


Figure 5.7-1 Telefonica Wholesale IPv6 services expansion

TID is also participating in other innovative project related to IPv6 services. Therefore the exploitation will continue in this line:

- SATSIX infrastructure and links will be kept as much as possible for new projects researching on Advanced Services enabled by IPv6.
- IPv6 services experience deployed in SATSIX will be continued and evolved with new advanced features (IPv6 Mobile enabled streaming flows, Replication service based on Multicast SSM, DNS delegation, etc).
- Telefónica I+D will continue the realization and organization of IPv6 trials with Latin American and European organizations.
- Telefónica I+D has already designed a detailed proposal to collaborate with Telefónica Wholesale (TIWS) and Telefónica Empresas (TEE) in order to improve their current IPv6 commercial services and incorporate new ones (IPv6 VPNs, VoIPv6 trial, etc).
- "Global IPv6 Service Lauch Event" demo with Brazil has concluded during 2005 in the Telefónica Empresas do Brasil IPv6 service.

- Telefónica I+D is already working in IPv6 related consultant activities requested by Telefónica business units:
  - IPv6 Addressing plans
  - Transition Phases and Strategies
  - Requirements for Commercial vendors (Software, Equipment)
  - IPv4 & IPv6 services co-existence
  - IPv6 courses for network operator and managers
  - Tools which need to be adapted to deploy IPv6
  - Cost Impact analysis about migration
- Telefónica I+D IPv6 knowledge and test-bed will be available to other IST projects where TID is participating to allow IPv6 tests and software development.

5.7.2.4 Telefonica I+D product portfolio

As have been mentioned at the beginning of this section, Telefonica I+D itself will benefit from the technical know-how earned during SATSIX execution, enhancing its own portfolio of products, specifically on the line of IP multimedia services & platforms.

1) SATSIX outcomes in the VoIP field, and specifically on SIP technology, are firstly based on an enhancement of the required know-how for the deployment of these services, based on the R&D outcomes produced. More specifically in terms of product prototypes, two main outputs can be described:

- VoIP provisioning platforms: open source based SER platform, in combination with others, will be improved according to the service and network needs. Standards based (SIP protocol) platform, that allows to provide an overlying videoconference service (it is not yet another proprietary videoconference service independent of basic VoIP platform of the service provider). Among the aspects considered for the adaptation of the platform: management, provisioning, interworking with other networks and systems, advanced customised services, billing...
- SW videoconference endpoints. Based on SIP protocol and using royalty free stacks to allow massive deployment without important investments. Development for Windows platform and interoperability tests for Linux. Allows a customised access to the IP conference service (in comparison with an off-the-shelf product like Windows Messenger). Integration of added value services. Wider support of codecs for enhanced quality. On the other hand, QoS has always been one of the main problems of the VoIP technology, and in this sense activities carried out with other partners involved, represent a very promising scenario for future collaborations, already started within the project, as already mentioned before.

More specifically, consultancy and training of VoIP services for different business sectors where technology is applicable: banking, administration, corporations, universities, insurance, SMEs,... License/marketing agreement for the introduction of VoIP products in the market. Joint enterprise or partnership for integrated VoIP products with other vendors in the field. Adaptation of their products to local markets where Telefonica is present or adaptation to Telefonica's companies needs. Joint R&D activities for open aspects of VoIP technologies

2) The second field that Telefonica I+D is benefit from, is the one related to TV services, comprising:

- TV channels.
- Music/video on demand in Internet
- Videoconference,

as well as TV internet.

Potential Offered for Further Dissemination and Use: Introduction of innovative products and services for end customers, into the different business units of Telefonica Corporation, from our position of R&D subsidiary: *incumbent fixed operator in Spain and some countries of South America (like Chile, the state of Sao Paulo in Brazil, Peru, Argentina,...); *mobile operators in Spain and South America (also UMTS licenses in Europe without operation yet); *ISPs companies of the corporation, both the one focused on the residential market (Terra) and the one focused on the business segment (Telefonica Data).

5.7.3 Roadmap for IP Broadband services over satellite

The recommendation of TID for Telefonica in relation to broadband IP services, and considering the progression so far, is the following:

2003	2004	2006/07	From 2008 on
IP broadband unidirectional access	IP broadband bidirectional access	DVB-S à DVB-S2	- IPv6 - New services: IPTV, triple play service

Table 5.7-1 TID roadmap of IP broadband services over satellite

5.7.4 Target market

As mentioned previously, Telefónica I+D exploitation plans include the dissemination and proposal of SATSIX related services through the different business units of the corporation, which currently offer services to more than 115 million final customers and have a potential market of around 500 million. The Telefónica Group has wide range of business units, each one specialised in a concrete field within the provision of telecommunications services, and all of them sharing a high grade of reliability, business efficiency and future projection. Almost all of them are potential providers, content generators or users in some fashion of the SATSIX infrastructure. A representative example of the long list of possible companies around the Telefónica Group that can be interested in the SATSIX services are the following:

- Terra: ISPs for the consumer market.
- Telefónica Empresas (knew as Telefónica Data): ISP for the business segment.
- Telefónica de España: Fixed incumbent operators (Spain and some countries of South America like Chile, the state of Sao Paulo in Brazil, Argentina, Peru,…).
- Telefónica Móviles: the wireless operator of the corporation.
- Telefónica Servicios Audiovisuales: multimedia services via satellite.

At the same time, Telefónica's customers can be roughly divided into two main groups:

- Other companies, both large enterprises and SMEs, which need widespread telecommunication solutions.
- End users (families and individual persons) who need personal communication services: fixed telephony, mobile telephony, Internet access, etc.

According to all these issues, TID's target market is expected to be made up of all Telefónica subsidiaries which own the mentioned platforms to offer services to final users. These Telefónica

subsidiaries would act as service providers; services would lay on the core business framework developed in SATSIX.

5.7.5 Training activities

Technical knowledge gained during the SATSIX project, by means of:

- Publications, industrial workshops, conferences, etc.
- Internal specific training to present other TID's employees the knowledge gained during the SATSIX project.

5.8 THALES ALENIA SPACE ESPAÑA

Thales Alenia Space España is located at the Technological Park of Madrid (Tres Cantos-Madrid-Spain),. The main activities are the following:

- Satellite Systems: Advanced Telecommunication Multibeam Systems based in regenerative and transparent payloads.
- On-Board Equipment: TTC, Active RF Equipment, Passive RF Equipment and Data Handling Units .

TAS-E has leaded the AmerHis project (ESA program) to produce the first DVB-RCS/DVB-S multibeam regenerative system in the world which is boarded in the Amazonas satellite (a continuation of the FP6 IBIS project). The coverage area of AmerHis includes 4 beams Europe, North America, South America and Brazil and allows full cross connectivity between them. This system will be expanded thanks to the new AmerHis 2 that will be boarded in the Amazonas 2 satellite in 2008.

5.8.1 New payload architectures and services

TAS –Spain will focus within SatSix on the definition of future payloads. The result would be exploited for future. Payloads supporting GSE encapsulation imply redesigning the general concept of operation with the correspondent implications on the satellite architecture. On the other hand it will allow defining new On board processing mechanisms based on IP which will represent a major breakthrough on the satellite industry and that will represent one of the baselines of the future All-IP networks. On Board Processors supporting ACM and DVB-S2 and the main impact on signalling both for terminals and the Management Station, signalling which will be analyzed.

TAS-E has integrated different e-learning and e-health applications to take advantage of this multiregional feature and of the real time capabilities of mesh connections. In this line TAS-E is participating in telemedicine pilots in Brazil in ESA projects (T@his) and in FP6 programs in Europe (Healthware). In SatSix frame a Multi-conferencing application will be integrated evolving to more complex and commercial corporate solutions.

5.8.2 Contribution to standardization

TAS –Spain has also focussed on the standardization of C2P to make it available for every DVB-RCS satellite communications. The results obtained within SATSIX project have a strong impact on the SatLabs and ETSI groups as well as system harmonization activities of TAS-E. It will allow the definition of a connection control protocol supporting ACM techniques, dymanic multicast for star and mesh communications and IPv6.

TAS-E has also represented the official liaison between ETSI SES BSM and SatLabs group, with the responsibility of coordination between the two groups.

SatSix project interest in SatLabs is to be up to date in what is now required to be SatLabs certification, getting the first feedback from DVB-RCS terminals and Hubs manufacturers, operators and technology providers of what are the technology trends for the coming years, in order to move SatSix results closer to the market. As TAS-E is a provider os systems it is important for us to know the market trends and expectations.

A strong activity was also followed for C2P, the Connection Control Protocol for DVB-RCS systems. For this purpose TAS-E has being the rapporteur and coordinator between the different standardization groups and actors involved in the C2P activity: TIA, ETSI, TM-RCS and ESA-SatLabs.

DVB-RCS standardization group was re-opened early this year to accomplish DVB-RCS mobile. Finally, a new version of the standard EN 301 790 v1.5.1 will be issued in January 2008, including DVB-RCS mobile LOS (Line Of Sight) and nLOS (non Line Of Sight) specifications, small clarifications and the impact of C2P, Connection Control Protocol, for DVB-RCS mesh networking. The interest of TAS-E in the SatSix project in the follow up of TM-RCS activities has been mainly due to C2P and mesh networking, but also the different handover mechanism and future NCC handover mechanisms to be synchronized with the studies done in satellite network mobility.

5.9 B2I

We, in B2i, are specialized in delivering service to our customers in the software development area. In this frame, we mainly aim at developing our skills to be able to do more for these customers. People from B2i working on Satsix now have a good experience in international shared developments and have increased their technical skills in the area of satellite telecommunication (and more accurately in the IPv6 area) and backhauling integration.

Working on Satsix project also allows us to work in the satellite community with labs, satellite manufacturer and operators and to create good contacts with them. For a small company like us, these contact points are crucial for our future development. This will bring us opportunities to develop ourselves through future R&D or industrial collaborations. First industrial contracts are being discussed with Thales Alenia Space to re-use Satsix knowledge in order to work on new products such as telemedecine network.

5.10 SYSTEK

As a telecoms research support organisation, Systek will continue to be active in other spheres and in liaison with several project partners in propagating the results of the project in the future. This exploitation will be done via a number of channels, and most notably through standardisation.

For example, Systek has played an active role in ETSI BSM WG during the course of the Satsix project in the definition of new standards which has already been reported on (Deliverable D4000-2). The standards can be found on the ETSI web site. Furthermore the ETSI BSM WG still has a definite work plan continuing for at least a further two years for the definition of broadband multimedia satellite standards. Systek will continue to play an active role in this group for this period and will employ the results of Satsix as a basis wherever appropriate in the generation of the standards. The Satsix work has been a valuable source of intellectual material without which the current, and no doubt also the future standards would be much poorer.

5.11 UNIVERSITY OF VALLADOLID

The University of Valladolid is one of the oldest in Europe, dating from the 13th century. It includes more than 100 degree courses, 17 postgraduate programmes and 50 masters. Number of undergraduate students is currently over 30.000, and the teaching and research staff over 2.400.
In order to keep its graduates in touch with the progress of knowledge, each academic year an average of 90 doctorate programmes, some of which are inter-university, are offered at the University of Valladolid. The average number of students registered on doctorate courses during recent years has been 1.500, 300 of which were foreign students who, on the programmes given outside Spain, follow their studies in their country of residence, with lecturers travelling to teach their classes.
The University of Valladolid is involved in significant research work in the fields of the humanities, social sciences, experimental sciences, architecture and engineering as well as biomedical sciences. To this end, it has a staff of research teaching personnel of whom 63% are doctors, with over 500 scholarship fellows and research contracts. Researchers at the University of Valladolid carry out their activity in different research units: 79 departments, seven university institutes, twelve university institutes of its own and six technology centres part-owned by the university. The University of Valladolid manages around 600 research projects financed by means of competitive public R+D+I calls (European, national or regional), and approximately 200 contracts and agreements aimed at the transfer of knowledge and technology, amounting to an average value of over twelve million Euros per year. Moreover, its researchers take part in almost 200 further projects and contracts managed by other institutions. As a result of this research work, the University of Valladolid has 43 patents and annually publishes around 600 articles in journals included in the Science Citation Index SCI, around 150 books, and is present at many national and international congresses with over 1.400 papers and communications. Furthermore, an average of 125 doctoral theses are read at the university every year.

5.11.1 Profile

UVa Communication and Information Technologies (CIT) research group belongs to the Department of Signal Theory, Communications and Telematics Engineering (currently over 100 professors) of the Higher Technical School of Telecommunications Engineering of the University of Valladolid. The Group is integrated by professors and researchers with a wide experience in international and national public funded research projects and also in collaborations with relevant companies of the telecommunications sector like Telefonica I+D, Vodafone, ONO national cable operator, GMV Sistemas, Nortel Networks, Nokia, etc, and also with the Regional Government and Cedetel regional Technological Centre.

Currently the most representative innovation lines of the group include:

- Quality of service provision (QoS) for multimedia (V2oIP) networking, including QoS monitoring and development of specific QoS measurement tools.
- Modelling of next generation network architectures capable of supporting enhanced services, supporting heterogeneous network environments.
- Convergence between fixed and mobile network systems.
- Identification, definition and development of innovative next generation services (over NGN), counting service infrastructure to enable users for easy and dynamic service creation and deployment in heterogeneous environments and ambiences.
- Traffic engineering, network planning and quality of service routing, mainly wireless design and optimization.
- Broadband access networks together with application and service quality analysis (Satellite, GSM-GPRS-UMTS, WLAN, HFC, xDSL, etc).
- Enhanced platforms for service and delivery notification to end-user including push-pull techniques.
- QoS satellite architecture focusing on functional, terminal and gateway architectures.
- Network security and privacy engineering counting security issues and protocols.
- P4P applications and development aimed to e-learning environments.

- Dissemination activities including projects web site management, technical and scientific publications, workshop organization, contribution to standards, etc.

In the last years the research group CIT has been actively involved in important European and national research projects that have allowed a deep know-how and expertise.
Following the most relevant projects are quoted:

ICEBERGS - IP ConferEncing with Broadband multimedia over Geostationary Satellites IST-2000-31110. European Commission. IST FP5. 2001-2003
European Commission Funding: 1.587.000 €
The main objective of the project was to define an optimised network architecture and related performance for the provision of IP multicast multiparty multimedia conversational services over a Ka-band, OBP based broadband satellite infrastructure. Moreover the interworking between the satellite network and the IP-based multimedia multiparty conversational services were designed and validated.
MEDIANET - Multimedia Networking
Ref: FP6-507452. European Commission. IST FP6. 2003-2005
European Commission Funding: 15.700.000 €
This project is about media content exchanges in digital networks. Targeting multimedia communications and A/V content distribution services for residential markets, it addresses new possible supply chain architectures and cooperation schemes between content owners, service providers, network service providers, and personal computer and consumer electronics equipment manufacturers.
Real time Multimedia services over heterogeneous IP networks
IPET. Ref:TIC2003-07074. Spanish National R&D Programme. Ministerio de Ciencia y Tecnología y fondos FEDER. 2003-2006
Total Funding: 70.400 €
This project aims to analyse Quality of Service (QoS) for real time communications in wide band access networks, determining the improvements offered by IPv6 and the analysis of the quality in heterogeneous networks. In the same way, new QoS enhancement techniques for wide band heterogeneous IP networks are being developed and validated.
QUAR2 - Quality of Real Time Applications End-to-End over Heterogeneous Domains
FIT-330200-2004-250. The Celtic Initiative. 2004-2006
Total Budget: 2.500.000 €
QUAR2 project performs the necessary research, development and validation of a system that can provide the long desired, yet hard to achieve, Toll-quality voice and video service over heterogeneous IP networks (V2oIP), and over heterogeneous network environment, focused on the access network. This will allow to offer audio-video services at low prices while spanning over the whole European continent and beyond, despite the heterogeneity of its communications infrastructure.
MaCS - Multimedia Communication Service
FIT-330200-2004-251. The Celtic Initiative. 2004-2006
Total Budget: 10.400.000 €
The goal of the Multimedia Communication Service project is to experiment a new Broadband Telephony Service for the residential market. This service-driven will develop, experiment and assess user acceptance of new Multimedia Communication Services such as Videotelephony, Multimedia Messaging, Presence Management, etc., providing business relevance analysis for Next-Generation-Network based Multimedia Communication Services.
IMAGES – Integrated Multimedia Architectures for Next Generation Services
FIT-330200-2004-253. The Celtic Initiative. 2004-2006
Total Budget: 14.000.000 €
The project focuses on the means which will be available to achieve end-to-end interoperability in NGN providing QoS control and security. These means are related to signaling protocols extensions for the setup and tear down of media streams. The project aims to integrate results provided in related areas in a network solution in which multimedia NGN softswitches play the main role in network resource control and allocation on a per-call basis.
ESA AO4694 - Applications layer QoS in DVB-RCS systems

ESA AO4694. European Space Agency projects. 2005-2006.
Total Budget: 150.000 €
The proposed study aims at evaluating solutions to integrate DiffServ PHB mechanisms at layer 3 (well known by the IP community) with the QoS capabilities offered by DVB-RCS systems at MAC layer. The evaluation of the different considered solutions will be performed with the aid of an in-lab emulator of DVB-RCS systems to which real user equipment will be connected to measure QoS parameters with real end-to-end applications. For such evaluation, several scenarios will be tested covering the different DiffServ/ DVB-RCS mapping alternatives, typical user and application profiles, and different network loads.
VISION: NEXT GENERATION VIDEO COMMUNICATIONS
CENIT 2006-2010. INGENIO 2010. Ministerio de Industria, Turismo y Comercio.
This project aims to enhance audiovisual digital communications in order to facilitate people in different locations perceive the sensation of been physically met at the same place. To achieve this objective VISION proposes deep research in technologies to gain the needed knowledge to develop new advanced high-quality communications systems and the ability to interconnect different and far away ambiences or places through communications networks.

5.11.2 Non-Profit Exploitation Plan

As a public education institution, the exploitation activities of the University of Valladolid are focused on non-profit actions.
University of Valladolid will use the knowledge obtained from the collaboration in SATSIX project for didactic and teaching purposes, using them as a platform for the education of graduate and PhD students. The results will be used for updating and introducing innovative topics in the programs of courses and seminars.
To give some numbers: during the life of the project, five new researchers have been incorporated to the CIT group, four students have started their Ph. D. studies and one more has achieved his first Degree Ph. D. dissertation about topics related to the work performed by the UVA within SATSIX project, and several Master Thesis have been done which contain work related to the project.
Besides, SATSIX project allowed the group to obtain new expertise in QoS traffic characterization in IPv6 satellite networks. Therefore, the skills gained within SATSIX will contribute to continue improving the research background of the group and this way, reinforcing the cooperation links with the partners of the project and setting the basis for collaboration in future projects. On the other hand, synergies with other projects and institutions will be analyzed in order to study the possibility of new alliances related to these topics.
Finally, the results achieved are being (and will be) disseminated through contributors to technical conferences, local presentations at the University and relevant national and international publications.

5.12 HUNGARO DIGITEL

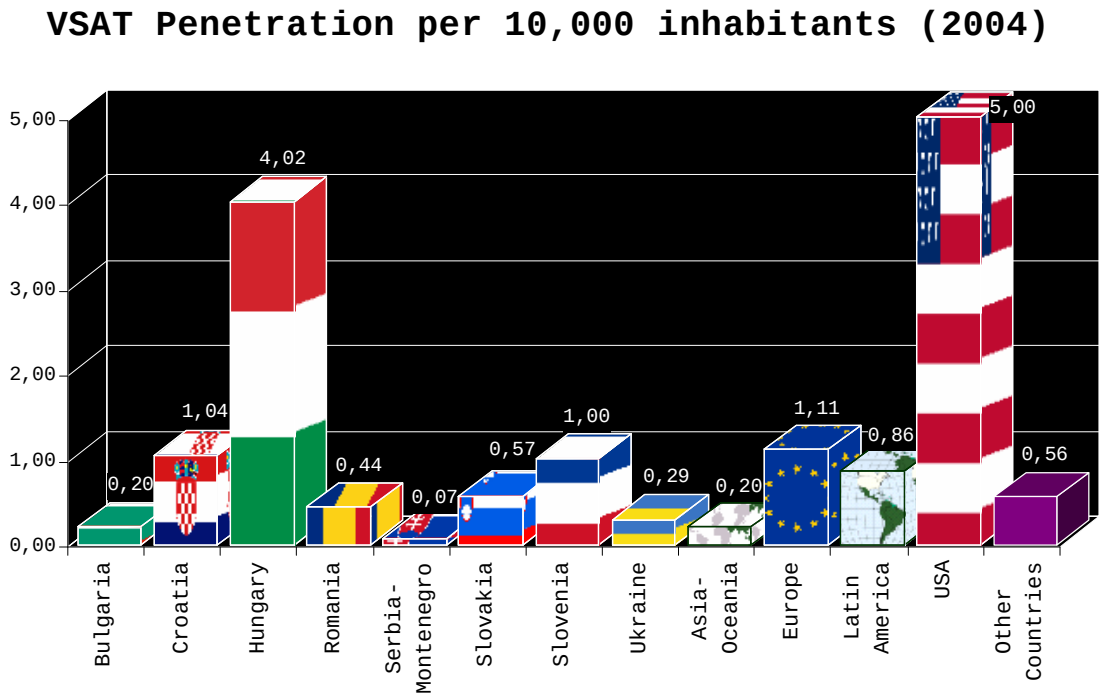
This exploitation plan describes the way HDT will exploit the results and the services it has committed itself to produce namely, as described in the WP3210 (D3000-6) for a collective access terminal scenario. It will include information about the business plan and the market analysis developed and the market feedback researched/acquired. As part of what was required by the Commission, it will also be presented the logic and justification of the validation process of each functionality to be addressed by HDT.

5.12.1 Business Plan – Motivations and Goals

5.12.1.1 General environment

It is broadly known that the most disseminated type of broadband connection is ADSL , Cable TV and fibre optic and in fact it plays the most significant role in the whole market. That being said, to be possible for the Wi-Fi and Satellite technologies to strengthen their position, innovative offers and progressive reduction of connection prices became imperative. As so, we see large networks and government driven projects more and more willing to support! such innovative technologies, denoting a direction favourable for WiMAX.

Bearing this in mind and the fact that VSAT penetration continues to be extremely high in the North America region and in Hungary makes a strong argument for HDT as a satellite data communication provider. Particularly, HDT as confirmed that amongst European countries the rate of VSAT connection usage on the Hungarian telecommunication market is extremely high and the usage rates in Croatia and Slovenia are similar to the European average.



In Hungary, satellite data communication is provided by Hungaro DigiTel and two other satellite service (VSAT) companies. Typically, those VSAT market payers strongly depend on one or two key customers while Hungaro DigiTel Plc. enjoys greater than average independence as well as a market leading position. Thus, Hungaro DigiTel has a leading role in supplying banks, fuel stations and commercial networks, SMEs, and the Government through the "Közháló/Publicnet" project with the former Ministry of Information and Telecommunications (now taken over by the Ministry of Economy and Transport).

5.12.1.2 Company resources and ***objectives***

With 2799 served terminal sites (at the end of 2006) Hungaro DigiTel Group is capable of offering, continuously and reliably, high quality satellite solutions in Hungary, Croatia, Serbia, Romania and Bulgaria.

With its stable and growing results, HDT assures profitability of the owners' investments, and based on steadily renewing challenges, granting professional improvement and progress for its associates.

HDT's VSAT systems, in accordance with demand in the data transmission field, aims at providing broadband and TDM based data transmission service to users demanding:

- a quickly implementable network - within a couple of days after the conclusion of the contract, or within a couple of weeks in case of a large network;
- a data transmission network that is independent from terrestrial networks susceptible to damage;
- a connection with an overall, constantly available backup route - using a satellite, independent from other media forms;
- fast repair services;
- 24-hours a day availability/ network control

5.12.1.3 Company culture

Hungaro DigiTel has been, since its beginning, betting on a policy of commercial and technology innovation, hand in hand with a customer oriented attitude. As so, continuous personal relationship with its key customers are maintained during the entire year, renewing and redesigning contracts, expanding networks, developing new service packages, etc. For this, feedback is continuously received and asked for from major potential customers, previously allocated in distinct market segments (banks, petrol station networks, commercial chains, industrial companies, government and SMEs).

On both national and international level, building new relationships are continued – with the expectation of transforming them into new business relationships – at conferences and negotiations, dealing with scientific and economic issues related to HDT's trade and at telecommunication exhibitions. So being, intensive negotiations were carried on during 2006 to facilitate expansion into the surrounding countries, especially in Bulgaria, Romania, and Croatia.

In terms of technology innovation, HDT intends to present and introduce already developed and improved solutions to other customers and make of those solutions part of a service package capable of being offered to potential new customers. At the same time, however, it is perceived as inevitably necessary the development of new services and service packages.

That being said, the SATXSIX project seemed an obvious and ambitious choice. A new market segment as central and eastern part of the European Union where the broadband network service is not

available in many rural places represents as new opportunity in terms of revenue and making a statement on the recent European policy of reducing the "digital divide".

Within the framework of the IST FP6 project of the European Union, HDT is therefore the only Central East European member of the SATSIX consortium of 14 members, established for the purpose of the further development of the satellite Internet service (DVB-S2/RCS + IPv6) and for the supplementation of the local networks (WiFi, WiMAX). HDT has on that account commenced activities significantly in terms of both international recognition and the usability of the results of the development, proven also to be successful financially.

5.12.2 Business Plan – Market Analysis and Market Plan

5.12.2.1 Market in Hungary

The business data communication market has been entirely liberalized in Hungary since its beginnings, with several participants.

Terrestrial networks are offered to users by local telephone service providers (Emitel, Hungarotel, Invitel, Magyar Telekom, Monortel) and alternative telecommunications companies (PanTel, Tele2, GTS Datanet, eTel). In addition, the major cable television companies also provide broadband internet services besides program distribution.

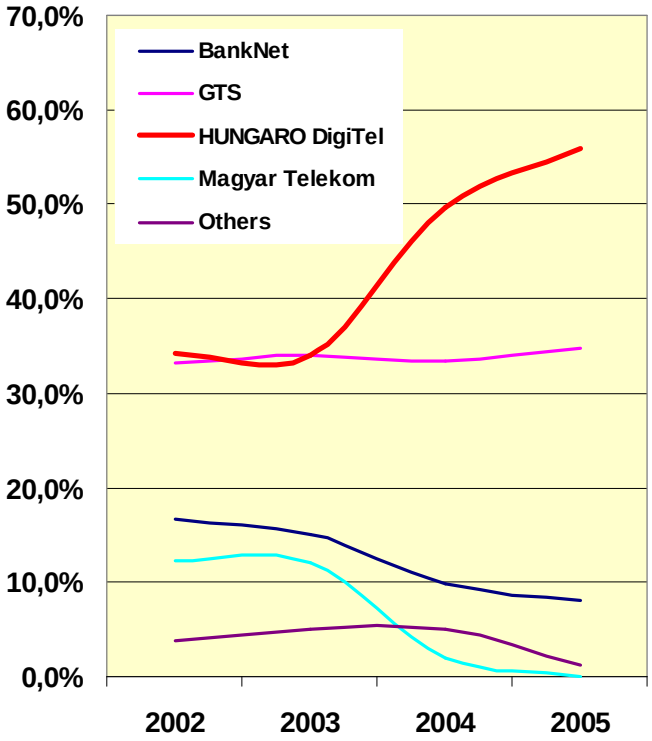
The market demand for microwave networks is satisfied by PANTEL (Invitel), Antenna Hungária and GTS.

As already stated, satellite data communication is provided – in addition to Hungaro DigiTel – by two other satellite service (VSAT) companies: GTS Datanet and BankNet/3C Hungary.

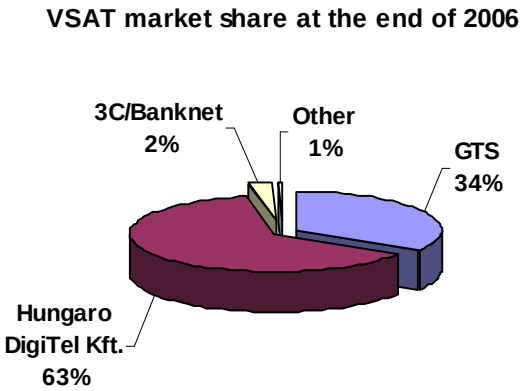
Several companies (Antenna Hungária, UPC, Magyar Telekom, PanTel-HTCC, GTS, etc.) provide this kind of service through a fiber optic cable network in and outside Budapest. There exist a few smaller, regional organizations (e.g. cable television companies) as well, which, for the time being, operate on limited areas.

Regarding VSAT service providers and satellite data communication, among the three companies on the Hungarian market which have their own HUBs. Hungaro DigiTel has started operating the first Hungarian broadband HUB in 2004. Nevertheless, there are also some foreign companies (HUBs) which provide services through certain VSAT terminal sites installed in Hungary (the equipment is usually installed by Hungarian companies) and it's that the quality of the services provided by these foreign HUBs to the customers is not sufficiently good.

Typically, all VSAT market players in Hungary are strongly dependent on one or two key customers, while Hungaro DigiTel Plc. enjoys greater than average independence. Furthermore, due to an ownership change in the market, 3C/BankNet has lost market share to HDT, making it hold at the end of 2006 nearly two thirds of the market.



Market shares at the end of 2006 on the Hungarian VSAT market:



Situation Analysis – SWOT

Strengths:

- § Highly developed technology within VSAT-technology, continuous development
- § Adequate financial background
- § Highly experienced and hard working staff
- § Customer-oriented attitude
- § General strength of the VSAT-systems: especially high reliability, easy to install, flexibly configurable
- § Market-leading role in Hungary and in Central Europe

- Powerful sales methods and marketing strategies

Weaknesses:

- High capital intensiveness, the return of the capital takes a long time
- Not very large clientele, the company greatly depends from four big customers: OTP, GKM, SHELL, OMV)
- Bandwidth-proportionate, expensive satellite capacity

Opportunities:

- By utilizing the advantages of broadband technology
  - it is possible to extend the range of services (development of new services);
  - it is possible to increase the number of provided terminal sites.
- It is possible to make traditional VSAT-systems more attractive with newly developed, value-added services.
- It is possible to penetrate into the markets of the surrounding countries
  - by relying on the existing customers;
  - by making use of the ownership relations;
  - by utilizing our own assets.
  - By providing good quality services, the company can remain a major service provider of its existing main partners (OTP, GKM, SHELL, OMV, etc.).

Threats:

- Intensification of competition by domestic competitors
- Terrestrial xDSL services gaining considerable ground, with declining prices
- Foreign companies penetrate into the domestic market, the appearance of new service provider(s)
- A relative decrease in demand for low-speed technologies
- The technical development may result in the appearance of new, cheaper data communication services.

5.12.3 Business Plan – Action Plan

5.12.3.1 Market research

As already defined in the project the collective access terminal scenario will be based on WiFi access for user's distribution behind Satellite Terminals. From the experience gathered from its activity, HDT decided to validate the process using live trials since this live trials are able to show the real user's behaviour and can help evaluating not only the measured parameters but also the users' perception of the service.

This trial will connect three different types of market segments users (education, government, SMEs) to the Internet and will evaluate the regarding applications:

- § e-Government (access to central databases);
- § e-mail;
- § FTP;
- § WEB browsing;
- § Dynamic multicast;
- § Mobility.

The trial will also focus on the security issues of this type of access platform.

In the education segment HDT has chosen to deploy this kind of service in remotely located schools. The main reasons for this choice are based on the fact that it's a new market to explore and because reducing the "digital divide" is also a concern for HDT. However, the trial will be performed at a university or polytechnic, because the feedback required for these trials is thought to be better achieved with this kind of higher education institutions. The applications for this segment will be: e-mail, dynamic multicast, FTP and WEB browsing.

In the government segment a remote local government facility will be chosen and it's where the security issues will be tested.

Regarding SMEs, there's already a SME chosen for this trial and it's also a HDT's client. Here, mobility and dynamic multicast will be tested.

5.13 TELESPAZIO

5.13.1 TPZ PROFILE

Telespazio is among the top worldwide satellite service providers. The Rome-based company employs around 1,400 staff, and operates a network of four space centres and 22 sites spread all over the world. Notably, these include the Fucino Space Centre, which has more than 90 operational antennas, and is the largest satellite telecommunications centre in the world for civil use. Telespazio also has a fleet of mobile units that operate in Italy and abroad.

The recent joint venture between Finmeccanica (67%) and Thales (33%) confirmed Telespazio's growth ambitions. The company also operates in France, through Telespazio France, managing and maintaining ground infrastructure and offering value-added services, and in Germany, through Telespazio Deutschland, which specialises in services for operators in the space sector.

As a satellite services provider, Telespazio is highly involved in areas of paramount importance for the public and private sectors, and provides satellite operation, multiple services in Earth observation, in satellite navigation, in integrated networks for multimedia telecommunications and integrated connectivity as well as numerous value-added services. In all these activities, Telespazio can count on its background of excellence, based on the technological expertise it has acquired in operating

infrastructure and its involvement in highly innovative space programmes, such as Galileo, EGNOS, GMES and Cosmo-SkyMed.

Telespazio responds to new demands in the satellite services market by producing innovation, and participating in various international projects. Today, more than ever, the company is a true innovator, transforming what were once just dreams into real services available to an ever larger public.

5.13.2 HIGHLIGHTS ON IPV6 INTRODUCTION IN THE FIELD OF SERVICES AND COMMUNICATIONS

The IPv6 protocol will produce in the medium term a deep change on the whole product portfolio of the Italian Telecommunication industry.
Ipv6 allows a huge increase in the number of available addresses and the communication nework is based upon a non-hierarchical architecture, avoiding the introduction of sub-dominions.
The distinctive elements are:

- network centric architecture (non-hierarchical web structure);
- direct management of the elements of a complex system (or not);
- end-to-end management of the value-added applications, guaranteeing the available protocol functionalities;
- direct addressing of data areas (soldier of te future): direct access to elementary information (geographical data, clinical folders) in security (Forza NEC, digital brigade);
- traffic control (aerial, maritime, railway, simplifying the authentication and identification processes);
- the recent decision of the USA DoD to complete the transition from the present protocol IP (IPv4) to the new generation IPv6 within 2008 creates the necessity to analyse the overall product strategies in Finmeccanica;
- IPv4 imposes a dynamic addressing (creation of private addresses in order to fulfil the continuous request of addresses, where their availability is limited);
- IPv6, thanks to the high number of available addresses, allows the static addressing. This IPv6 characteristic allows to proceed towards a Network Centric Orientation (Ubiquous Network);
- The Network Centric Orientation allows the development of Communication solutions for Logistics, Value Added Services (Tele-learning, Telemedicine) for the professional market (Civil Protection, Police Forces), Military and Emergency;
- IPv6 owns native peculiarities listed in the following:
  - Security (IP sec)
  - Mobility Management
  - Multicast
  - Better Management of the Addressing (ICMP)
  - Quality of service
- The IPv6 characteristics counterbalance positively the larger heaviness of the IPv6 protocol.

5.13.2.1 Impact on the Introduction of IPv6 on Telespazio activities

Technologies/Competences:

- Communication Architecture
- Communication Network
- Satellite with IP router
- full integration terrestrial/satellite

Business Development

- Value Added Products
  - Applications (logistics, traffics, map products, Telemedicine, etc.)
  - Centre Management services VA
  - New network elements
- Evolution of existing Products towards IPv6 (platforms, sensors, etc).

5.13.3 TELESPAZIO MARKETS

- The market target of Telespazio is that of the Network professional Services TLC for the Civil/Military national Defence and Institutional Entities which need to utilise the satellite for connections integrated to the terrestrial infrastructure or in geographic environments lacking an adequate terrestrial infrastructure. The above identified market will soon mandatory pass to the implementation of the new protocol IPv6.
- The Telespazio offer is characterised by a strong orientation to services and to Satellite solutions, including the strategic objective to become a Dual Satellite and niche Operator, through the control of the satellite capability and/or of the specific payload functionality (ex. SAR).
- The main markets to which it is addressed are:
  - Market Military (tactic and infrastructural)
  - Market Professional (Public Administration, Police Forces, Civil Protection, Transports, Industry…)
  - Avionic Market (Military and civil).
  - Large Private Clients

5.13.4 STRATEGY OF EXPLOITATION

The aim of this strategy is to assert Telespazio as a reference player for solutions and integrated systems for Security and Defence, reinforcing the in habilitating competencies in the field of sensors, of the communication and ICT infrastructures, improving the positioning on the Italian and on the foreign markets.

Telespazio in the framework of its own Technological Plan, foresees a series of activities for the study and realization of systems and relative applications in the satellite field, correlated to the use of the IPv6 protocol, on which the use of the IPv6 protocol with a router on board of the satellite would have a strong impact.
In this framework it is important to create and maintain a technical liaison between the results of the SATSIX programme and the European Satellite Platform called ISI.

It is of great interest to address the ISI support initiative to include the possibility of considering the presence in the Platform of the IPv6 technology on ground and onboard. The benefit to satellite communications to have an IP router on board is potentially very meaningful, considering both the possibilities of having IP and YCP functionalities in the technological development roadmap.

The main activities are related to:

Communications Network Architecture: Systems and Prototypes

- § Activity of study, definition of new architectures, simulations, prototype to specify new product families and updating (for example Management of Security Networks)

Communication

- § Insertion of router IPv6 on board of Athena Fidus and future satellites (agreements with other companies)

Earth Observation

- § Realization of a Platform for Services and Applications VAS (high computing and storage capability in order to provide every single user with images fulfilling its own necessities)

Navigation

- § Realization of a Platform for Services and Applications VAS (high computing and storage capability in order to provide every single user with services fulfilling its own necessities).

In this framework, the results of the SATSIX projects, namely the:

- development of new satellite access technologies for the integration of wireless networks (WiFi and WiMax) in order to
- demonstrate how the access on a satellite broad band is able to integrate new generation networks
- based on IPv6 and able to support new multimedia applications

will support and improve the knowledge, updating the competencies of this research sector.